International Cartographic Association
Association Cartographique Internationale

Maps for the Future: Children, Education and Internet

Joint ICA Symposium

Event organized within the activities previous to the 25th International Cartographic Conference

30 June–1 July 2011
University of Orléans, France

Participating ICA Commissions and Working Group

Commission on Cartography and Children
Commission on Education and Training
Commission on Maps and the Internet
Commission on Planetary Cartography
Working Group on Cartography on Early Warning and Crisis Management

Editors: László Zentai, José Jesús Reyes Nuñez
Department of Cartography and Geoinformatics, Eötvös Loránd University, Budapest

Design and Layout: Krisztina Irás
Department of Cartography and Geoinformatics, Eötvös Loránd University, Budapest

National Development Agency
www.ujszechenyiterv.hu
+36 40 638 638

HUNGARY RENEWS

The Project is supported by the European Union and co-financed by the European Social Fund (grant agreement no. TAMOP 4.2.1/B-09/1/KMR-2010-0003).

ORGANIZERS

Organizer Institutions

International Cartographic Association

Laboratory CEDETE (Centre d'Etudes pour le developpement des territoires et l'environnement)
University of Orléans, France

Department of Cartography and Geoinformatics,
Eötvös Loránd University, Budapest, Hungary

Scientific Organizing Committee

Jesús Reyes, Co-Chair, ICA Commission on Cartography and Children (Hungary)
Temenoujka Bandrova, Co-Chair, ICA Commission on Cartography and Children (Bulgaria)
David Fraser, Chairman, ICA Commission on Education and Training (Australia)
László Zentai, Vice-Chair, ICA Commission on Education and Training (Hungary)
Michael Peterson, Chairman, ICA Commission on Maps and the Internet (USA)
Georg Gartner, Vice-Chairman, ICA Commission on Maps and the Internet (Austria)
Kira B. Shingareva, Chairperson, ICA Commission on Planetary Cartography (Russia)
James R. Zimbelman, Vice-Chairman, ICA Commission on Planetary Cartography (USA)
Henrik Hargitai, ICA Commission on Planetary Cartography (Hungary)
Milan Konečný, ICA Past President and Chairman, ICA Working Group on Cartography on Early Warning and Crisis Management (Czech Republic)

Local Organizing Committee

Annabelle Boffet Mas, Laboratory CEDETE, University of Orléans
Josée Bouyer, Secretary of Human Sciences, University of Orléans
Guillaume Giroir, Laboratory CEDETE, University of Orléans
Matthieu Lee, Laboratory CEDETE, University of Orléans
Philippe Quodverte, Laboratory CEDETE, University of Orléans
Vanda Turczi, Laboratory CEDETE, University of Orléans

CONTENTS

Posters

FOREWORD

The biannual International Cartographic Conference is one of the most important events for cartographers. After the 1st General Assembly held in Paris, cartographers of the World are going to meet again in the capital of France.

It is quite common to organize events (seminars, joint meetings, workshops) that are connected to the main conference. In 2005, before the XXIIIrd International Cartography Conference in A Coruña (Spain), five ICA Commissions met in Madrid to have a Joint ICA Seminar. This year, almost the same commissions and a working group organized a similar symposium at the University of Orléans.

The participants are Commission on Cartography and Children, Commission on Education and Training, Commission on Maps and the Internet, Commission on Planetary Cartography and Working Group on Cartography on Early Warning and Crisis Management. The submitted papers from all participating commissions were considered equal; organizers did not intend to emphasize specific topics. This is the reason why a short title was selected for the event: “Maps for the Future”.

The papers of this symposium deal with a wide range of cartography. The topic of most papers was not directly related to certain commissions, but they were interdisciplinary. This makes these joint seminars, symposiums worthwhile: presenting new ideas to the participants and helping us to follow the development of our science.

Organizing a symposium is not just collecting abstracts and papers and publishing them on CD-ROM and later in the Proceedings. The most difficult and time-consuming task is to organize the event itself (including all logistic elements: accommodation, meeting place etc.). A small group of people from the University of Orléans undertook this busy job to host more than 50 participants during the symposium. Many thanks for their efforts that let us realize this meeting here, in Orléans.

The diversity of research topics being developed by the members of the ICA commissions and working groups all over the world is clearly demonstrated in the papers to be presented during these two days and in the proceedings published digitally.

Organizers would like to thank the commission chairs for their support and active collaboration. We also thank the support of the ICA Executive Committee for their participation either as authors or as just visitors.

Orléans – Budapest, 20th June 2011

Guillaume Giroir Director of CEDETE Laboratory	László Zentai ICA Commission on Education and Training	Jesús Reyes ICA Commission on Cartography and Children

Maps for the Future:
Children, Education and Internet
Joint ICA Symposium

Keynote Speech

INTERNATIONAL ASSOCIATIONS AND THE PROVISION OF OUTREACH PROGRAMMES FOR EDUCATION AND TRAINING

William Cartwright
President, International Cartographic Association
RMIT University, Melbourne, Australia
william.cartwright@rmit.edu.au

Abstract: The cartographic profession has changed to one that is supported by contemporary digital production, storage and distribution devices and communication resources. What has also changed are the organisations that conduct mapping programmes and 'build' repositories of geographical knowledge, digital and material. Long gone are the days of large governmental mapping agencies that had their 'tried and true' methods of data capture, processing and dissemination. Today is the workplace of small government agency; contractors (large and small); regional, national and global publishing collaborations; and map producer/user. This, in turn, has led to changes in cartographic education courses, from what could be described as focused courses to more generalist courses. Gone are the days when a graduate could accommodate the in-house practices and procedures on day one of a job. Everything has changed, but the underlying need for useful (and usable), accurate and timely geospatial products remains as the essential underpinnings for what we do. In order for students to have access to relevant courses and for industry to keep abrest with developments in technology and contemporary cartography and GI Science thinking it is important for relevant educational courses to be offered. This can be done through face-to-face courses or via online delivery. The International Cartographic Association (ICA) is committed to supporting existing educational courses and providing specialist courses wherre needed. This paper provides an overview of the ICA's strategies towards the provision of education, internationally. It also gives examples about how educational courses have been presented by the ICA's international cartography and GI Science community.

Introduction

The International Cartographic Association is the world authoritative body for cartography, the discipline dealing with the conception, production, dissemination and study of maps. The ICA was founded on June 9, 1959, in Bern, Switzerland. The first General Assembly was held in Paris in 1961. The mission of the International Cartographic Association is to promote the discipline and profession of Cartography and GIScience in an international context.

The activities of the ICA are important for promoting and advancing the theory and praxis of cartography. Throughout its 50-year history, ICA has brought together researchers, government mapping agencies, commercial cartographic publishers, software developers, educators, earth and environmental scientists, and those with a passion for maps.

The International Cartographic Association exists:

- to contribute to the understanding and solution of world-wide problems through the use of cartography in decision-making processes,
- to foster the international dissemination of environmental, economic, social and spatial information through mapping,
- to provide a global forum for discussion of the role and status of cartography,
- to facilitate the transfer of new cartographic technology and knowledge between nations, especially to the developing nations,
- to carry out or to promote multi-national cartographic research in order to solve scientific and applied problems,
- to enhance cartographic education in the broadest sense through publications, seminars and conferences,
- to promote the use of professional and technical standards in cartography.

The Association works with national and international governmental and commercial bodies and with other international scientific societies to achieve these aims. (Adopted by the 10th General Assembly of the International Cartographic Association, Barcelona, Spain, 3 September 1995.)

An important contribution that ICA makes through its international community is outreach and technology transfer. This is supported through direct ICA initiatives, the activities of Commissions and Working Groups and programmes conducted with ICA Affiliates.

The ICA Strategic Plan

The ICA Strategic Plan (ICA, 2010) provides a number of guidelines for implementing an Education plan. It covers both Education and Professional Practice.

Professional Practice

It notes that "Amateur and professional practice within the Geospatial sciences will change in nature, increasing the necessity for Continuing Professional Development".

Education

The Strategy Plan proposes that the ICA should:

- investigate ways to strengthen and monitor education programmes in Cartography, GIScience and related subjects at all levels: university; high school; elementary; and life-long learning,
- providing fora for discussions of education programs and curricula in Cartography and GIScience,
- develop information networks and virtual universities on Cartography and GIScience,
- organise educational courses on Cartography and GIScience in developing countries and for regional purposes,
- offer 'master classes' in GISystems/mapping to guide managers in spatial decision-making,
- investigate methods (and funding sources) to encourage the participation of students and other young members in ICA work.

It proposed the following actions:

- to analyse existing university curricula in Cartography and GIScience, and encourage promotion of the goals contained in the ICA mission,
- to help widen the Cartographic/GIScience knowledge base and skills into new segments of Society,
- to increase efforts directed to capacity-building, especially in developing countries, especially with reference to human resource development,
- in co-operation with commercial suppliers, to develop virtual academy courses on Cartography and GIScience to support and complement what is currently available,
- to provide geospatial data for educational use,
- to establish a network of university/school teachers to provide a forum for discussion and the possibility for support,
- to extend travel awards for young scientists; lower conference participation fees for students.

This paper reports on some of these actions being carried out by the ICA, its member nations, Commissions and Working Groups and affiliates.

The International Cartographic Association and education

The ICA's Strategic Plan proposes a number of actions related to Ideas and Actions for the Organisation and in the Wider Operational Environments. Some of these actions that relate to education are:

- to help widen the Cartographic/GIScience knowledge base and skills into new segments of society,
- to increase efforts directed to capacity-building, especially in developing countries, especially with reference to human resource development,
- in co-operation with commercial suppliers, to develop virtual academy courses on Cartography and GIScience to support and complement what is on offer.

The ICA addresses these and other issues through direct ICA initiatives through its Executive and member organisations and with partners from ICA affiliates, sister societies and industry. The activities of Commissions and Working Groups and programmes provide the 'powerhouse' that supports these endeavours.

Commissions and Working Groups outreach activities

To achieve its aims the ICA operates through a number of Commissions and Working Groups. Commissions and Working Groups carry out the general operations of the ICA. They address the full range of scientific, technical and social research that is the mark of ICA activity. They achieve the transfer of knowledge about Cartography and GIScience and GI Science by publishing books and special editions of journals and running workshops and educational courses. Colleagues from the ICA community conduct these workshops on a volunteer basis, generally with the support of the national member organisation of ICA or the national mapping body.

Courses and workshops by ICA Commissions and Working Groups

ICA Commissions and Working Groups have conducted many outreach courses. Here, examples of some of the courses are provided.

The ICA Commission on Education and Training, in collaboration with the National Cartographic Center of Iran, ran a workshop on Cartography in Tehran, Iran in May 2009. Figure 1 shows some of the thirty participants at the workshop.

Figure 1. Participants in the Workshop on Cartography, Tehran, Iran, May 2009. Photograph courtesy ICA Commission on Education and Training

This course followed a successful course run in 2008 – a hands-on web-mapping technologies – conducted by the ICA Commission on Maps and the Internet and organised by the National Cartographic Center of Iran. The workshop focused on the technological and methodological basics of delivering maps on the web, including such topics as basic tools, design questions, interactive functions and using map server technology. In July/August 2010 the ICA Commission on Education and Training will run training courses in in Ho Chi Minh, Vietnam and Jakarta, Indonesia.

The ICA Commission on Management and Economics of Map Production has regularly organised workshops in Urumchi and at the Intercarto-conference and an ICA-sponsored workshop in Gent in 2009.

Through their input in the United Nations Group of Experts on Geographical Names, ICA cartographers have regularly participated in the toponymy course programme of UNGEGN. Courses have been held in Khartoum (2003), Bathurst (2004), Maputo (2004, 2006), Malang (2005), Tunis (2007), Ouagadougou (2008), Vienna (2008), Timisoara (2008), and Nairobi (2009). The major item in these courses is the conveyance of the awareness of the importance of geographical names as part of a nation's spatial data infrastructure, and the need to collect these names correctly and efficiently for use on maps and in gazetteers.

Figure 2. Participants preparing for the names-collecting fieldwork UNGEGN toponymy course. At left Tunis 2007 at right Malang 2005. Photographs courtesy of Ferjan Ormeling

The ICA Commission on Education and Training has developed a virtual course on Cartography and GIScience in collaboration with contributions from universities and individual academics. The courses have been provided by academics and practisioners from the international cartographic community. They can be accesed and used free of charge. The courses can be accessed via the Commission Web site at: http://lazarus.elte.hu/cet/. The image in figure 3 shows the interface to one of the courses – Map projections – that are offered on-line.

Figure 3. Commission on Education and Training on-line course on map projections. Source: http://lazarus.elte.hu/cet/

The ICA Working Group on Open Source Geospatial Technologies promotes multi-national holistic research in free and open source geospatial technologies in order to make accessible the latest developments in open source tools to the wider cartographic community. The WG attempts to enhance the usage of free and open source geospatial tools among the cartographic community worldwide, especially for education. The WG organises workshops with the aim to capacity building participants by providing hands on experience to develop skills in the application of open source geospatial software.

Figure 4. ICA Working Group on Open Source Geospatial Technologies course on open source geospatial software. Photograph courtesy of Suchith Anand

Courses in collaboration with industry

In collaboration with ESRI, Inc., a major sponsor of ICC2009 in Santiago-Chile, the Cartography with ArcGIS course was taught after the ICC2009 in November 2009. Mr. Makram Murad-al-shaikh, a Senior Instructor in GIS and Cartography at ESRI's Educational Services Department, taught the course. The course was offered free to all candidates attending the ICC2009 conference and later was opened to lead Chilean cartographic organisations. Nineteen attendees were trained for three days on both basic cartographic design principles together with hands-on training on ESRI's ArcGIS software tools for mapping design and production. All of the cartographic tools available in ArcGIS were explored with best practices taught on how to use them in hands-on exercises.

Figure 5. ESRI's ArcGIS course, Santiago, Chile, November 2009. Photograph courtesy of Makram Murad-al-shaikh

Seminars for students

In November 2009, in collaboration with SNIT (Sistema Nacional de Coordinación de Información Territorial), Chile, members of the ICA Commission on Geospatial Data Standards presented a seminar for Cartography and GIScience students and staff at Universidad Technológica Metropolitana del Estado de Chile (UTEM) in Santiago, Chile. Presentations covered the areas of 'INSPIRE', quality standards for the spatial data modeling, 'SNIT' national spatial data infrastructure of Chile and standards for geographical information. Participants at the seminar are shown in figure 6.

Figure 6. ICA Commission on Geospatial Data Standards presented a seminar for Cartography and GIScience students, Santiago, Chile, November 2010. Photograph courtesy of Antony Cooper

Graduate students' seminars

At the first ICA Symposium on Cartography for Central and Eastern Europe, in Vienna, Austria, in February 2009 included a special session where junior scientists presented their research work in a dedicated PhD/Master Forum. PhD students presented the results of their research and a panel of experienced researchers provided feedback to student presenters.

Figure 7. Panel session at the PhD/Master Forum at the CEE Symposium 2009, Vienna. From left ICA Vice-President Prof. Dr. Georg Gartner, ICA President Prof. Dr. William Cartwright, Prof. Dr. Necla Ulugtuken, Prof. Dr. Ferjan Ormeling and ICA Immediate Past-President Prof. Dr. Milan Konečný. Photograph courtesy Géza Simon

Education for children

The Barbara Petchenik Children's World Map Competition is organised every second year to coincide with biennial International Conference of the Association. This is a map design competition for children ages 15 years and younger. It is held to honor of the late Dr. Barbara Bartz Petchenik, a past Vice President of the ICA who was extremely interested in maps for children and children as cartographers. The competition is organised by the ICA Commission on Children in Cartography.

This competition has been taken-up by teachers around the world to involve their students in the world of mapping. One example of the local support to children to enter the competition in South Africa, where staff members from the Department of Geography of UNISA (University of South Africa) in Pretoria visited schools throughout the country to liaise with teachers and children and explain the competition theme – "Living in a globalized world". The photograph in figure 8 shows Professor Elri Liebenberg, Chair of the ICA Commission on the History of Cartography, and former ICA Vice-President, in one of these classes conducted by UNISA.

Figure 8. Mapping class for children at the Department of Geography at the University of South Africa. Photograph courtesy of Elri Liebenberg

The ICA Commission on Children in Cartography has worked with ESRI Press to publish books containing winning entries from the competition. In November 2009 a second book – Children Map the World (Figure 9) was published. It features 100 selected drawings from the 2005 and 2007 Barbara Petchenik Children's World Map Competition.

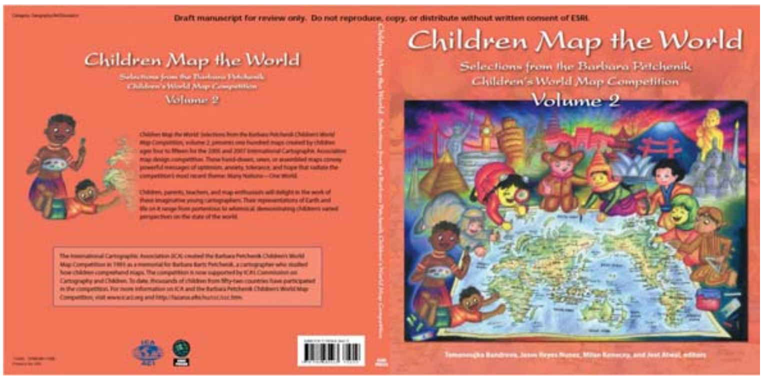


Figure 9. Children Map the World - Temenoujka Bandrova, José Jesús Reyes Nuñez, Milan Konečný and Jeet Atwal. Image courtesy ICA Commission on Children in Cartography

Conclusion

The activities of the ICA are important for promoting and advancing the theory and praxis of cartography. Throughout its 50-year history, ICA has brought together researchers, government mapping agencies, commercial cartographic publishers, software developers, educators, earth and environmental scientists, and those with a passion for maps. The Cartography and GIScience world has changed significantly since 1959 – the role and impact of ICA has been steadfast. Its mission is to support and promote Cartography and GIScience – globally. Its outreach programmes, in many instances conducted with national member organisations, affiliates and industry, are conducted to contribute to the transfer of knowledge and to foster the advancement of the discipline.

Acknowledgements

This paper was prepared with inputs from colleagues from the ICA international community. Thanks to Dr. Suchith Anand (Chair, ICA Open Source Geospatial Technologies Working Group), Dr. Antony Cooper (Chair, ICA Geospatial Data Standards Commission), Professor Dr. Philippe de Maeyer (Chair, ICA Management and Economics of Map Production Commission), Dr. David Fairbairn (ICA Secretary–General/Treasurer), Assoc. Professor Dr. David Fraser (Chair, ICA Education and Training Commission), Professor Dr. Georg Gartner (Vice-President ICA), Professor Elri Liebenberg (Chair, ICA History of Cartography Commission and former Vice-President of ICA), Makram Murad-al-shaikh (ESRI, Inc.), Professor Dr. Ferjan Ormeling (Former Secretary- General/Treasurer ICA, Vice-Chairman of the UN Group of Experts on Geographical Names (UNGEN) and Convenor of the UNGEGN Working Group for Training Courses in Toponymy) and Professor Dr. Michael Peterson (Chair, ICA maps and the Internet Commission).

References

ICA (2003) "Strategic Plan"
http://www.icaci.org/documents/reference_docs/ICA_Strategic_Plan_2003-08-16.pdf

Maps for the Future:
Children, Education and Internet
Joint ICA Symposium

Keynote Speech

EXERCISES IN CARTOGRAPHY

Ferjan Ormeling
Utrecht University

Cartographic apprentice

When I first started as an apprentice atlas editor, in 1961, I had to learn how to apply lettering to maps, and I spent many evenings just drawing the letter o. After a week I graduated to variations of o, such as a, b, d, g, q, c and e or p. Then I moved on to n, and varied it with h, u and m the next month would be focused on i and l, f, j, t and odd letters like k, r, s, v, w, y and z. The next step would be to combine these letters and to get used to the differing distances between them. I did not feel particularly enriched by these long evenings and I merely wondered whether I had opted for the right profession. Fortunately, nowadays this lettering is done digitally and cartography students won't loose time in doing lettering exercises – at least not on lettering itself, but they still have to do exercises in the application of geographical names to maps.

Here they have to apply the theories of Imhof, Bonacker or Spiess to the map, in order to make sure that there is no ambiguity regarding the symbols a name refers to, to ensure the shortest possible time to find a name on the map, by using variations in type styles, sizes, boldness, spacing and colour (see figure 1).

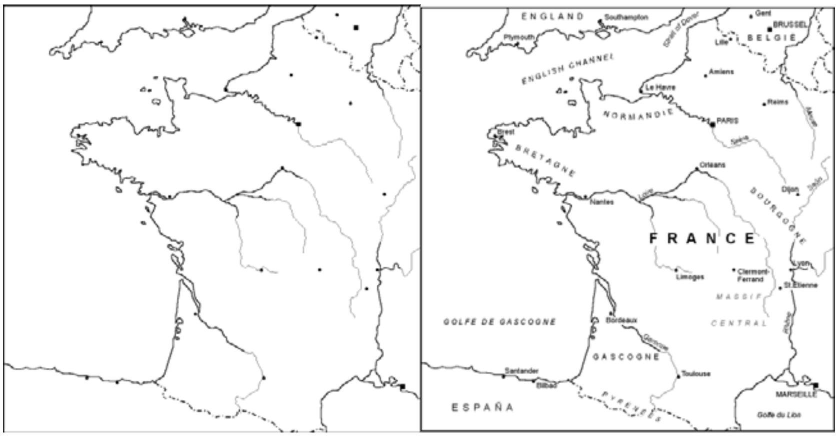


Figure 1. Exercise in map lettering from the Basic Cartography Exercise Manual

In my cartography classes at the university at the same time I had to be able to operate geodetically or photogrammetrical equipment, and map contour lines from pairs of aerial photographs, using both hands and feet. So I had to do mapping exercises with the equipment. Again, this was not particularly stimulating. As my main subject was geography we also had to engage in statistical exercises, do sums in order to compute the number of observations needed to end up with results that were 99% significant, or compute different kind of averages. The course in statistics was used as a threshold to keep out those without a head for mathematics although I never later on perceived any need why such a head was required in geography, nor in cartography. Fortunately for me, the looming onset of computers had obliterated – in the mind of the teaching staff – the need to do exercises in the plotting of map projections, with coordinatographs and the assistance of goniometric tables. As part of geography we also had to do geomorphology courses, and here we had to learn to draw all kinds of diagrams, cross sections, block diagrams and longitudinal sections. As we were interested in visualization we taught ourselves how to draw panoramic maps, based on topographic maps (see figure 2).

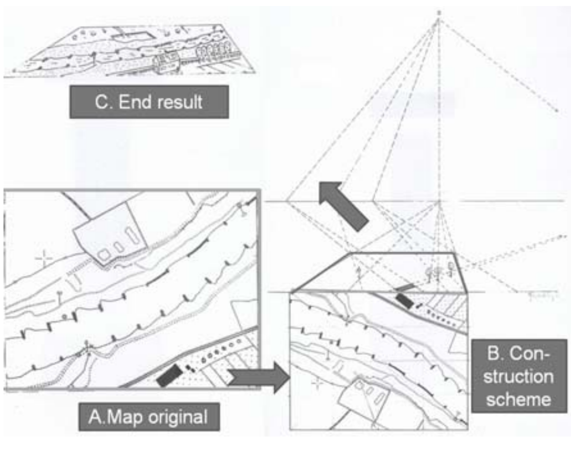


Figure 2. Producing a panorama from a topographic map

Cartography courses

But the real interest in cartographic exercises only started when I had graduated and, as a member of Utrecht university staff, helped to start up a master's programme in cartography in 1971. Then we got to know a French publication called "La cartographie thematique comme methode de recherche", by Claval and Wieber, which finally presented some intellectual challenge. It contained statistics on point, linear or areal data and base maps on which these data had to be visualised. Here at least there also was an opportunity to apply one's geographical knowledge, as doing these exercises frequently called for judgement regarding what was most important from a geographical point of view. As an example, in figure 3, I show an assignment to map statistical data on agriculture for Indonesia, where one has to pick the most important aspect of the table (based on one's geographical knowledge of the country) and visualise it.

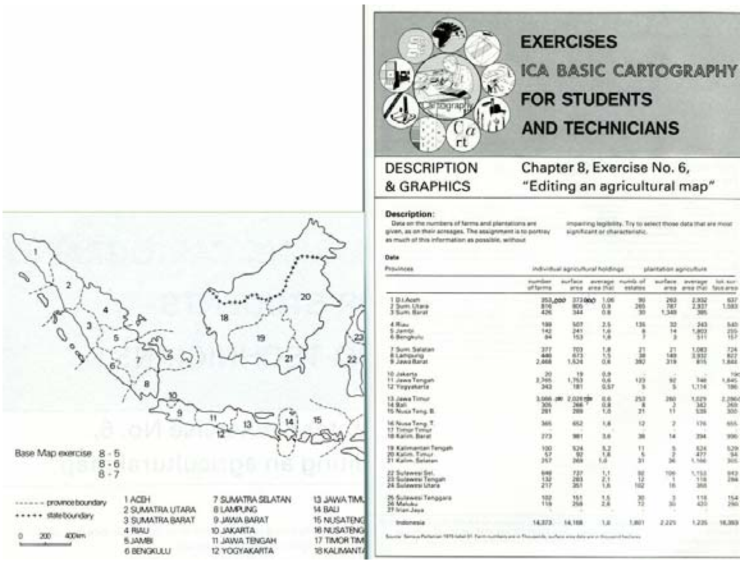
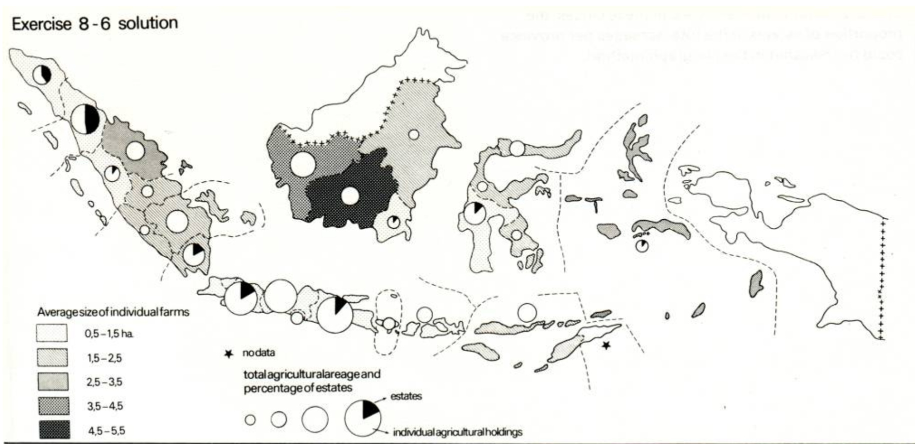


Figure 3. Exercise on agricultural mapping from the Basic Cartography Exercise Manual, 1991, with relevant base map. For solution see below:



The textbook by Claval and Wieber also showed us that – at least within Europe – there were different schools of cartographic design, using different mapping techniques. For instance, in France in the 1970s the areal cartogram method devised by Aimé Perpillou was en vogue. This was a quite elaborate method of showing different percentages of land use, per enumeration unit, by using coloured bands that together made up 100%. The method called for extreme generalisation of the data and the resulting images were not altogether straightforward. This method was never used in Germany or in the United Kingdom. In Germany, isoline maps were only used for physical phenomena, and the United Kingdom was an early advocate of anamorphosis maps, which were rather frowned upon in Germany. And it was only in Czechoslovakia that a particular time-related diagram type ever occurred.

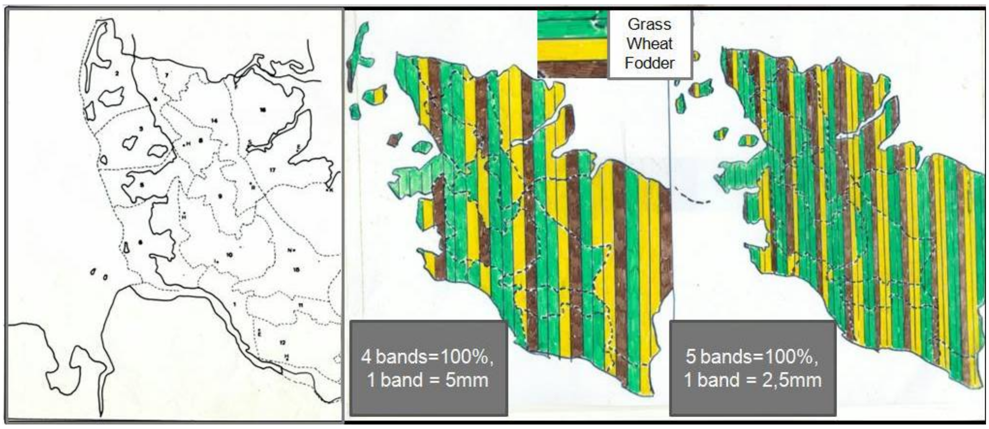


Figure 4. Diagram map following the Aimé Perpillou method (from Claval and Wieber)

ICA's Basic Cartography programme

In the 1970s, there was already an ICA project under way to produce a textbook for cartographers. This endeavour was supported by UNESCO, and it resulted in the "Basic Cartography manual series", containing 3 manuals (with contributions from France, FRG, GDR, Israel, Japan, the Netherlands, Nigeria, UK, USA and Sweden) and an exercise book. I travelled all over Europe to visit cartographic establishments in order to solicit 500 printed copies each of their best exercises, framed in a uniform ICA template and to put together this exercise manual, which finally consisted of contributions from, Austria, Belgium, Canada, France, Germany, Hungary, Israel, Japan, the Netherlands, Sweden and Switzerland.

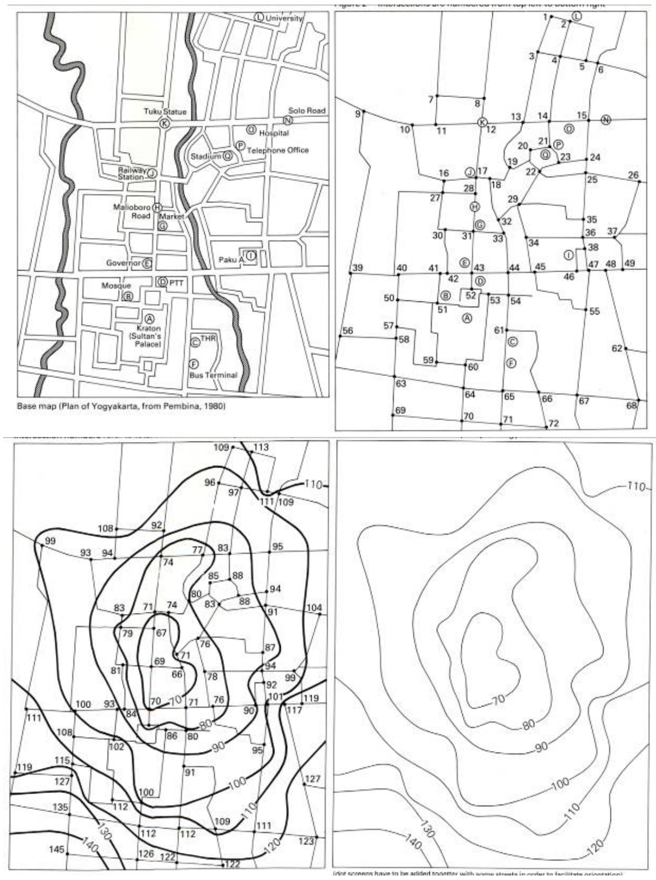


Figure 5. Map exercises to assess the accessibility of urban services; the cumulative number of steps it takes to get from one service point to all others is used as input for an accessibility isoline map (from Basic Cartography Exercise Manual, 1991)

Apart from map construction exercises, the geographers in our faculty also had to do map use exercises, for analytical purposes, and these existed for instance of assessing accessibility, nearest neighbour values or quantifying patterns and shapes (see figure 5, for instance).

What is especially significant in doing most of these exercises is that the students see the effects of their design decisions by comparing their results with those of their colleagues and perceive how these differences affect or boost the information transfer: which method is best, pie graphs or columns to render absolute statistical values? Is it better to render the absolute values of the data or to link them to other data, so as to normalize them? (See figure 6). In a dot map exercise, where a base map and a description of the residential housing characteristics for a campus would be provided and the students asked to work out the best representative value and size of the dots with which to render the population pattern, again comparing the results always was as much of an eye-opener to the students as doing the exercise themselves.

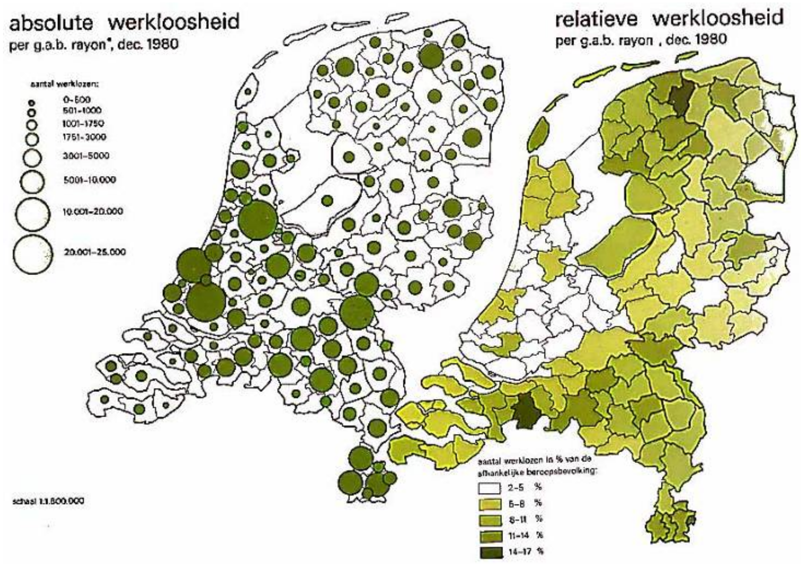


Figure 6. Unemployment in the Netherlands, left rendered with proportional symbols, and at right normalised, i.e. expressed as a proportion of the total labour force

Next to map lettering, the most important exercises before the advent of the computer surely were those of rendering information according to a standardised legend, in which all the symbols and their measurements, and the various line widths were prescribed in a master legend. This part was rather repetitive, tiresome and disappointing, as the teachers always seemed to be able to discern who had drawn which map, in spite of us all adhering to the prescribed legend and specifications.

As my country is rather small there seemed not to be enough potential cartographic draughtsmen to start a regular cartography course for, so we opted for a correspondence course, in which the participants had to do exercises and had to send them in, and would receive them back within a week, annotated with the comments of the teachers (PBNA cursus). On the exercise sheets the planimetry to be inked in was rendered in blue, and with special drawing pens and India ink the map detail had to be applied. In my first presentation to an ICA conference, in Moscow 35 years ago, I reported on our experience with setting up this correspondence course.

Meta-exercises

Next to map drawing and map lettering came map generalization, and here it was again important that one developed a feeling of hierarchy, a feeling of what was important and should be retained, even if this activity was closely outlined as well, so as to render the differences between the results of individual cartographers as small as possible. Legend-sheets with the exact dimensions of the symbols and lines to be used served as examples, but even when these specifications were adhered to as strictly as possible students still ended up with a wide range of different results. When we confronted the students with the variation in their results, there was a meta-effect in this exercise – as the students could see that the results of their colleagues would deviate to some degree from their own, and this showed them a bandwidth of cartographic licence, it showed them that different results based on the same original data still were acceptable to a certain degree (see figure 7).

Another drawing technique that had to be mastered through exercises where some geographic knowledge came in handy was hill-shading, which we would do with pencil, but which Swiss and Austrian experts would apply with airbrushes.

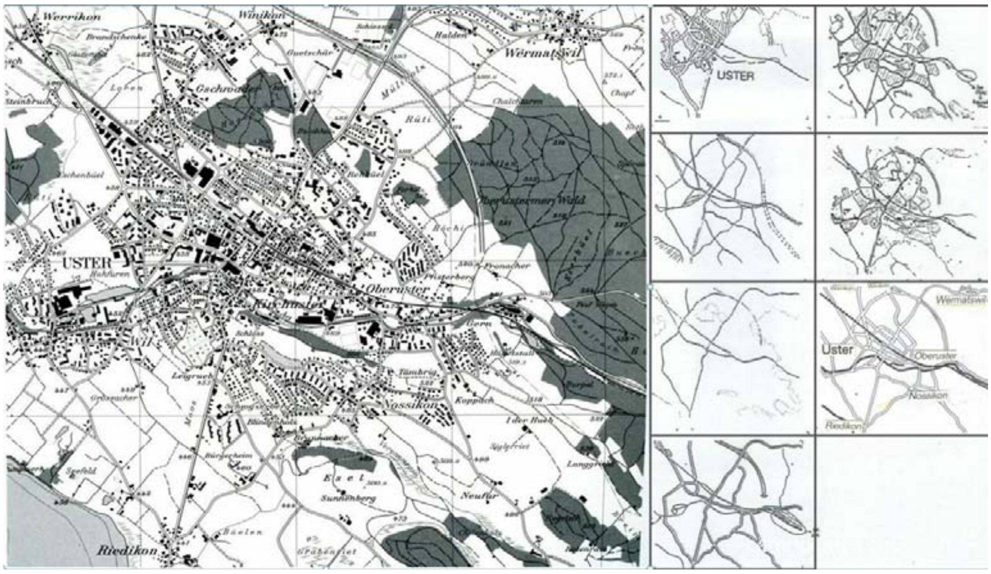


Figure 7. Generalisation exercise with results (by Prof. Spiess, Basic Cartography)

Picking the correct colour schemes or colour ramps is another item to do exercises in, in order to make sure that students see for themselves which colour combinations work or not, when diverging hues should be opted for, or how a colour ramp can be extended to accommodate a larger number of classes.

Cynthia Brewer here helps students doing exercises on these items enormously with her Colorbrewer website (http://colorbrewer2.org).

For myself I have found much profit for the students in an exercise in which they are asked to render a same phenomenon, using the same figures in as threatening a way and in as inconspicuous a way, just by manipulating colours and class boundaries. By doing this exercise they realize the impact of their selection of class boundaries and colour schemes.

For the map reproduction classes we had in Utrecht University in the 1980s, prior to the advent of digital techniques, we did a simple exercise to produce a map of the university campus. Students could select their own target audience for this campus map, and customize the spatial information to convey accordingly. Here again the results are most instructive when compared. That is because they show how – even with very simple data, as on the function of buildings, their number of floors or the transport facilities – a host of different images will emerge, based on different decisions regarding information hierarchy, preferential colour schemes or student outlook – even differences between car-owning students and public transport advocating students would stand out on the maps (see figure 8).

Part of the Utrecht cartography programme consisted of fieldwork, in France, where one of the assignments was to update an existing topomap, and another to do a land use survey of a small area. Apart from the generalization aspect, the results here provided another example of the impact of individual land use classification decisions, and of the generalization rules followed, even if the assignment, to produce a land-use based map 1 : 15 000 for the area for cyclists and hikers would let us to expect rather homogeneous results. The realization that the same reality, to be mapped to the same specifications, could be reflected in so many different, but valid views of the same reality certainly was an eye-opener for the students.

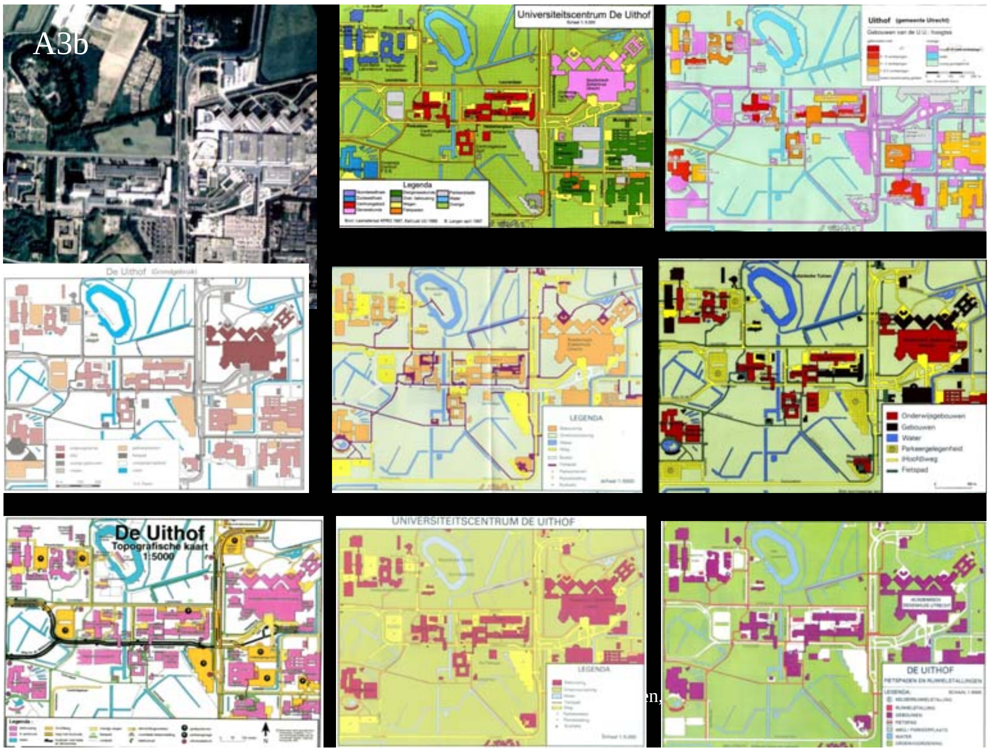


Figure 8. Student maps of Utrecht University campus, based on aerial photograph

Computer classes

The map drawing exercises that replaced the manual ones took place on the computer, using specific drawing programmes like Aldus Freehand in the 1990s, and now perhaps Adobe Illustrator. I suppose every university cartography department would train its students with exercises to become familiar with these mapping packages, learn to deal with the various layers, at least before the advent of GIS software programmes, when boundary files could just be matched with statistical data sets, and many students do not get beyond learning how to combine data sets in EXCEL and deal with shape files in ArcGIS.

Of course the new digital environment also affected reproduction. The reproduction exercises contained in the ICA Basic Cartography Exercise manual, like those on the production of small-scale topographic maps, or of tourist maps no longer were relevant, and would have to be restructured. The same was valid for the production diagrams. A fair amount of time used to be spent on exercises on their compilation; I remember ICA workshops all over Asia where we trained students to find the least expensive ways of reproducing maps through these exercises that now had to be reworked, necessitating new sets of symbols for the new digital techniques required.

Atlas production exercises

Atlas production exercises simulate many aspects of the cartographic profession, as they would train both the design and the production planning aspects. I reported on them at the Tokyo ICA conference (1980). In Atlas production classes e.g. layout exercises were done, to establish a template for the individual atlas sheets, and for finding the best sequence of map subjects. An example here is the exercise how to structure a school atlas of Turkey, to be printed on both sides of a single printing sheet, one side in colour and the other in black and white. The sequence had to make sense and be thought logical; the most important maps would have to be coloured, but also the chorochromatic maps that would not be legible in black and white. For all individual atlas maps, preliminary drawings or mock-ups would be made, before starting with their digital production, in order to be sure all necessary elements would be incorporated (see figure 9).

Superior examples of atlas production exercises would be the atlases compiled at Oxford Brookes University where Roger Anson would take his students to the continent each year in order to gather the information to visualise in the next term.

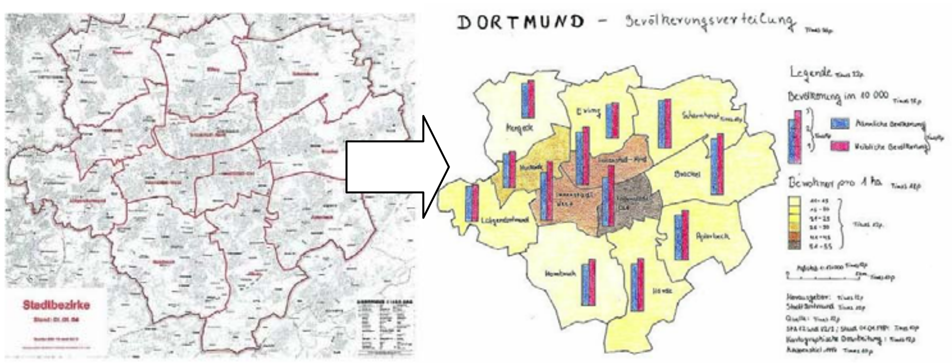


Figure 9. Mock-up for an atlas map exercise, from 'Ausbildungsleitfaden'

Toponymy is another area of atlas cartography where exercises are used in order to speed up the student's grasp of the subject matter. We would ask them, for instance, to do an exercise in script conversion, or to compare geographical names on a map of Spain from a Spanish school atlas and from a British school atlas, and then ask them to work out the rules the editor of the British atlas would have followed in order to adjust the toponyms to his British audience. Production of a place names index from a map would teach students how to deal with generic name parts like Rio or Cape in a names index, what to do with homonyms and allonyms. First they would have to copy all names from a map, identifying their object category and location, and then reordering them according to a specific alphabet.

A final aspect of map production would be an annotation exercise: how to prepare one's map or atlas in such a way through adding marginal information that an independent librarian would be able to list all the relevant information (impressum, publisher, author, date and place of publication) for a web bibliography or catalogue.

Map Use exercises

Interpretation of maps or doing measurements on them is the other half of cartography, and although map use exercises are not primarily oriented at cartographers, they are still very suitable to increase the cartographers' awareness of how map users react to their products. Doing these kinds of exercises, they would for instance find out to which degree different measurement outcomes thought to be relevant by map users are just a consequence of generalisation.

Some examples of map use exercises are e.g. how to prepare a slope map (where, per grid cell the difference between the highest and lowest point is assessed first and then converted in a slope value, assigned to the grid cell centre, and followed by interpolation to produce an isoline slope map), drainage density assessment (here the length of rivers per km^2 grid cell would be computed, and the grid cell data categorised) or an exercise to interpret landforms from a contour line map.

Map Exercises for the future

The framework of all these cartographic exercises described here has been different in scope – there were those meant for in-house training for apprentices, there were exercises that were part of the training of geographers and exercises meant for cartographic draughtsmen. There were higher education or university cartography courses that had exercises in a classroom environment, and there were exercises that formed part of correspondence courses, or of manuals developed by cartographic societies or individual teachers. The Netherlands Cartographic Society used to invite foreign experts for its courses on specific techniques like map lettering or hill shading, for the benefit of their members who had to do exercises in order to master these techniques.

All of these exercises were meant to train, for the participants to practice the theoretical aspects, to pass on knowledge and experience. The ICA tries to continue this training work globally with the hands-on courses it has been organizing for some 30 years, not only through its Commission on Education and Training (CET) but also through the Commission on Management and Economics of Map Production and the Commission on Maps and the Internet, frequently also jointly.

As only a small audience can be reached, however enthusiast these commissions are, with lecturing teams only within the last two years flying in into Central Asia, Iran, Indonesia or Vietnam, developing web courses are a way to reach larger audiences, even if interaction and feed-back still present problems. Already an enormous variety of cartography courses is being offered on the web, and the ICA Commission on Education and Training under Laszlo Zentai and David Fraser has selected the best ones and incorporated them on the CET website, a major job that deserves acknowledgement. The only aspect perhaps lacking in these web courses are exercises. I think the best and most challenging exercises that we have devised for our own students should be incorporated onto the CET website next to the current lessons or lectures that have already been stored there, just as we collected the best paper exercises in the past for the ICA Basic Cartography Exercise manual.

These best and most challenging exercises should show students how many-sided and intellectually stimulating cartography is, and they might thus be induced to follow a career in our discipline. With these exercises we would visualise the challenges of our profession, to adapt geospatial data to the objectives and the target groups of information transfer, to support spatial decision making now and in the future.

Literature

Anson, R. E. and Ormeling, F.J.: Basic cartography for students and technicians. 3 volumes, 1st edition 1984–1996 and the second edition 1993–2002.

Anson, R. E. and F. J. Ormeling: (1991) Basic Cartography for students and technicians. Exercise Manual. Oxford: Elsevier Applied Science.

Claval, Paul et Jean-Claude Wieber (1969) La cartographie thematique comme methode de recherche. Paris: Annales litteraires de l'Université de Besançon.

Kommissionn Aus- und Weiterbildung, Deutsche Gesellschaft für Kartographie e.V. (2000) Ausbildungsleitfaden Kartograph/Kartographin.

PBNA cursus Cartografisch tekenen. Arnhem: Nederlandse Vereniging voor Kartografie and Koninklijke PBNA 1973–1976.

Schulz, Georg: (1995) Lexikon zur Bestimmung der Geländeformen in Karten. Berliner geographische Studien Band 28. 3rd ed. Berlin: Institut für Geographie der Technischen Universität Berlin.

Warn, Chris: (1980) The Ordnance Survey Map Skills Book. London: Nelson.

Annex – Overview of cartographic exercises

A) Map production exercises

- A1 Information analysis
  - 1a establish information/parameter hierarchy
  - 1b establish parameter characteristics
  - 1c establish rules for language-dependent toponymy
- A2 Exercises in mapping technique
  - 2a map lettering
  - 2b hill shading
  - 2c generalisation
  - 2d drawing panoramic maps/block diagrams
  - 2e line drawing exercises
- A3 Exercises in design
  - 3a selecting map types
  - 3b classification/characterization
  - 3c classification/manipulation
  - 3d colour ramp/colour scheme exercises

B) Exercises in map reproduction

- B1 Devise optimal reproduction method
- B2 Construct reproduction diagrams
- B3 Devise optimal atlas structure (Turkey)
- B4 Prepare (atlas) map annotation to enable proper documentation
- B5 Prepare map names index
- B6 Produce standard lay-out and specifications
- B7 Produce a mock-up of an atlas (sheet)

C) Map use/analysis exercises

- C1 Recognise symbology
- C2 Assess accessibility
- C3 Determine patterns: nearest neighbour
- C4 Recognise terrain forms (geomorphology)
- C5 Working with grids
- C6 Find position, in degrees, minutes and seconds or in decimal degrees,
- C7 Convert decimal degrees into degrees, minutes and seconds
- C8 Establish directions, describe way points
- C9 Assess network densities
- C10 Assess terrain changes in-between successive map editions
- C11 Assess slopes/gradients; describe expected relief on a route
- C12 Establish distances and time needed to reach a destination
- C13 Compute areas and distances
- C14 Establish profiles, visibility analyses
- C15 Establish spatial association (Spearman's rank correlation coefficient)
- C16 Compute the map scale

Maps for the Future:
Children, Education and Internet
Joint ICA Symposium

Cartography in Education

CARTOGRAPHIC RESPONSE OF CHANGES IN GEOGRAPHICAL AND HISTORICAL SCHOOL CURRICULUMS

Temenoujka Bandrova
University of Architecture, Civil engineering and Geodesy (Bulgaria)
tbandrova@abv.bg

Abstract: We are living in the time when many GI specialists will recommend usage of electronic maps and atlases and will not develop traditional cartography based on paper version products. The report consider both aspects: why we are not ready to use only electronic version of maps and atlases; how we can improve the traditional cartography – by new topics and modern visualization. Several examples are given by the latest school atlases, which are used in Bulgarian education in geography and history.

Some new aspects in cartographic products and visualization were created because of permanent changes in school curriculum and in the content of the geography and history atlases. Working by experiences and research in the schools, cartographers try to be better in all steps in maps' and atlases' creation and compiling.

Introduction

Working in cartography field the specialists should respond to every day changes of the life. But several months or years are necessary to change school curriculums. Meanwhile new important topics appear and cartographic products become outdated ones before their creation. Were we ready to respond to Haiti children after the earthquake that struck on Jan. 10, 2010? "A study by the Inter-American Development Bank estimated that the total cost of the disaster was between $8 billion to $14 billion, based on a death toll from 200,000 to 250,000. That number was revised in 2011 by Haiti's government to 316,000" (The New York Times, 2011). Are we ready to respond to the technically most developed nation and its children – Japanese children? Let's think about what happened for the first three months of 2011: floods, earthquakes, landslides! Some scientists and journalist already defined 2011 as "a year of disasters". McKibben B., 2011 gives us some data which is used to complete Table 1.

Table 1. Natural Disasters in 2011 (January–March) by data of McKibben B., 2011

Types of disaster	Place	Time, 2011	Human cost	Economic cost
Earthquake of magnitude 9.0, followed by a 15–20 m high tsunami	Japan, north-east coast	March	More than 10,000 dead; 17,000 missing	€ 215bn
Landslide	Brazil	January	916 dead; 345 missing	€ 213m
Floods	Australia	Nov. 2010–Jan., 2011	37 dead; nine missing	€ 22bn – Australia's costliest natural disaster ever
Earthquake of magnitude 6.3 hit the city of Christchurch	New Zealand	February	166 dead	€ 5bn – € 7.6bn
Devastating floods	Sri Lanka	January–February	62 dead; 1.1 million displaced	€ 340m
Earthquake of magnitude 6.8	Myanmar (Burma), 30 miles north of Tachileik on the Thai–Burma border	March	At least 75 dead; more than 110 injured	Not known in 3 April, 2011
Floods, heavy rains continued from December last year	Philippines	January–March	At least 75 dead	€ 30m
Severe storms, lightning and floods	South Africa	January	91 dead; 321 injured	€ 83m

During the last 3 months amount of countries and millions of people were affected (see Table 1). How cartographers will respond to children from Japan, Brazil, Australia, New Zealand, Sri Lanka, Burma, Philippines and South Africa? In such moments it is visible that we are not ready to give response, it is visible that we are too slow to change something, that we are not ready with standards and visualization of all process that are happening around us in the nowadays geography All these comments make evident the need of more scientists to work on the topics, of more projects to be financed and developed, of more governments to help the scientists to develop standards and fast responses to everyday changes and to prepare our children and students for right behavior and give them enough information and knowledge.

Natural disasters are only one the many topics such as globalization, sustainable development, environmental protection that should appear in geography and history subjects in school curriculums. They are relatively new and find places in school curriculum's changes. Cartographers try to respond by including such themes in their new cartographical products illustrating that way geography and history lessons. The problem is that these cartographical products need to be updated more often that it is doing now.

Changes in geography and history contents

The Ministry of Education in Bulgaria is responsible for the creation and approval of school curriculum for all subjects in elementary, secondary and high education. Here I will describe the situation in geography and history subjects. The changes are happening every 5 to 10 years. This situation is not typical only for Bulgaria. Zhang and Foskett (2003) declare for UK that the changes are in subject matter in 15 sets of British geographical text-books from 1907–1993. Some of changes are from general to regional aspects similar as concepts "regions" in elementary and secondary schools in USA (Stoltman, 1992). These changes lead to new aspects, details and topics in teaching problems. Every new curriculum is made to improve educations and give children more new aspects of modern society. In many countries this is done to provoke independent and active learning (Paris and Byrne, 1989).

A new law about elementary, secondary and high education in Bulgaria is preparing in the moment. This will bring new changes in geographical and historical curriculum. Many changes were done also in last few decades. The largest ones were in the general context of the mentioned subjects. The school subject of Geography changed its name to "Geography and economics" and History one – to "History and civilizations. These new scopes developed many topics which enlarged simply subjects 'geography' and 'history' to more broad ones including sustainable development of the society. The content in geography was enriched with some new topics like risk management, environmental protection and ecology. New topics also arisen in history field. As example we could present a visualization of Troy war and brigade distributions in socialistic time among others.

Cartographical response to the new aspects in geography and history subjects

To help geographical and historical education, cartographers propose different types of cartographical products: wall maps, atlases, electronic atlases, contour blind maps, globes, virtual cartographic representations, etc.

Kindergarten

The first questions could be "when we should start?" There was a discussion between old cartographic generation keeping positions in state cartographic company and new generations, working for different private companies. Before 1990 students faces with the first map in the geography lessons in 3rd grade (10 years old children). Nowadays children receive everyday information by media, radio, TV, Internet and they start to use and read maps in their kindergarten ages. The fact that young kids are able to use maps was proved by experiences with child-ren in 15 kindergartens in Sofia. Children had knowledge about the continents' names, Bulgarian boundaries and cities, the names of the biggest mountains and rivers. They have been very active and accepted the questionnaire as a pleasant game. On the base of this experiment we created 2 posters for kindergarten: 1. Plants and animals in the World and in the opposite side of the poster: Plants and animals in Bulgaria (see Figure 1). 2. The major sights in Bulgaria and in the opposite side of the poster: 6 great Bulgarians important for our history (see Figure 2).

Figure 1. Plants and Animals in the World

Figure 2. Major Sights in Bulgaria

Our work for and with children in kindergartens aims to achieve results in several aspects:

- prepare children for first lessons in school which need use of maps;
- improve their geography culture;
- give them additional knowledge in distracting way: by playing games and drawing pictures;
- show them art aspect of the maps and train them in aesthetical view of the maps.

All participants in this initiative believe that these kids will learn how to use maps in an appropriate way Facing with maps of high quality teachers and kids will be able to distinguish the good and useful products from the low quality ones which are sold on our free market.

Electronic variants of cartographic products

Students and kids share the values of a new generation who is using computers every day for every need. That is way the most appropriate solution is to propose geographical and historical mapping visualization through the medium of electronic cartographic products. Several ideas have been realized worldwide. An electronic school atlas of Quebec is a good example of product which architecture and content is connected to the child (Anderson, Carriere, LeSann, 2003). Other research (Pfander, Kollen and Greenfield, 2004) represents the Arizona Electronic Atlas (http://atlas.library.arizona.edu) as an interactive Web-based state atlas which allow users to create, print or download maps and data. The efforts of its creators are focused on the integration of the Atlas into the university classroom.

There are different opportunities for students training in organizing information according to classification schemes, understanding intellectual property rights and mastering the use of Internet based tools in the Norwegian GeoAtlas (http://www.avinet.no/). A lot of examples of electronic Atlases are available on the market and in the web. Nevertheless only few of them are developed for children and students use. There are large numbers of advantages of these atlases. They are well described by Uluğtekin and Bildirici (1997). One of the biggest advantages is shown by the same authors as they wrote “Atlas publishing in electronic form will become financially interesting more and more”.

Figure 3. A possibilitiy of electronic atlas for data combining and use

After this short introduction about electronic atlases development in the world, we could pay attention to Bulgarian version of such atlas, called “MaxInfo”, product of Datamap-Europe Ltd. It contains a lot of information about Bulgaria, Sofia and other Bulgarian cities: maps, legend, photos and texts (see Figure 3). This information could be visualized in computer screen and printed after that. Teachers and students could include the necessary objects by interactively chosen symbols and automatically situate them on the base map. The students can search the necessary information by taping a keyword and situate or see it in pictorial and/or text form. In such a way they get knowledge about GIS function in the first step of their education. The Atlas is working in user-friendly way, so the students will begin to use GIS questions and will understand the productivity and usefulness of the real GIS (Bandrova, 2001).

The training with electronic atlas could be directed in 3 points:

- Work with data. Different kind of tasks can be given to students. They can select a list of type objects, classify objects, examine some details of every object and connect them with information for other objects. It is flexible system for object searching according to different criteria: name, type, address, key words and others. Every reference can be saved for future usage.
- Work with maps. There is a possibility for scaling maps, move map images, switch on or off the visibility of layers, choose a symbol system for object mapping.
- Work with data and maps. Students can add data on a map as a separate map layer, receive information for objects, find the object situation from a data list, etc. Examples of teachers tasks can be the following according to Ormeling F., (1996):
  1. What is on a map (identifying);
  2. What is where on the map (classifying);
  3. Do you see a relationship on the map (relating);
  4. Check if this relationship is valid for each region on the map (checking, monitoring, validating).

This electronic atlas has CD version and it is sold in Bulgarian market. This makes it difficult for use by teachers and students. Main users came by business field. Students are using free version of another Bulgarian web based atlas. It can be found on www.bgmaps.com. Its main purpose is to give the possibility to find address in the city situation. It is not adopted for student or children use.

Compromises?

Compiling and mapping geography and history information which we needed for school atlases and wall maps provided us with enough data which allow us to produce electronic or virtual variants of these cartographic products. From cartographer's point of view this will not be a problem. Also in these days many variants of electronic text-books appeared. It is clear that this will be the future of the school cartography development. However, the situation is still bad because of the poor computer equipment in school rooms. Only one room per a school is equipped with computers. This room is all time occupied by students studding computer science. There are no possibilities for geography teachers to use this room for their lessons. For this reason we still propose only paper atlases and wall maps in Bulgarian market. However, in outline maps and in some atlases there are tasks that require from users to perform an Internet research. Other reason is the open issues in terms of legacy. The students will use their personal notebooks we cannot allow usage of illegal software. Unfortunately, the necessary software for cartographic applications is too expensive. This point of view has been developed in the work of Gold (2008). He states that „However, where vandalism, or irresponsible use such as software piracy, are perceived to be problems with the result that the machines may only be used when staff supervision is available, then even a large number of microcomputers in a laboratory may provide extremely limited access to students taking computer cartography courses".

A good idea is that geography and history lessons could be developed as computer games apropriate for different ages. Such experiment could be found in The Serious Games Institute (SGI) at Coventry University. Wortley (2008) says that it is established to „create an international centre of excellence for serious games and virtual worlds. The SGI has been pioneering the use of virtual environments for a range of applications which include e-learning, simulation, disaster management, virtual conferencing and social and business networking". Here, the issue is how to make such product cheep enough or free of charge for teachers and students and how to make it attractive enough for students' needs.

Modern visualization

The visualization of geographic and historic information on the school atlases is one of the main topics of modern cartography. Mapmakers should reach students' attention and provoke map reading and analysis. How do children think in terms of cartographic aspects? We can find different responses on this question as well as a lot of proposals. Many of these proposals are the result of questionnaire research. Reyes Nuñez at al (2005 and 2008) on the base of international research and questionnaire propose to be used "satellite images in the textbooks and atlases..., which help the pupils to understand the content of the physical maps by visualizing the represented territories in their natural dimensions" (Reyes Nuñez et al., 2008).

How to visualize the necessary information; how to choose the appropriate symbol system, what colours we should use? The answers of these questions need experiments with children to understand their maps' perception (Konecny and Svancara, 1996). To work with students and to be close to their thinking is one of the main steps of proposed technology for atlases creation in the work of Bandrova (2007). After many experiments, conducted mainly by questionnaire the prepared maps and atlases were approved and later published (Bandrova, 2010).

Figure. 4. Use of photos and drawings in map's design

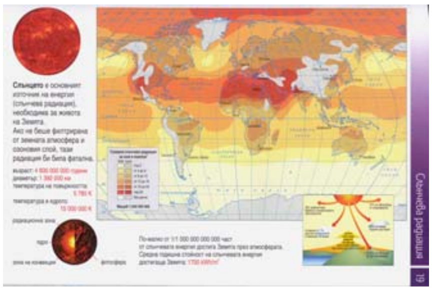


Figure. 5. Use of diagrams and text in map's design

Figure. 6. Visualization of different kinds of maps and mapping

There are several main differences in comparison with the old atlases proposed on the Bulgarian market:

- Usage of many photos and drawings in maps' and atlases' design (see Figure 4). This attracts students and direct their attention towards the topic of the maps;
- Use of different diagrams, statistics and text like in encyclopedia style (see Figure 5). These not only textual but also visual elements capture students' attention, provide them with more specific and curious information which is easy to understand and memorize. Use of examples in topic explanations. On Figure 6 this method was used to explain different types of mapping and maps;
- Use of colors on the borders of the pages or under the title to separate different parts of atlases.

All these improvements accompanied by the high quality printing and publishing make the atlases popular and attractive for students, parents and teachers.

New topics

The adoption of the new topics in the atlases and wall maps is related to the new curriculums in geography and history. Cartographers must adjust their products to the new curriculums because their cartographic assets should be approved by the Ministry of education. Thereby, these products could be used in Bulgarian schools.

New ideas and maps in the Geographical Atlases

Some the new topics are included in order to facilitate the teaching of other topics that the students find difficult to understand. For example different kinds of mapping and maps (see Figure 6) or map projections (see Figure 7).

Another reason is to help teachers and students to understand more complicated themes in their lessons. Map projections represent such a challenge. We try to show students how we manage to display the sphere on the plane. Different kinds of deformations appear (area, linear, angular) as a consequence of this transformation. This is visible in the map-play included as a separate part of the Atlas on geography – a puzzle or an icosahedron (volumetric map of the world with 20 equal triangular parts in gnomonic projections). The play with them is multifunctional in terms of geographical, cartographical and mathematical aspects (Fig. 7).

Figure 7. Map puzzle is used in lessons on map projection and deformations

Other new topics which appear in the geographical atlases are related to natural risks and disasters, natural resources, ecology and others.

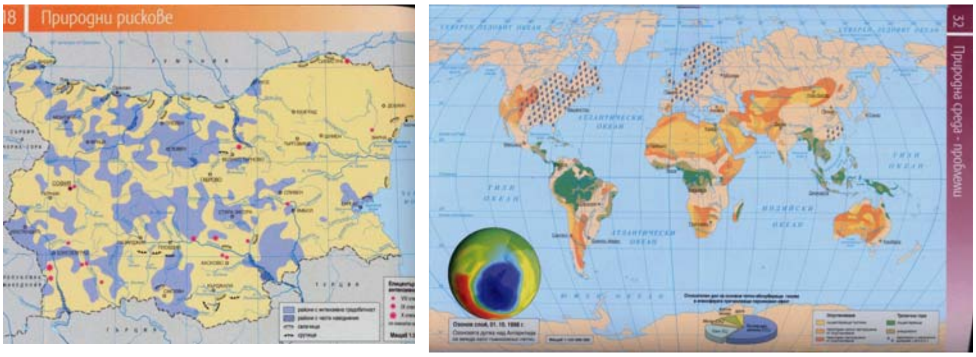


Figure 8. Maps from school atlases representing nature risks and disasters

Such examples could be seen on Figure 8. Children and teachers are prompted to describe and analyze the most affected territories and spots where disasters are likely to happen or some consequences that have already appeared. On the base of such maps some preventive activities could be planed and discussed.

The cartographer's role is to help children, students and teachers in their educational process. Another goal is to direct students attention to the global and regional problems and to the ways to improve and safe the environment. The next tasks are to find data and represent it in regional atlases in larger scales and thus we will help also regional geography items.

New ideas and maps in the Historical Atlases

The old historical atlases were criticized by teachers mainly in the following directions: too many represented objects from general geographic base, a lot of information represented in atlases for young students (for example, the history maps of Bulgaria for school years 5. and 11. have similar contents), too many symbols in common legend. The authors tried to avoid these difficulties and the new historical atlases are compiled on different way:

- clear general geographical base: only the biggest and relevant to the map's topic rivers are represented, the shade relief has replaced a lot of mountains names;
- different representation of one and the same theme for different school years: maps, compiling atlases for high school have richer content needed to studied topics;
- not so many symbols (only the most associative ones, for example, symbols represented state border, city, capital, etc.) are represented in the general legend.

The new idea for atlas compiling is related to representation of specific themes in the Atlases. Such theme is the Trojan War which is not represented in old atlases. It is mapped based on the information taken from the Homer's poem "Iliad". The result could be seen on Figure 9.

Figure 9. A map for the Trojan War published in the Historical Atlas for school year 7

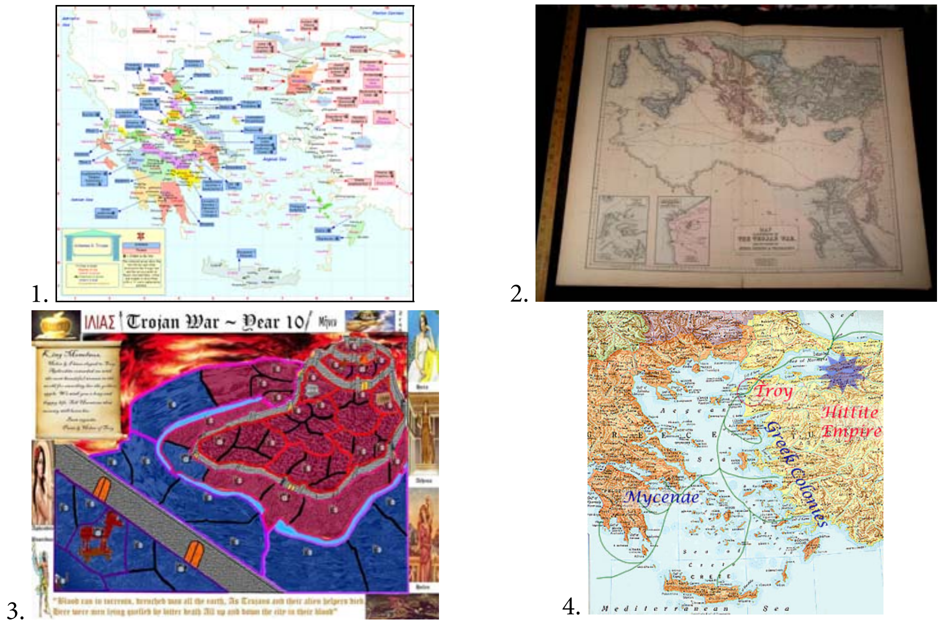


Figure 10. Different maps of Trojan War
Source:
1. http://www.bc.edu/bc_org/avp/cas/ashp/NEWhp252/portnov/trojanwar.html
2. http://www.raremapsandbooks.com/index.php?main_page=product_info&products_id=12628
3. http://sillysoft.net/lux/maps/Trojan%20War%20-%20Year%2010
4. http://mmtaylor.net/Holiday2000/Legends/trojan.war.html

The existing maps representing Trojan War (see Figure 10) did not provide us with the necessary information. The war was partly represented or with insufficient information. The explanations in text books should be expended with descriptions taken by literature. The teachers are very positively surprised when they receive such maps and can visualize their explanations.

Other new topics in historical atlases are related to the newest history. Brigade movement is one of the topics which are newly developed. These new maps regroup the distribution and localization of different meetings, grouping activities, protests and others are represented. The students have visualized topics and they can use the maps to connect historical lessons to situational facts.

Conclusions and directions for future works

The idea of this research was to find topics in school curriculum in geography and history where cartographers should react on fast way. The best variant is when people in responsible ministers react also on time and don't take a year or more but if it is not possible cartographers could propose some new themes as additional topics. This is allowed because the school atlases should contains about 20% additional contents than this one in school text books. Such examples are shown and the most important topics in these days are crises respond and disaster management. In the new Bulgarian atlases of geography some maps of these themes are already done.

Other decision could be if electronic variants of the atlases will be produced. Then the updating and including of the new themes could be easy and faster. The main problem for countries as Bulgaria is the possibility to use computers laboratories in the school in geography and history lessons. These laboratories are occupied by the lessons of electronic sciences and informatics. Teachers have not possibility to use them but students could use such atlases for home works and studying.

To help teachers in difficult topics cartographers could be ready to supply them with additional materials, maps, cartographic products. Such example is icoahedron product which will help teachers in explanation of map projection topic. Some new ideas for visualization of topics which are did not propose up to now will also help teachers and students in their educational process. Such example was a Trojan War.

The modern visualization in the new cartographic products (paper and digital) will be cartographers' target to reach students' attention and better understanding of all topics which should be studied. The electronic variants of atlases and maps give cartographers most power tools to do this by animation, sound and videos, 3D presentations and allowing users to produce their own products. This will be our tasks in the very close future to supply schools, teachers and students with such new cartographical products. This will be our respond to school curriculum changes.

References

Anderson, J., Carriere, C., LeSann, J.: 2003. A Pilot Electronic School Atlas of Quebec. International Research in geographical Environmental education, Vol. 12 : 4. p. 383–390.

Bandrova, T.: 2001. The first Bulgarian Electronic Atlas – A Possibility for Cartographic Teaching in Schools. E-mail Seminar of Cartography, Vol. 3, p. 93–98, Sofia, Bulgaria.

Bandrova T.: 2007. Cartography – Close to Users: A Technology for Compiling of School Atlases for Education on Geography in Bulgaria, XXIII International Cartographic Conference, 4–10 August, Moscow, Russia, CD proceedings.

Bandrova T.: 2010. Bulgarian Cartography: From Paper To Virtual Reality. 3rd International Conference on Cartography and GIS, CD Proceedings, Nessebar, Bulgaria, ISSN:1314-0604 (keynote presentation).

Gold, C.: 2008. Cartographic Education in Canada, [online] Available at: <http://www.voronoi.com/wiki/images/6/66/Cartographic_education_in_canada.pdf> [Accessed 09 March 2011].

Konecny, M., Svancara J.: 1996. (A)Perception of the Maps by Czech School Children. Children and Education in Cartograpy. pp. 137–146, ICA, Gifu, Japan.

McKibben B.: 2011. Natural disasters? The Guardian [online] Available at:

<http://www.guardian.co.uk/world/2011/apr/02/natural-disasters-floods-earthquakes-landslides> [Accessed 03 April 2011].

Ormeling, F.: 1996. Teaching Map Use Concepts to Children. Seminar on Cognitive Map, Children and Education in Cartography. Gifu, Japan.

Paris, S.G., Byrne, J. P.: 1989. The Constructivis Approach to Self-regulation and Learning in the Classroom. Zimmerman B.J., Schunk, h. (eds.) Self-regulated Learning and Academic Achievement: Theory, Research and Practice. New York, Springer, p. 169–200.

Pfander, J., Kollen, C., Greenfield, L.: 2004. The Geographic Literate Student: The Arizona Electronic Atlas Experiment. [online] Available at:
<http://proceedings.esri.com/library/userconf/educ04/papers/pap5050.pdf> [Accessed 09 March 2011].

Reyes Nuñez, J., de Moretti, C., Garra, A., Erika, G., Rey, C., de Castro, V., Dibiase, A.: 2005. Reading thematic maps in Argentine and Hungarian schools: experiences in both countries. Mapping Approaches into a Changing World. 22. ICC 2005 conference CD Proceedings. A Coruña, Spain.

Reyes Nuñez, J., de Moretti, C., Garra, A., Erika, G. Rey, C., de Castro, V., Dibiase, A.: 2008. Resuming an international project: Map use in Argentine and Hungarian schools. Second International Conference on Cartography & GIS, p. 113–122. ISBN: 978-954-724-036-0. Borovets, Bulgaria.

Stoltman, J.: 1992. Geographic Education in the United States: The renaissance of the 1980s. Naish M. (ed.) Geography and Education. London University: Institute of Education.

The New York Times, 2011. Haiti, Overview, World. [online] Available at: <http://topics.nytimes.com/top/news/international/countriesandterritories/haiti/index.html> [Accessed 03 April 2011].

Uluğtekin, N., Bildirici, İ.: 1997. Advanced Mapping Technologies: Electronic Atlases. Second Turkish-German Joint Geodetic Days, p. 641–649, Berlin, Germany.

Wortley, D.: 2008 GIS And Virtual Worlds The Importance Of Place And Community, Bandrova, T. (ed.), 2nd International Conference on Cartography and GIS, Vol. 1 p. 317–322, UACEG, Sofia, Bulgaria, ISBN: 978-954-724-036-0.

Zhanng, H., Foskett N.: 2003. Changes in the Subject Matter of Geography Textbooks: 1907–1993. International Research in geographical Environmental education, p. 312–329, Vol. 12 : 4.

Maps for the Future:
Children, Education and Internet
Joint ICA Symposium

Cartography in Education

TEACHING CARTOGRAPHICAL SKILLS IN DIFFERENT EDUCATIONAL SYSTEMS OF EU

Eszter Simonné Dombóvári
Vienna University of Technology (Austria)
eszter@cartography.tuwien.ac.at

Abstract: The European Union means a union of countries with different past and development, various national traditions, customs and educational systems. The main aim of these educational systems is to import growing and basic knowledge in a socially institutionalized way. Teaching cartography is one little piece of these systems and it appears at different level of these education systems. We can obtain this knowledge in many ways with the help of numberless educational tools. With the new possibilities of the web mapping 2.0, method and content of teaching expands and a new quality in teaching and training comes into life. The aim of this research is to find the answer on the questions what the role of new media in education is and beside traditional tools what new techniques are offered in the field of cartography teaching. These experiences of comparisons can help us to improve cartographic education in schools.

1. Introduction

The European Union means a union of countries with different past and development, various educational systems, national traditions and customs. The member states pay great attention to care for cultural diversity and preservation of national values (Ormándi, 2006). These differences give the multicolourness of the Union.

The European Union was an economic cooperation until the 1990s but it is a lot more now, a global economic and political integration which also affects education. A kind of globalization can be observed in this field as well. The role of the community is growing. In the interest of faster development, the inner educational politics of the member countries are coordinated. As standards unify, it needs unifying teaching that leads to unified compulsory education (Kozma, 1997).

The competitive and continuous knowledge renewal, the role of skills and competencies appreciate which is the primary source of education and training (OKM, 2009). Nowadays the goal is an education and a training system of high quality. A competitive and knowledge-based society has brought "lifelong learning" as well as the competency-based education (appropriate for student's skills) for the last decade, and also has posed challenges to the traditional educational systems.

The EU recommendations deal with education, training, adult learning, lifelong learning, mobility and e-learning (OKM, 2010). Nowadays the member states decide only on their own educational politics (compiling teaching material as well as their school systems). Their task is the implementing of the European Union programs and they are responsible to revamp their education system. The Union is responsible for promoting cooperation, supporting the process and encouraging additional community programs to achieve a competitive union (Ormándi, 2006).

The differences of the educational systems enhance the role of international comparisons. The base of the comparison may be e.g. the length of compulsory education and of teaching periods, the structure of pre-school, primary, secondary and tertiary education and educational means (Ormándi, 2006). My aim of the resource is to show the educational systems and teaching of geographical and cartographical knowledge in a few member states of the EU.

2. Educational systems in european union

One of the most important tasks of public education is knowledge transfer based on educational systems with several different layers of learning and training. The educational systems of a given country include all the schools of the country and show an organization where schools (of different type, level, function, maintenance) are connected horizontally and vertically (Mezei and Szebenyi, 1998). Its main aim is to import growing and basic knowledge in a socially institutionalized way.

Every single school system has evolved and developed differently in the influence of different factors (e.g. traditions, historical, social and economic development) shaping them. Therefore there are similarities and differences between them. Differences may not only be in maintaining schools but also in education – such as the length of compulsory education, the age of school beginning, different school types, school system and interoperability between schools, the level of state influence.

To examine every single different method we need a homogeneous scheme. UNESCO, OECD, EU have formed international standard classification of education (ISCED) in order to interpret educational training forms and programs homogeneously (UNESCO, 1997). With its help the different educational systems can be compared easily. There are seven levels determined within educational systems (Figure 1).

Level 6	Second stage of tertiary education (leading to an advanced research qualification)
Level 5	First stage of tertiary education (not leading directly to an advanced research qualification)
Level 4	Post-secondary non-tertiary education
Level 3	(Upper) secondary education
Level 2	Lower secondary (second stage of basic education)
Level 1	Primary education (first stage of basic education)
Level 0	Pre-primary education

Figure 1. ISCED levels

The Eurydice Network contains information and analysis of educational systems and policies in 31 of the members of the EU Lifelong Learning Programme in Europe: the 27 EU countries, Liechtenstein, Norway and Iceland (as member of the European Economic Area, EEA) and Turkey. The publications and the databases of the member states' education and its comparison are organised by the EU Education, Audiovisual and Culture Executive Agency in Brussels (Eurydice, 2011) which formed the basis for this comparison.

The compulsory education lasts 9–10 years in most EU states (in Luxembourg, Malta and UK 11 years, in the Netherlands and North Ireland 12 years and in Hungary 13 years). It is between the ages of 6–16. In Luxembourg, Ireland and the Netherlands compulsory education starts at the age of 4, while in Bulgaria, Estonia, Finland, Lithuania, Denmark and Sweden only at the age of 7. Usually the start of the compulsory education coincides with the start of the primary education. In case of earlier start, the pre-school program is part of the primary education. Primary education is generally completed at the age of 12, but it is linked up to lower secondary education in some countries and it can take to the age of 15–16 and the upper secondary education to the age of 18–19.

In most countries the school pathways for pupils are generally identical up to the end of the lower secondary level (14 or 15 of age). Malta, Poland and the United Kingdom have core curriculum up to the age of 16. In some countries, pupils can choose a specific type of school at the beginning of lower secondary education (Germany, Austria, the Netherlands and Luxembourg). In other countries compulsory general education is organized in single-structure schools up to the age of 14 or 15 without a transition between primary level and lower secondary levels. But from the age of 10 or 11, pupils in some countries can attend another school – Czech Republic, Latvia, Hungary and Slovakia (Herodot, 2007).

Different levels have developed differently in the countries of the European Union, but structural similarities can be recognized (Figure 2 and 3). We can distinguish three models where different levels – elementary, lower and upper secondary – are connected or separated (Lannert and Mártonfi, 2003):

- the model with two cycles (elementary + lower and upper secondary) has a 4–6 year first period and a 6-9 year second period (4 + 8, 6 + 6, 4 + 9) e.g. in Austria, Germany, Belgium, The Netherlands, Ireland etc,

- the model with two cycles (elementary and lower secondary + upper secondary) where the first period is longer and the second one is shorter. It can be 8 + 4, 9 + 3, 9 + 4. The countries are e.g. Portugal, Scandinavian countries and countries in East-Europe,
- The model with three cycles (elementary + lower secondary + upper secondary) can be 5 + 4 + 3 (e.g. in Italy) or 6 + 3 + 3 (e.g. in France).

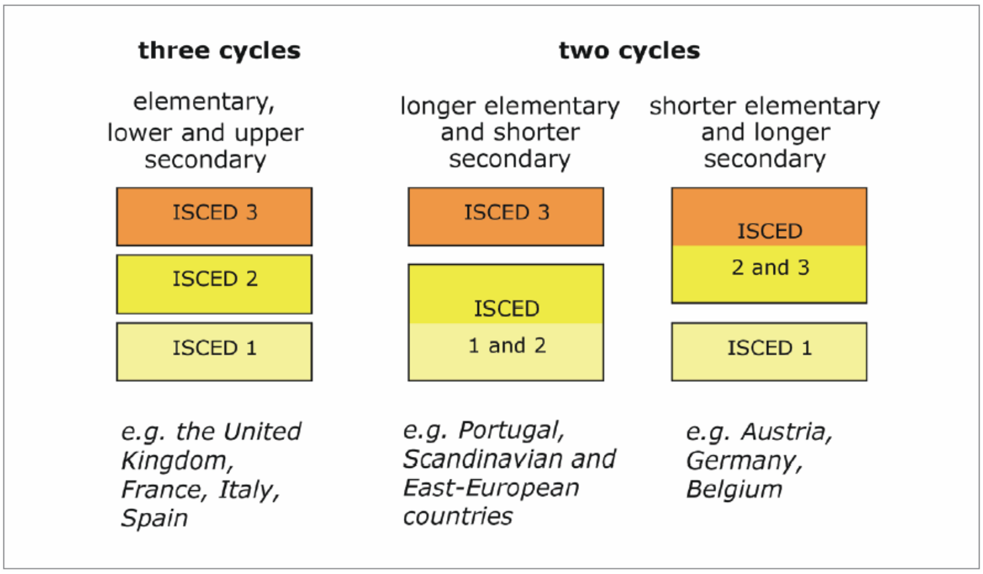


Figure 2. Types of school systems in the European Union (with ISCED levels)

Different models influence learners. The model with three periods in different schools means more changes for children. When the first period is short, selection is too early. (The early selection process means, the children of the largest segment of the population are underrepresented at higher schools. Educational systems tend to reproduce traditional social structures instead of being a vehicle of opportunity or social mobility). If the first period is longer, foundation of teaching is better. For the last years, emphasis is on openness and individualization of education, on the process of teaching and learning, on developing claim for learning, on improving learning abilities, on attaining active learning strategies, on forming abilities to cooperative learning. Learning has expanded both in space and time and it takes place more and more outside school building. These changes need foundation of good quality where formal schooling is in dominant position (Lannert and Mártonfi, 2003).

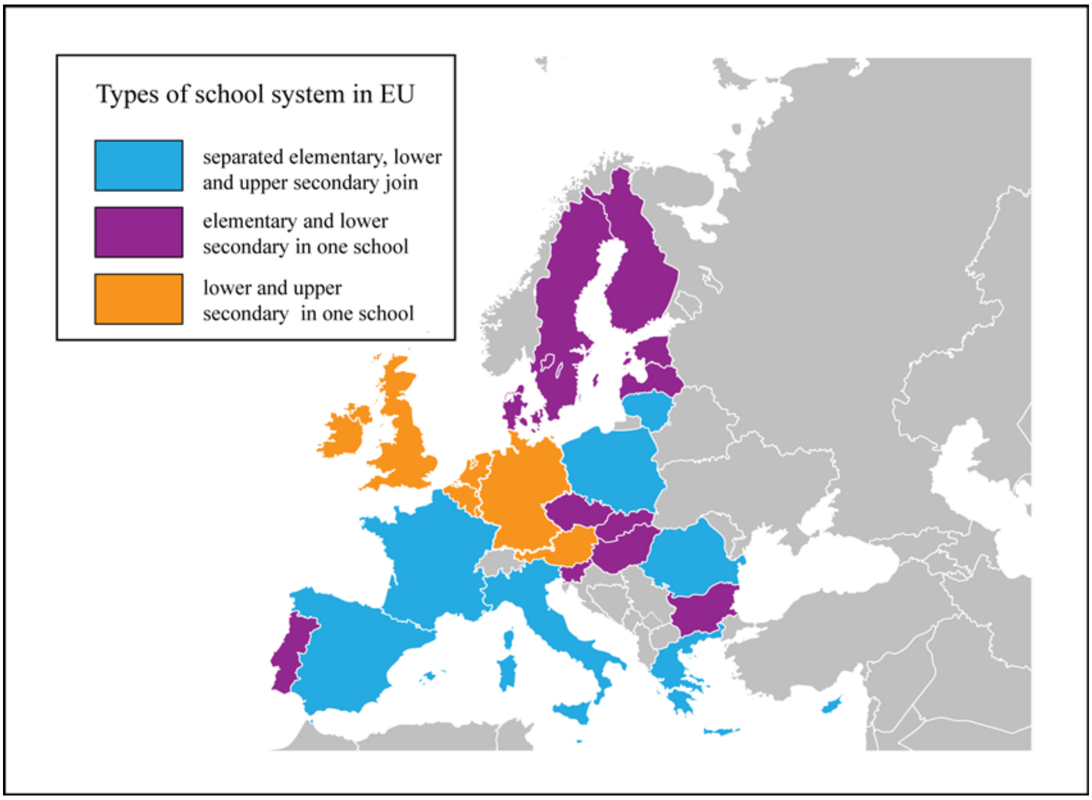


Figure 3. Types of school system in the European Union

3. Curriculum in european union

The curriculum is a partly pedagogical, partly educational guidance document which consists of general teaching and training aims, aids of didactics, offered teaching method, lesson plans, teaching material for subjects and grades (OKM, 2003). The aim of the curriculum for each school type is to develop subject-specific and new competences (new competences: e.g. information and communication technology – ICT, foreign languages, entrepreneurship, social skills and technical culture). There are five separate areas of studying: language and communication, individual and society, nature and technical sciences, creativity and planning, knowledge of health and physical education (Eurydice, 2002).

The digital technology is transforming every aspect of people's lives. The educational systems must adapt to these individual needs and requirements. Today, the goal is the skills and the competencies required for practical life rather than factual knowledge (Ormándi, 2006). The two main topics of the European educational policies are the foreign languages and digital knowledge. The purpose is to develop skills to a knowledge-based society, to ensure an access to ICT, to increase the number of students in scientific and technical studies, to open learning environment, to make teach more attractive (Eurydice, 2002).

The general trend in EU member states is keeping students for a long time in school to obtain the necessary skills and to prepare "lifelong learning". The period of the compulsory education increases. The time devoted to nature and social science subjects as well as foreign language education is growing. The following disciplines are emphasized in the different stages of the educational systems (Eurydice, 2009):

- the curriculum of primary education is almost the same in all member states. The differences are only in flexible timetables and obligation to provide ICT instruction and religious or moral instruction. The main subjects are the language of instruction (one-quarter and one-third of teaching time), mathematics, sciences and social sciences (9–15% of teaching time), physical education (7–12%), foreign language (less than 10%), religious and moral instruction (4–8%). The information and communication technology (ICT) education as a subject takes very little time and often belongs to other disciplines,
- The timetable of the subjects is changing in the secondary school: almost every member state reduced the proportion of the native language and mathematics, respectively increased the proportion of natural and social sciences. The natural science will find the largest number of lessons in some countries (the Czech Republic, Estonia, Slovenia, Slovakia and Finland). 10–20% consists of teaching foreign languages, mother tongue, mathematics, natural and social sciences. Foreign language education is the same ratio compared to the primary education but the education of arts is less at this level,
- in upper secondary education general education and vocational education are separated.

3.1. Teaching geography

Teaching geography in each member state is characterized by autonomy in the subject, changes in content, attitude and number of lessons. Teaching cartography is one little piece of geography education but this is one of the most important knowledge to show the spatial and temporal trends of geographical phenomena and processes. The geographical content is an important part of the curricula, such as cartography. This is a compulsory curriculum either it is a separate subject or it is integrated in another subject. It is taught at least in two years between level 4 to 11 (Curić, et al., 2007).

Geography is required for different long time in each member states. In most countries it is a compulsory subject between the age of 15-16 (Austria, Czech Republic, Denmark, Finland, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, the Netherlands, Poland, Portugal, Spain and Sweden). In Cyprus, Greece, Italy, Slovenia and the United Kingdom it is the age of 13-14, in Belgium, Malta and Slovakia from age of 10-12, but in Bulgaria, Estonia, France, Poland and Romania, it must be studied to final exam of the secondary school (Herodot, 2007).

The role and the teaching time of geography has been reduced both in primary and secondary education. Some progress can be observed in Estonia, Slovenia and Sweden (Herodot, 2007). The decrease of the lesson number is observed in all countries. Lessons per week: primary last secondary education Hungary (7), Slovakia (16), Slovenia (12), Romania (12 to 17, depends on school), Poland (12) and Austria (16) (Ütőné, 2009). But in many cases only the curriculum determines the teaching time of individual subjects and each school can decide the exact curriculum: e.g.

- in Sweden the government provides the teaching time of the subjects for the duration of 9 years education,
- in Ireland there is the minimum amount of time,
- in the Netherlands schools have the largest autonomy. Schools themselves decide the number of lessons,
- in England the teachers can decide this, but the theme should be tailored to the curriculum.

In some countries the theory and related knowledge acquisition is important, but less attention is paid to practical cognition. Such are the countries in Central and Eastern Europe, e.g. Czech Republic, Slovakia and Hungary, which have a so-called traditional way of science teaching. However, the Anglo-Saxon and Nordic countries have a major role in the experiments and practical tasks. In the latter countries, science or integrated science courses appear in general (TIMSS, 2007).

In every country: the preparation of educational content, the use of different teaching methods and forms, different types of student work (individual work, testing, pair and group work, discussion, field work, project, presentations, essays, posters, projects, presentations) is important. Furthermore, it is important to connect geographical knowledge to other subjects. In the 1990s, Geography, as a subject, began to be independent. It is an integrated subject in primary education in most cases and later it is an independent subject in the curriculum (e.g. the situation of the geography depends on the type of the upper secondary school). It is an independent subject in Austria, Slovenia, Hungary, Ireland, the Netherlands, Finland, Germany and Great Britain. In some countries, geographical knowledge is part of social sciences (Germany, Sweden) or natural sciences (Finland), or both (e.g. Slovenia, Great Britain, Austria, Ireland, the Netherlands, Hungary). Therefore often not the specialized teachers educate the geographical knowledge and they pay less attention to geography. In some countries geographic knowledge is taught with other topics at some educational levels (Curić, et al., 2007), e.g.

- in Austria with economics in the lower and upper secondary level,
- in France and Ireland with history at the upper secondary level,
- in Finland with biology at the lower secondary level,
- in Sweden it is included in the social sciences like history, religion and society.

3.2. Cartographical themes in the curriculum

Cartography is "the art, science and technology of making maps, together with their study as scientific documents and works of art" (Neumann 1997, p. 29.). Cartography in schools, as a section of cartography, deals with making maps or map-like representation for school purpose and forming the criteria and the base of didactic-methodical use (Bollmann, Koch 2002). School cartography is map-making for school use (Neumann, 1997) and includes not only the cartographical skills but also the use of maps and map reading and the topographic knowledge. The aim of topographic education is not collecting pieces of information, but developing ability and independent search and arranging knowledge. The topographic fundamentals, location, explanation of places, attaching geographic knowledge are also important.

European Schoolnet (EUN), a virtual learning network, has got 31 members of Ministries of Education in Europe since 1996. Its aim is to bring about cooperation, innovation and exchange in teaching and learning to its key stakeholders: Ministries of Education, schools, teachers and researchers. The main educational portals and the Ministries of Education of the member states can be found in it. The basis for this comparison is this website and some school books (Figure 4, 5 and 8). The open and free educational contents are available from the Learning Resource Exchange (LRE) portal for schools from many different countries and providers, including 18 Ministries of Education.

Table 1. Cartographical themes and topic in schools

Cartographical themes	Cartographical topics
The map	• definition of the map, map types, globe, atlas, scales and scale bar, units • history of cartography
Cartographical representation	• generalization, methods of representation, colours on the map • representation of relief, symbols, geographical names • projections, distortions
Orientation	• directions, compass, north and their determination, orientation of the map • determining the position • coordinate systems: geographic coordinate systems, • km grid
Measurements on the map	• determining the amount and coordinates • measurement of distances, distance, areas and angles • use of maps and atlases (finder grid, telemetry) • gathering information from maps (earth grid, points of compass, GPS, compasses) • creating topographic profiles
Remote sensing	• satellites, satellite images

If we focus on cartographic topic in schools of e.g. Austria and Hungary (Table 1, Figure 4–5), we can declare that:

- In primary school, 3rd–4th grades (at the age of 8–10), pupils learn about orientation in time and space for the first time.
- In lower secondary education, in the 5–6th grade, cartographical themes are taught with the help of globe, maps, atlases and pictures during the first 5–10 lessons. Students learn most important fundamental elements: such as map types, direction and distance, orientation, map symbols, relief, use of maps and atlases (finder grid, telemetry) and gathering information from maps (earth grid, points of compass, GPS, compasses). In all themes local complements are added. Topography plays a role in processing school work. According to valid curriculum its task is connecting topographic knowledge with geographic content.
- In the upper secondary education, the 9th grade, pupils mostly revise cartographical knowledge learnt at earlier stages, but mainly make use of map reading and analyses. They use maps, air and space photos in studying different themes. Requirements are map reading, comparative analysis of thematic maps and explanation of space photos, different geographical exercises (e.g. determining northern direction and height, orientation on maps, code and measurement of distance, zone and standard time).
- In the next years there are no cartographic fundamentals taught at this level but orientation and use of maps in Geography lessons become important, expression of ideas on the basis of obtained knowledge, logical comparative analysis and identification of phenomena of nature on contour maps are important. As the amount of topographic events grows and time in school is little, extra lessons are needed in spare time.

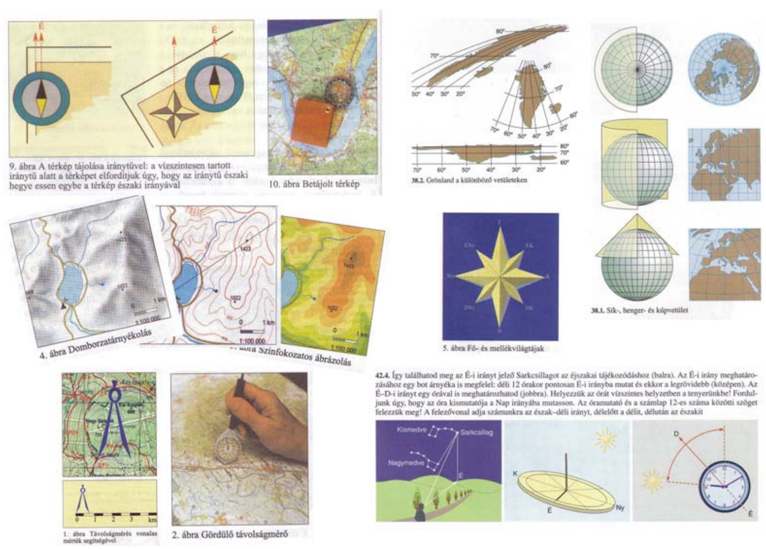


Figure 4. Some illustrations from different Hungarian school books (Jónás, dr. Kovács and Vízvári, 2001)

The final exam at the end of upper secondary school is different in the member states. In some countries there is only a written exam (Bulgaria, Greece, Cyprus, Lithuania, Portugal and Finland). But in most countries, it has both written and oral parts. Often an external authority compiles and values the written exam. But the same (internal or external) committee organizes always both parts of the final exam, e.g. (Eurydice, 2009):

- in the Netherlands, internal written and/or oral exam is set by the school, the external written exam is organized by external authority,
- in Belgium, in the Czech Republic, Slovakia and Iceland the written exam is set by the teachers within the school,
- an internal and an external exam is obligatory in Greece,
- in Portugal there is only an external final exam,
- in Austria the school supervisor sets the questions for the written exam, and the teachers do it for the oral exam.

Figure 5. Some illustrations from different Austrian school books (Zeugner, 2006)

In some countries, e.g. Austria there is no uniform final exam. Geography can be chosen. Cartographical fundamentals are out of question. Only map reading and local knowledge are important. In other countries, e.g. in Hungary there is a new, uniform, two-tier system of secondary school final examination. Beside the original secondary school final examination, students can choose a raised level exam which serves as an entry exam to universities and colleges. One of the most popular optional subjects is geography. The written exam contains topographic knowledge (15% in medium level, 20% in raised level – Figure 6) and exercises (determining place and height, scales, local and zone time). To answer test questions, school atlases can be used. Spoken exam also has cartographic and astronomical topics. The requirements of the exam are: the use of maps, analysis with the help of atlases. Topographic knowledge is based on a list issued by the Ministry of National Resources (OKM, 2005).

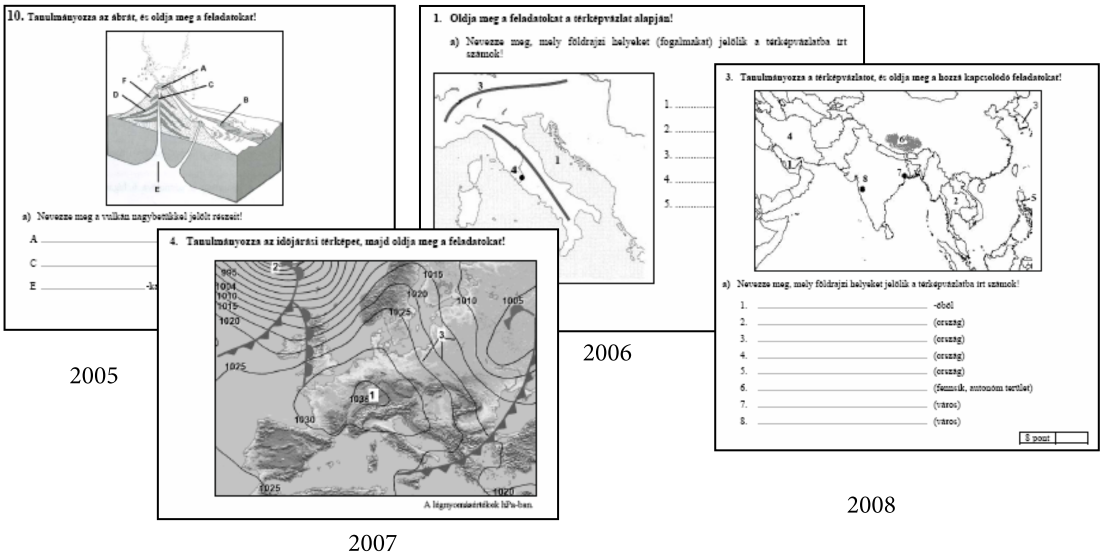


Figure 6. Some tasks from Hungarian written school leaving exams (OKM, 2005)

4. New media in education

We can obtain this knowledge in many ways with the help of numberless educational tools. Schools use great number of traditional means. Nowadays we can choose from wide range of educational tools taking into consideration the opportunities of informatics. As internet and especially interactive web pages are new resources to help our daily lives. Since students in today's classes tend to surround themselves with modern technology, beside simple classroom aids (books, workbooks, visual aids: maps, atlases, globes, foils, slides etc.) they may increasingly expect it in the classroom as well. The various digital sources play more and more important role in the education of geographic and cartographic knowledge. The numbers of CD-ROMs and DVD-ROMs have increased which can be used successfully for teaching continents, countries and some topics (astronomy, meteorology and topography). The problem is that only a few suit the demand and content of geography teaching.

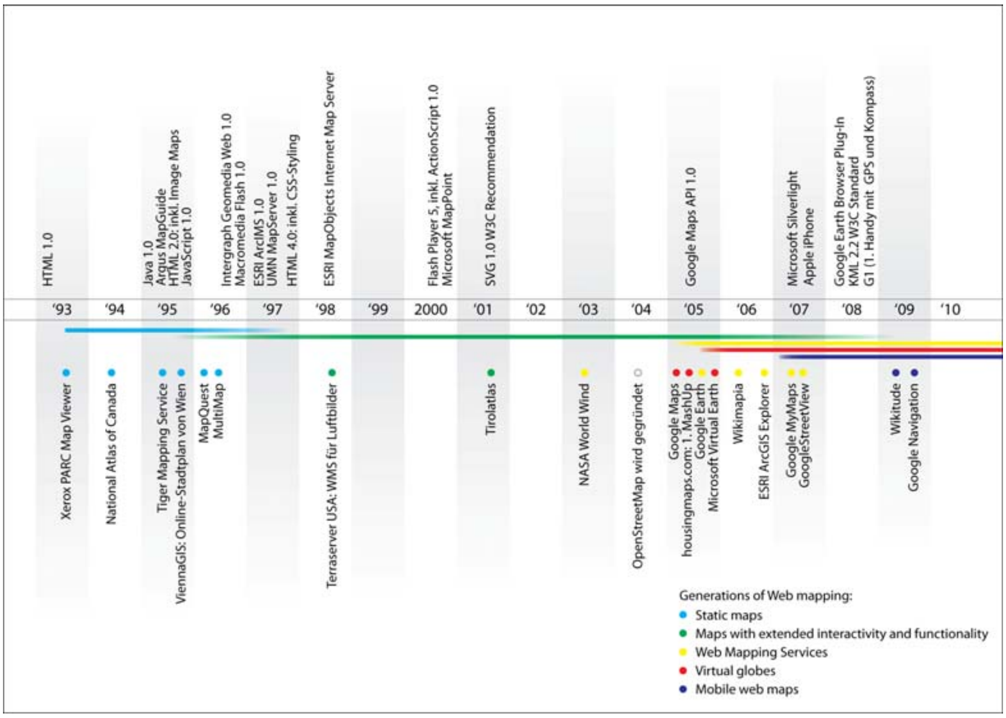


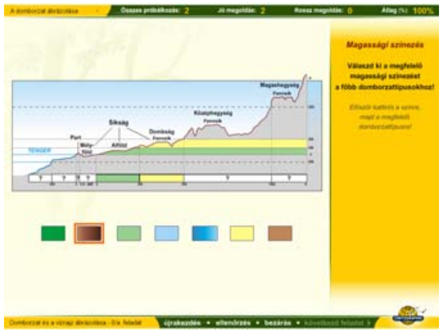
Figure 7. Web Mapping software, techniques and standards (Simonné-Dombóvári, Schmidt and Gartner, 2010)

Internet is becoming more and more important. The web cartography can also distinguish different types of maps according to their complexity (Figure 7). We can find plenty of geographical portals, databases or web pages containing tests, puzzles, quizzes and blank maps which can be used to prepare for the school lesson or tests. The web cartography can have different roles and advantages in the geography and cartography education:

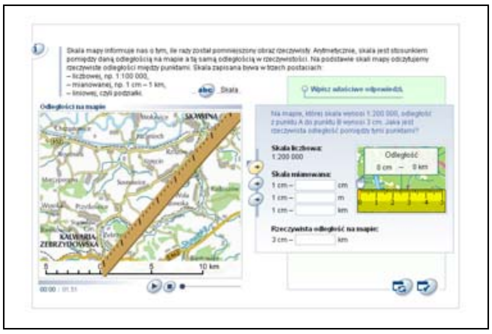
- simple, fast and cheap source in internet,
- it ensures a permanent presence all over the world,
- more effective communication with its multi-media, interactive and 3D elements,
- with the popular mapping service and entertainment components arouse pupil's attention,
- educational content in the form of tasks and games,
- you can not only read, see, hear, but also try it,
- available both at home and at school.

With the new possibilities of the web mapping 2.0, method and content of teaching expands and a new quality in teaching and training comes into life. These websites can be founded on a concept of edutainment (education and entertainment), which is the method of attractive teaching and learning with multimedia applications. On the other hand, it can be used to enhance the attractiveness of cartography in different age groups. These can be used universally but with their help it is playful and stainless to memorize, deepen, test knowledge (Figure 8).

a) Work with Google Maps (Geohra – Czech Republic)



b) Relief (Interactive Geography for primary schools – Hungary)



c) Scale (Skala mapy – Poland)

d) Legend (Tirol 4 Kids – Austria)

Figure 8. Examples for cartographical educational tools in EU
a) http://env.kraj-lbc.cz/mapserv/geohra/;
b) http://www.cartographia.org/demo/frajz_demo.exe;
c) http://www.scholaris.pl/cms/index.php/resources/ekran_skala_mapy.html;
d) http://tirolatlas.uibk.ac.at/kids/modules/learnmaps/index.py/index?lang=de [Accessed 18 April 2011].)

5. Conclusion

Countries with dissimilar past, development and tradition have joined the European Union and have come closer while regional differences are going to disappear. Their aim is the approach to uniform compulsory education, teaching competences, openness and individualization of learning. Unifying systems value international comparisons. Studying and comparing the everyday practice in these countries can help with finding better ways to teaching.

The first things that can be easily compared are the models how different levels of compulsory education follow one another, when they join, when they split. We can recognize three variations. As far as I see, for students too short first period or too many changes bring early selection, while a longer first period means "better foundation", a solid knowledge.

The more number of lessons guarantee the more experience. But the role and the teaching time of geography has been reduced both in primary and secondary education in some of the member states. Nowadays the main aim of teaching is giving competitive and renewable knowledge. Its sense is put into the curriculum. If it is controlled, every school has the same possibility. If it is defined by schools, teachers of different schools offer different knowledge for students. They may cause principal differences.

Teaching cartography is one little piece of these systems and geography education. If Geography, Cartography is integrated, it suits lower levels of education. It may be not enough at higher level, when detailed knowledge of Geography is needed with the help of specified teachers. Teaching focuses on skills, preparing lifelong learning these days. In schools practice has greater value than paper knowledge. We can obtain this knowledge in many ways with the help of numberless educational tools. New techniques, active learning strategies are needed such as cartographical educational tools on the web.

With the new possibilities of the web mapping 2.0, method and content of teaching expands and a new quality in teaching and training comes into life. The role of new technologies and web cartography is becoming more and more important in our daily lives as well as in education. It brings new possibilities in learning and practicing in school or at home. It can help to teach one of the most important knowledge in geography to show the spatial and temporal trends of geographical phenomena and processes.

References

Bollmann J. and Koch W.: 2002. Lexikon der Kartograpie und Geomatik. Heidelberg: Spektrum Akademischer Verlag, p. 313–314.

Curić Z., Vuk R. and Jakovčić M.: 2007. Geography curricula for compulsory education in 11 European countries – comparative analysis. [online] Available at: <http://hrcak.srce.hr/file/39111> [Accessed 29 March 2010].

Eurydice, 2002. Structures of education, vocational training and adult education systems in Europe. [online] Available at: <http://eacea.ec.europa.eu/ressources/eurydice/pdf/041DN/041_AT_EN.pdf> [Accessed 08 January 2009].

Eurydice, 2009. Key Data on Education in Europe 2009. [online] Available at: <http://eacea.ec.europa.eu/education/eurydice/documents/key_data_series/105EN.pdf > [Accessed 03 February 2011].

Eurydice, 2011. Information on Education Systems and Policies in Europe. [online] Available at: <http://eacea.ec.europa.eu/ education/eurydice/index_en.php> [Accessed 03 February 2011].

Herodot, 2007. Aspects of the State of Geography in European higher education. [online] Available at: <http://www.herodot.net/state/state-geog-report.pdf> [Accessed 10 October 2009].

Jónás I., dr. Kovács L. and Vízvári A.: 2001. Földrajz 9 – Kozmikus és természetföldrajzi környezetünk. Szeged: Mozaik Kiadó.

Kozma T.: 1997. Például Ausztria. [online] Available at: http://www.oki.hu/oldal.php?tipus=cikk&kod=1997-10-vt-Kozma-Peldaul#top [Accessed 11 October 2008].

Lannert J. and Mártonfi Gy.: 2003. Az oktatási rendszer és a tanulói továbbhaladás. [online] Available at: <http://www.oki.hu/oldal.php?tipus=cikk&kod=Jelentes2003-Tovabbhaladas> [Accessed 11 October 2008].

Mezei Gy. and Szebenyi P.: 1998. A közoktatás rendszere. Budapest: OKKER Kiadó.

Neumann J.: 1997. Encyclopedic Dictionary of Cartography in 25 languages. München: K G Saur.

Neumann A.: 2008. Web Mapping and Web Cartography. In: Shashi Shekhar und Hui Xiong, ed. Encyclopedia of GIS. NY: Springer, p. 1261–1270.

OKM – Oktatási és Kulturális Minisztérium, 2003. 243/2003. (XII. 17.) Korm. rendelet a Nemzeti alaptanterv kiadásáról, bevezetéséről és alkalmazásáról. [online] Available at: <http://www.okm.gov.hu/letolt/kozokt/nat_070926.pdf> [Accessed 08 January 2009].

OKM – Oktatási és Kulturális Minisztérium, 2005. Az érettségiről tanároknak. [online] Available at: <http://www.okm.gov.hu/letolt/kozokt/erettsegi2005/tanaroknak/foldrajz/foldrajzbe.htm> [Accessed 08 January 2009].

OKM – Oktatási és Kulturális Minisztérium, 2009. Az Európai Unió és az oktatás, képzés. [online] Available at: <http://www.okm.gov.hu/main.php?folderID=861> [Accessed 26 January 2010].

OKM – Oktatási és Kulturális Minisztérium, 2010. Az oktatás területét érintő európai uniós jogszabályok listája. [online] Available at: <http://www.okm.gov.hu/jogszabalyok/oktatas-teruletet> [Accessed 10 October 2010].

Ormándi J.: 2006. Összehasonlító pedagógia. Gyula: APC-Stúdió.

UNESCO – United Nations Educational, Scientific and Cultural Organization, 1997. International Standard Classification of Education ISCED 1997. [online] Available at: <http://www.uis.unesco.org/TEMPLATE/pdf/isced/ISCED_A.pdf > [Accessed 08 January 2009].

Ütőné Visi J.: 2009. A földrajz tantárgy helyzetét és fejlesztési feladatait feltáró tanulmány – Kérdőíves elemzése felmérés alapján. [online] Available at: <http://ofi.hu/tudastar/tanitas-tanulas/foldrajz-tantargy > [Accessed 08 January 2009].

TIMSS, 2007. Összefoglaló jelentés a 4. és 8. évfolyamos tanulók képességeiről matematikából és természettudományból. [online] Available at: <http://timss.hu/KMEO-TIMSS-2007.pdf> [Accessed 10 October 2009].

Simonné-Dombóvári E., Schmidt M. and Gartner G.: 2010. Kartenanwendungen im Web. HMD – Praxis der Wirtschaftsinformatik, 276 (2010), p. 59 – 67.

Zeugner K.: 2006. Hölzel-GW 1 – Faszination Erde 5. Schulstufe. Wien: Ed. Hölzel.

THE CARTOGRAPHY IN STUDIES OF ENVIRONMENT: BILINGUAL PRACTICE AIMING INCLUSION OF DEAF STUDENTS

Tiago Salge Araújo[1], Maria Isabel Castreghini de Freitas[2]
1 Faculdade de Psicologia e de Ciências da Educação, Universidade do Porto (Portugal) salarau@hotmail.com
2 Universidade Estadual Paulista, UNESP/ Rio Claro, São Paulo (Brazil) ifreitas@rc.unesp.br

Abstract: When it comes to Special Education are countless proposals, debates and disagreements. In Brazil, the fact is that special schools has been extinguished by yielding, more place to schools heterogeneous and full of diversity. Regarding Deaf students must highlight their own language and culture so that ultimately require study and foremost "a desire to integrate". This research was mainly aimed to identify possible methodologies and activities targeted to the Deaf students entered into the regular Education. Because it is a Qualitative Research on a school located in the outskirts of on city in Brazil, was elected to Urban Environmental Problems such as thematic development activities. Assuming that to intervene in the problems of the environment, at first, we must realize the place that we live, the Cartography was the important instrument used in the activities proposed by this Project.

1. Introduction

In 2008 I was drafted to replace a professor of geography at the municipal schools in the region of Rio Claro, São Paulo, Brazil, and in one of the classes might have contact with two deaf students. The replacement period of two months was insufficient for a more comprehensive work was developed with these students, combined with the difficulties of orientation and infrastructure offered by the school to work with this particular class. However the special needs of deaf students have shown clear during the lessons, highlighting the fact that being included in the regular education system often does not ensure linguistic equality and so full of knowledge acquisition from the regular school. It was on this experience that came my interest in investigating the matter and the need to explore issues relating to this situation. In expectation of confronting the question of inclusion in regular school, there is the proposal of this research. This research has as main objective, plan and develop teaching activities focusing on geography, in particular with regard to spatial perception, which relates to the different methodological and linguistic needs of a mixed class of regular schools with deaf. It is important now to emphasize that this work is not intended to "give voice to the deaf" because that group is extremely organized and committed to their policies and politics. For several centuries the Deaf has been struggling to articulate in pursuit of their goals, conquering space for participation, engagement and dialogue in our society. And just by understanding them as a cultural group that shares the history and linguistic situation in common in that, throughout the paper, we will adopt the terminology Deaf. To cite Skliar (2001, p. 144), "Sign Language nullifies the deficiency and allows the Deaf are, then, a linguistic minority community different and not a deviation from normality". This proposal aims to share experiences working methodology, to contribute with other professional teachers who were faced daily with deaf students in their classes. At first, the practices related to this research would be directed to study and activities with maps, charts and aerial images, however, the mapping developed in this work was very far beyond activities with coordinated, scales and types of representations. The project was being developed, and as it unfolded, new activities have emerged and been proposed in an attempt to better understand and also encourage Deaf students in their perceptions of living space. However, with regard to the effectiveness of the process of school integration, we must emphasize that this, necessarily depend on the cooperation of everyone involved, from the teachers prepared until the students who participating in the activities. As proposed the "Qualitative Research, the information are not collect to confirm or disprove hypotheses constructed previously, the abstractions were built as private data were gathered and were gathering". (Bogdan; Bilken, 1994, p. 50). Drawing on Bogdan and Biklen (1994), our planning was being done throughout the research and data analysis, even if they have been analyzed more systematically in the final stages of research. But it's also important that the bases for the planning of learning activities are well defined, as well the materials and teaching methods adopted, "interlacing the individual parts" (Bogdan; Biklen, 1994). For being Deaf children, with own language and culture, it essential that the content of available resource to work in Portuguese and in Sign Language. In the sense, from cartography, photos, games drawings and field work, accompanied by an interpreter of Brazilian Sing Language, teaching sequences were developed able to meet the needs of a class with deaf and hearing students, with the theme "The Urban Environmental Problems: From The world to my school".

2. Games, pictures and cartography

This work is not aimed to explore all the central elements as cartographic projections, scales, their coordinates and mathematical relationships. More than that, this work in cartography, a tool to enhance knowledge of the world and the living space of the students involved in research. To Callai (2005), a form of scanning the world is through the reading of space, which embodies all brands of men's lives. "Thus, reading the world goes far beyond reading cartographic representations which reflect the local area, sometimes distorted because of the cartographic projections adopted. To read the world is not just doing a reading of the map or by the map, although it is very important. You do the reading of the life world, building daily and expressed both our utopias, and limits that we are put in, whether the scope of nature, within the context of society (cultural, political, economic)". (Callai, 2005, p. 228)

Therefore, in the development of activities with deaf students, the use of maps is not the sole factor, but is an important visual resource for exploring the living space and teaching of geography. By corroborating this view, it is said that "in the school, the discipline of geography, in particular the contents of Cartography, offers subsidies to expand the students' understanding of the place where they live and work". (Juliasz; Freitas; Ventorini, 2007). The Cartography is therefore an important resource for the teaching of Geography, because it allows the representation of different perspectives of space and scale that is appropriate for teaching. Thus, the mapping allows the student to understand the manner in which he or she is inserted in space, which can be in local, regional and global levels. Through maps, they will be able to distinguish the different and distant locations, giving them the possibility of a more critical view of reality which they belong. According to Almeida (2010) "The importance of learning in a socio-cultural context of modern society, as a necessary tool in people's lives, requires a certain mastery of concepts and references to spatial displacement and ambiance, and more than that, so that people have a conscious and critical view of their social space" (Almeida, 2010, p. 10). In the developed work there are also other ways of representing and perceiving space. As Almeida and Passini (1989) point out, "The living space refers to the physical space, experienced through movement and displacement. It is learned by children through games or other forms by going through it, enclosing it or arranging it according to their interests" (p. 30). Combining the use of Cartography, drawings, photos and games, we aimed to improve understanding of space by students. In the case of deaf children, it was essential to value their vision. The option of showing and building drawings with them is in agreement with the studies based on the perspective of Oliveira Jr., who says: "The drawing was really a scape option. Fleeing from the word, whether oral or written, as the only transmitter of knowledge and information. But it was also an option for that approach. Approaching to a language more suitable for the transmission of knowledge about space, where the elements would be presented spatially, without the need for a chain of words and expressions. When looking at a drawing we already have a global view of it and we can 'read' it in several ways, from various points. It is also like this with the space and the city" (1994, p. 9). Regarding to games, we shared Albres' idea (2010) that tells us that "childhood is a significant period for language acquisition. At this stage, recreational activities are built in the form of games" (p. 92). The same author points out the relationship among games; language and cognition development in deaf children. For this reason, during the study, it was privileged recreational activities that would allow communication between the students, and that would give importance to the visual field.

3. Research

3.1. The study area

The research was conducted at the Municipal School Professor Armando Grisi, located in Jardim Paulista, in the outskirts of Rio Claro / São Paulo, Brazil, housing a community of low income. The neighborhood has several problems in the urban environment in this way, a work on the perception of space and character "environmental educator", which embraced and integrated the students in this school, proved to be of great importance. Even for the school where the research was conducted in two thousand and six, we started work only with the inclusion of deaf students in the district that it is located. In fact, because of a imposition policy, the school received these students, however the support was poor. The school principal in the period in which the proposal was implemented, on a visit made in 2009, reported that, despite the difficulties, staff and students committed themselves to actually include the deaf community in the context of regular school. From this context, they took their own project and structured (Bilingual), defined needs, strategies and possibilities. According to the director, this work would be impossible if there was no engagement of all staff and students. Currently, City Hall / Department of Education provides funds to guarantee an expert educator in BSL accompanying nine deaf students who attend school regularly in elementary school. Regarding the distribution of deaf students in classes, the Director during the visit, in 2009, told us that at start, all who attended the same grade would be placed in the same class. However, she said, motivated by the interests of hearing students to learn sign language, the classes were rearranged so that there was a greater "integration" and learning from each other, even though this might be discussed.

3.2. Students involved

Initially, when this survey was idealized, it was thought in the implementation of activities in classrooms with deaf and hearing students, but during the visits and conversations with the teacher and pedagogical professional hired by the school, it was decided to carry out activities only with the deaf students, believing that this way the main design goals would be achieved. However it is worth noting that all activities were planned and designed so that they could be developed in classrooms with deaf and hearing students. At the same time, the different levels of proficiency in Portuguese and in the written form of Brazilian sign language, the different levels of deafness and the various difficulties of the students involved, eventually constituted a very heterogeneous group and also mixed. In some activities we divided them into two groups, with the intention of making a careful observation and rethink the attitudes. Therefore, students involved in the project were 9 children ranging from 9 to 12 years old, all students, deaf, in elementary school and in regular school.

3.3. Activities

3.3.1. Building the city

The first practice with the students sought, from the appreciation of the visual field and the Brazilian sign language, awakening the students to the impacts of Brazilian urbanization and environmental problems resulting from this process. Starting with the practice of assembling a jigsaw puzzle containing a drawing of a modern city (Figure 1), we tried to stimulate the visual discrimination, analysis, synthesis, and visual-motor coordination (Albres, 2010, p. 112). The puzzle was designed using cardboard paper, the drawing of a city and impermeable adhesive paper to make it more resistent. In case we had more time, it could also be possible that each student would be asked to design their own puzzles with their own drawing and then be exchanged between them. After students have managed to form the puzzle, it was asked them to locate the elements present, cars, buildings, factories, trash, etc...

The next step of this activity was a sequence of pictures, which sought to portray "from the natural environment to urban problems, which presented situations such as the construction of the first railroad tracks, the industrialization of the cities, the verticalization, the queues for jobs, segregation socio-spatial, visual pollution of cities, and other situations. In all images shown, it was included subtitles in Portuguese and sign language. Ending this practice, it was proposed that the students would draw what drew more attention to them, some students drew some garbage in cities, buildings and others drew up the slums. Interestingly, one student chose to draw a rural landscape, arguing that since there were many different urban elements it would be difficult for his own work, showing that some situations can indicate a possible misunderstanding, it may actually be revealing. With this practice, it was clear how the language is fundamental in the organization of thoughts: those who had a more structured language, had an easier way to understand the subject matter and then represent it.

Figure 1. Student "building the city"

Regarding the designs produced by students, it was noted that in the first (Figure 2), the student was concerned with aspects of designing an urban landscape, a building and a vehicle, undeniable "symbols" of cities. In this second design (Figure 3) is very interesting to note that the student took care to also show her mastery of Portuguese in the written form when writing garbage in the trash where a kid throws a package. We also noted the contrasted ideas of two different situations, a guy throwing the trash from car and another having a more correct environmental point of view. Still related to the design, we also note that the student can recognize and draw the elements into perspective, a characteristic usually developed after 8–9 years of age (Almeida; Passini, 1989). Student Nathalia soon was encouraged by family, which is the listener, to learn the Brazilian sign language, she has no difficulties to realize the contents exposed, moreover, is one of the students more attentive and not let dispense easily, unlike her friends. In the next representation (Figure 4), the student exhibited some situations also presented and discussed by the images shown previously. The student portrays a girl with some bags in her hand, perhaps inspired by the images on consumerism that also were presented to them. The rain and the house might want to tell us something related to floods. However, it is worth noting that the student does not place the drawing elements at the bottom of the paper, for a child of 11 years, could we say that he/she is pretty childish for his/her age? Can we infer about their cognitive and spatial sense?

In the last drawing (Figure 5), there is no doubt that it makes us reflect on different aspects. The student has serious problems regarding the acquisition of the Portuguese language in the written form and according to the interpreter, presents poor and difficulties BSL. When he finished his drawing, we questioned him about what he had done and he told me that he had designed a "hill" (note the square at the bottom left, which would be boxes) and a car "falling" into a flood. It would be fair to say that their language deficits interferes with their ability to represent it? The absence of a structured language troubled him to express what he really liked to do?

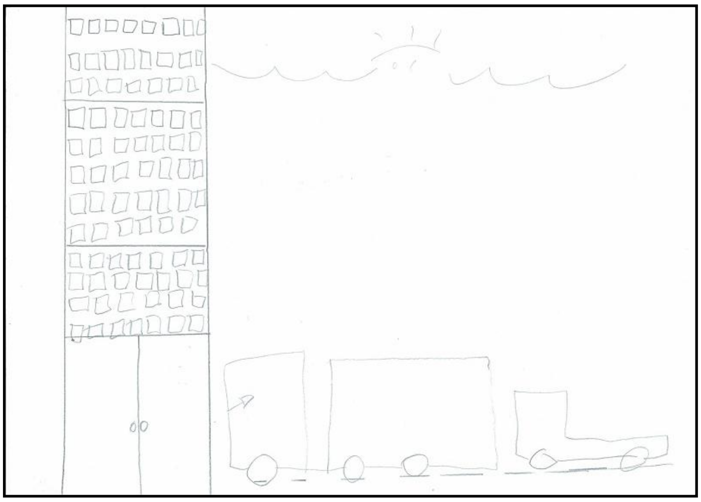


Figure 2. The design of the building and truck

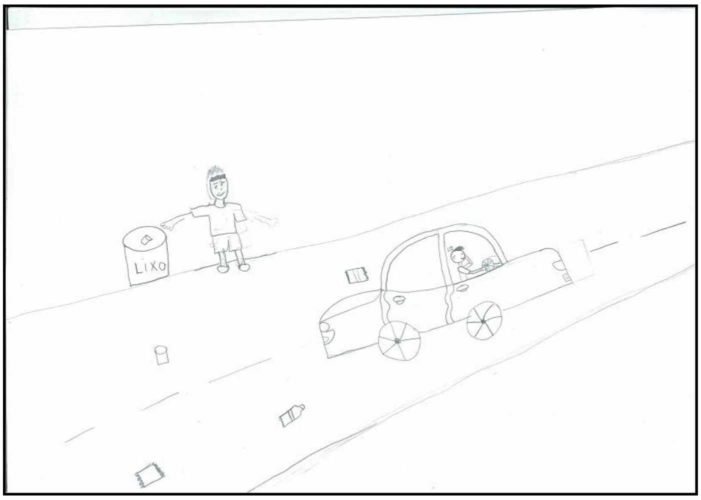


Figure 3. The representation of opposing situations

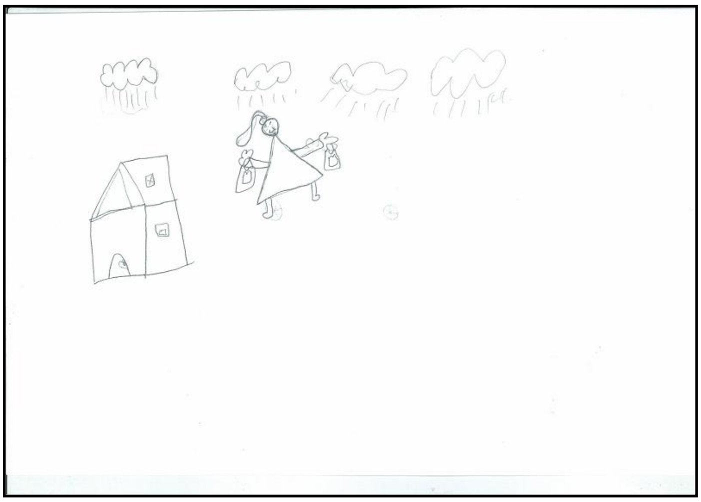


Figure 4. "Consumerism rain and the house"

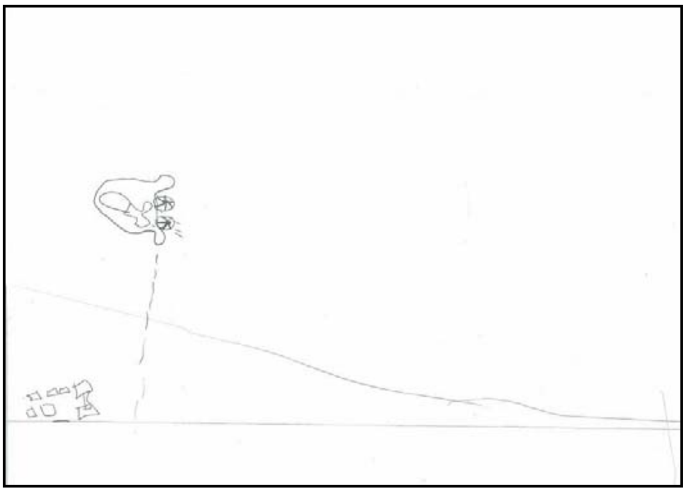


Figure 5. "The suburbs and the car"

3.3.2. From the world to my school

The second stage of the project came up with the proposed of giving the students an idea of Geographic Space before talking about environmental issues. We used a globe and different maps, including one of the our city, "Rio Claro", as our idea was to give the students a global and a local idea of space (Figure 6). Having found where Brazil is located in the globe, they were given a colorful map of Brazil printed in A4 size in order to check if they were able to identify which country it was. This activity aimed to encourage them to acquire Portuguese vocabulary in the written form, and present them important elements of maps and charts also the separation of title, content and caption. The map of the political division in Brazil was given after that and they were supposed to only paint the province in which they lived. The map was printed without color, leaving all the states represented with white background, so that students could paint our state. To provide them first with the globe and the physical map, and only after give them the political map aimed to show them that space is not "born" with boundaries. The idea was first to introduce the students to a unique Brazil, explaining them the differentiation of colors depending on the types of relief, and so onwards. We wanted to show them that the States are a recent chapter in Humanity's history, as pointed out in the "Notes on the education of visual maps: (un) nature of the idea of representation", by Oliveira Jr. (2009). The next step was to get the map of the city of Rio Claro to try find out the localization of the school and of the houses in which each of the students lived in. This phase of activity was a lot of fun to the students because they all wanted to be faster than the others in finding the school and their homes. For this activity we use only a city map available at newsstands. To finish this practice, we individually asked the students to draw up mental maps of the possible routes from their homes to the school, and some of them went further by placing signs in the Portuguese language about reference points along the way, like stores, streets, etc. By doing this activity, we aimed to increase their spatial perception in different scales and we wanted to encourage the students to think about a possible hierarchy: World – Continent – Country – State – City – Suburb.

Figure 6. Materials used in this activity

On this first map (Figure 7), made by the same student that made the "Figure 2", there was a concern to make it flat, like a conventional map. It is interesting to note that again she was concerned about indicating reference points in the Portuguese language (aunt's house, bar, market, etc.). The student also used symbols to point her reference marks, such as crosses to represent the churches along her journey from home to school. One aspect that caught attention was that while developing her map, the student told me that she had to draw everything "too small" in order to fit everything in there, which gave me the impression that her sense of scale had already improved.

In the second map (Figure 8) drawn by another student, only was reference point was indicated, another school located in the same street where the school they attend is. In this case, two children of the same age, but present levels of perception and spatial representation quite different. We can even say that while the previous representation has "characteristics of a map – at locating the places in two-dimensional plane, trying to play their way and streets" (Marandola; Oliveira, 2007, p. 7) – this other (Figure 10) can be considered a design. In it, we noticed the lack of perspective by portraying the street seen from above and the other elements seen from the front (Almeida, Passini, 1989, p. 40). De Paula (2010) warns that the problems regarding the mental maps are concentrated, in part, at the time subsequent to the acquisition of material, data analysis and says: "Both representations have their advantages and disadvantages. A two-dimensional mental map is advisory because the individual fits into a system of directions (right, left, front and back), but loses ground to the possibility of developing related images, such as topography. The oblique representation from a skyline, despite decreasing the clarity of spatial relationships between Euclidean distances and directions, allows the individual to draw the elements according to their size and shape, it is this perspective that we often see the world. There is no restriction on the form of representation; it is for each object of research methodology and charting their own ways and more optimal use of the map information". (De Paula, 2010, p. 8). We also highlight that in your drawing, Gustavo was careful to indicate the room number where we gathered to do the activities, showing that possibly even leave his own body as a reference for the location of objects, possibly not having gone through the process of "decentering" which according to Almeida and Passiani (1989, p. 34)" (...) Is the passage of child egocentrism to a more objective approach to reality through the construction of conservation structures that allow children to have a thought more reversible. This is because it begins to consider other elements for the spatial location and not just their perception or intuition about the phenomena". The third map, made by the same student who made the "drawing 4", it was clear his difficulty in representing his perception. We are not saying what is 'right or wrong', especially because the maps and drawings are mainly expression of their creativity, but we can't deny the difficulty shown by this specific student. In general, we can say that this activity with drawings and maps was really informative about the characteristics and needs of the students.

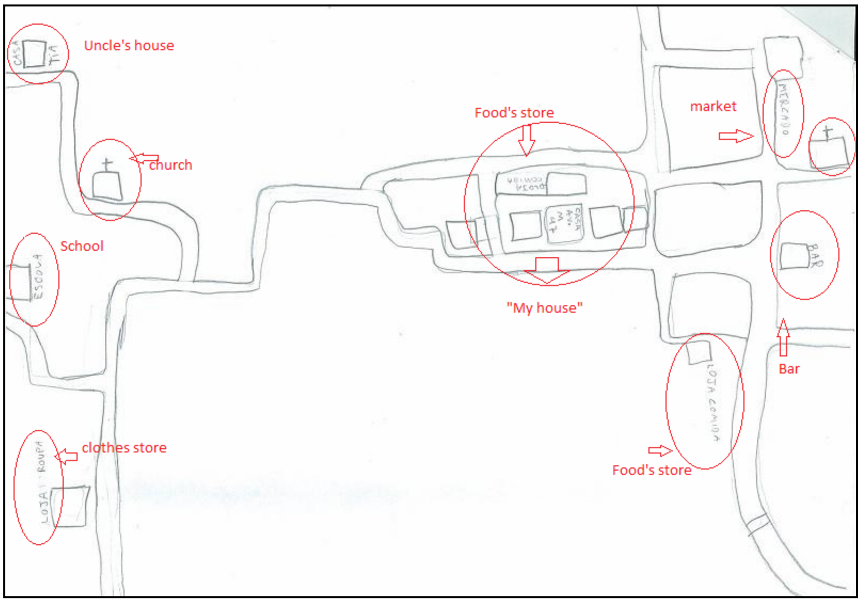


Figure 7. Map of student Nathalia, landmarks and directions in Portuguese

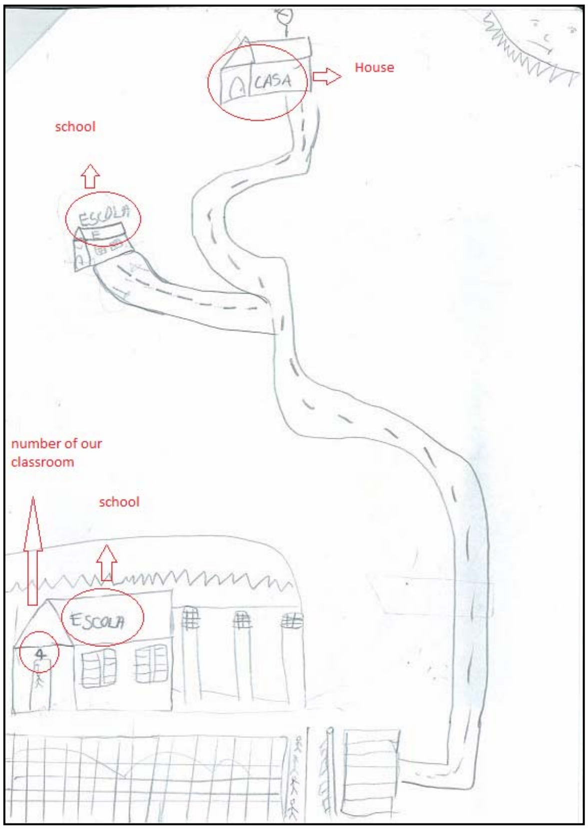


Figure 8. Representation made by the student Gustavo

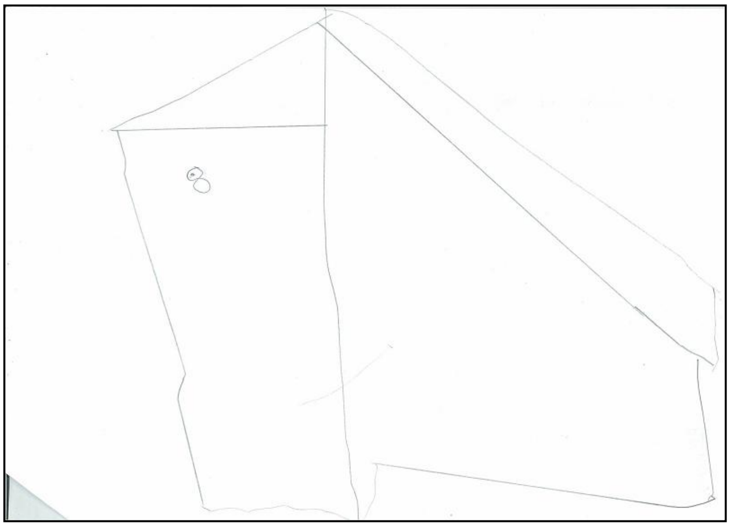


Figure 9. Representation made by student Paulo

3.3.3. Fieldwork in the school district

In order to aggregate the elements discussed in the previous practices, we decided to do a fieldwork on the block and around the school. The area around the school has serious problems of urban and environmental policy, such as unpaved and poorly maintained roads, garbage dump on the banks of a small stream, fires and illegal housing. In order to develop a complete work, before starting it we returned to the idea of different scales of spatial analysis via the image below. We provided maps to the students with a highlighted route so they could follow the steps of the field work. We decided to use Google maps to present them with an accessible and free to use map. The option of not introducing them to 'scales' was made because the main goal of the work was not to ask them for 'calculations' and cartographic operations. Along the way, besides the map, each student had a digital camera so they could record the aspects that drew most attention. Besides enhancing the students' visual field perception, the idea was to capture images able to allow a further analysis of the elements that were more interesting to them and this activity was more important for the deaf students. Helped by a school interpreter, we talked about the importance of the preservation of our water resources, as well about the impacts of the urbanization process and of the irresponsable garbage in 'Corumbataí' river, which is located near the school where they study.

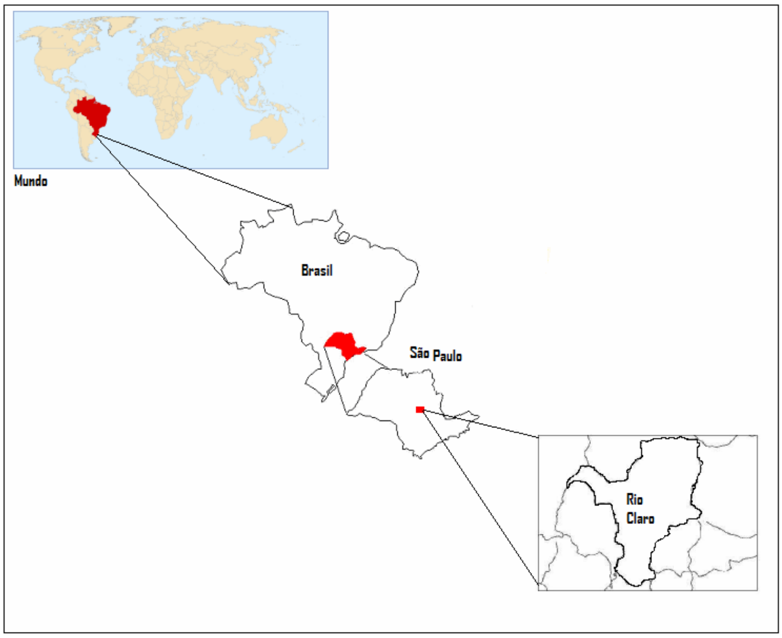


Figure 10. From global to local (Prepared by: Tiago Salge Araújo, 2010)

Figure 11. Map delivered to students with the course of fieldwork

Figure 12. Some pictures taken by the students during the fieldwork

During the fieldwork, besides the problems related to waste and pollution of water sources, housing issues also attracted the attention of students. Back to the school, we had a picnic in the schoolyard and talked about the impressions the students had about what they had seen: they liked the beauty of the sky, the animals they found along the way, such as cows, birds and dogs; they also liked the fieldwork in itself, but they didn't like the garbage, the dirty water and the holes on the road.

3.3.4. From the reality to the representation

As a final activity, it was proposed to build a model of the route taken during the fieldwork with the students. This activity focused on the importance of stimulating the students' perceptions of the living space. According to Freitas, Lombardo and Ventorini (2007, p. 128), "the use of model allows the representation of landscape elements in three dimensions, providing a synthetic model of the complex reality of the use and occupation of urban land". Quoted by the same authors, Filett (2004) points out that the reduced models bring children to the materialization of real spaces that provide concepts often not understood by them, since the children of the first cycle of elementary school have a level of abstraction in development and require viewing to understand them most of the times. Certainly the collective construction, along with students, is the most appropriate way to explore all aspects and steps of a model. According to the authors mentioned below: "The model can be used as a collective representation of lived space, which explores the dimensionality, therefore helping to improve the spatial reading of each individual through the exercise of viewing and interpretating the city". (Freitas, Lombardo; Ventorini, 2007, p. 128). However, in order to conclude the research on time and considering the fact that I would be moving to Portugal to start my master degree in Education, the construction of the model was made by me and Carla Lombardi, the school interpreter. The students then only used and explored it. In order to give them a sense of the land level, the model was based on a 1 : 25 000 topographic scale of the area. The model was built to an extent so one half of the model would be the representation of the trajectory and the other half would be a great legend in 'Brazilian Signs Language' and Portuguese. In order to stimulate the implementation of the "real to the abstract", some photos taken by the students themselves were printed and glued on small polystyrene and sticks, so they could poste them on the model. Each photo was accompanied by a title in Portuguese and in "Brazilian signs language". Moreover, numbers were given to the students and they had to put them in the model in the most appropriated place, considering its representation of each place. This aimed to encourage the students to look into their memories for the location of the elements observed in the fieldwork (real) and transport them to the model ("abstract").

Figure 13. Model of the route taken in the fieldwork

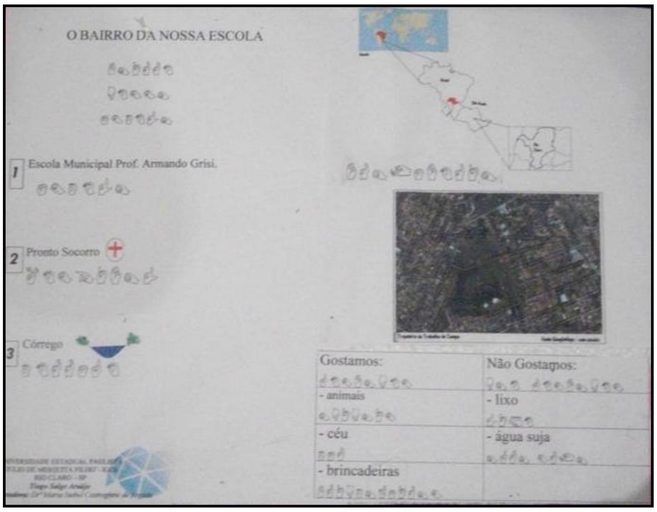


Figure 14. Large bilingual legend containing references and points list with what the students liked and disliked on fieldwork

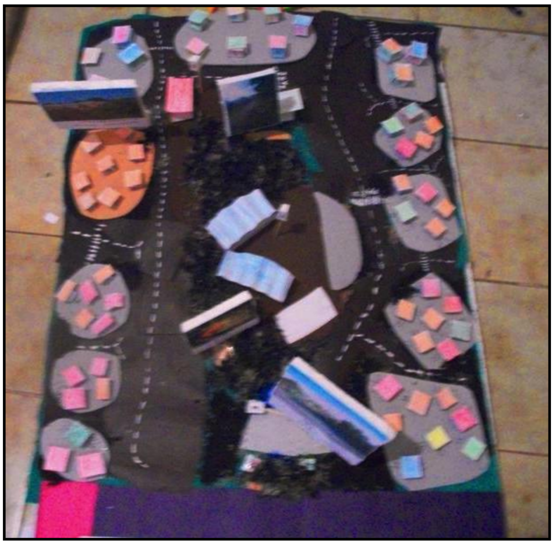


Figure 15. Photos posted on the model

In this activity, all students participated in the survey were involved together and the activity lasted for approximately 2 hours and performed during a late-August. When we discussed the application and handling of the model, we think that it might be best to recall them from the pictures they took, the route taken during the fieldwork. However to our surprise and delight, it was not necessary. As soon as they saw the demo, the students were very curious and wanted to know everything, “whether it was school, whether it was the neighborhood, etc...” We then began to work each element, we asked to look at the legend and try to identify what he said. Then ask that relationship and puts in the representation, the number indicated in the legend (Figure 14) in place. Students Renato, Dalila and Nathalia soon found the most suitable places and the others sometimes distracted by small details of the model, such as the composition of materials.

Next, we ask that the photos fit together (with subtitles BSL) in the most appropriate, as the field work (Figure 15). The photos chosen were those shown in Figure 14, and for judging fairly representative of different points of the route. Again some students have excelled, showing a greater interest while others just participated. Finalizing the framework discussed this activity "like – don't like" that was written according to what they said at the picnic after the fieldwork. In a general evaluation of this activity with the model, we conclude that the ideal way to have been done, no doubt, would have been individually or in pairs. Thus the devolution would probably have been smaller and everyone could have attended the same way. However, we shall understand this as being an excellent activity as well as introducing elements of cartography, allowing visual discrimination, memory and perception of living space.

4. Final condiderations, far from one conclusion…

Start by saying that, methodological and practical issues, we are far from one model or way of doing. This happens because if the Deaf community shares cultural and linguistic elements, which enables us to define them as such, on the other hand the specific needs and characteristics of each subject and students, we make it impossible to draw a circle homogenizing. If the listener in culture is the same logic, we recognize the differences among students regarding the Deaf because it would be otherwise? I mean that we should not expect formulas already set for teaching and we can work with Deaf students and / or mixed classes. Each student, deaf or listener, has its potential, specific needs and desires. With respect to all the research and activities, we were very clear how the language is the key element when it comes to teaching the Deaf, the respect for their language and their appreciation of the visual field may be the only thing we can say categorically. It is impossible to think about full inclusion if the classes are designed under the logic "ethnocentric listener" (Fernandes, 1998). The teacher, who is faced with this situation, should dip in a constant process of reflection and their teaching practice. If we want a democratic school, we should expect it to be prepared to receive each of the students, deaf and hearing. The teacher of deaf students should contact the relevant bodies and dedicate yourself to know this other culture. For the teacher to be prepared for this situation, he must live with the deaf community, seek, where possible, to know more and learn sign language (even if the school rely on an interpreter) and thinking about broader pedagogy (Skliar, 1998, p. 37 as cit. in Strobel, 2006, p. 250). In the context of cartography, this proved to be an important instrument of perception and knowledge of living space. Through her, and with it, we awaken in students a greater sense of space, reflecting on our position in time and space. The first activity, with the puzzle, photos and drawings, allowed us to learn more of the students and understand their forms of representation. From the second activity with maps, globe and maps, we believe that we were able to show them important elements of cartography, also indicating their utilities and various forms. The fieldwork and handling of the model enabled a performance analysis and spatial perception rather interesting, transposing the real to the abstract, directing and "freezing stares". In general, we see an evolution in the spatial perception of students, comparing the first activities with the activity of the model. We therefore believe that the objectives initially proposed by the project were achieved: we can prepare materials in cartography, in Brazilian Sign Language and Portuguese, which enabled the students involved, expand their knowledge of the mapping applied to environmental studies, beginning in the studies using satellite images, aerial photos, letters and fieldwork. Moreover, the activities provided an insight to the lived space and environmental issues involving water resources in the study area. We are sure that the work is not completed, now depend on other professional teachers continue to encourage and develop skills with these students. Perhaps the biggest key to the question whether we begin to see how different, we realize that "the difference is us" (Magalhães, Stoer, 2005). According to these researchers proposed, we should look at the difference on another perspective: This discharge of voice may not escape the boundaries of another as an object, this time through our political generosity. This is why we put ourselves under the statement "the difference is we". The difference in this perspective is the "product of a relational game in which there is no longer a privileged center from which one can determine who are the others, who are different" (Magalhaes, Stoer, 2005, p. 10). We share the ideas of Stoer and Magalhães (2005, p. 138) say that the other is different and so are we. The difference is the relationship between different. We therefore conclude by saying that when it comes to education "special" or inclusive, we must look at all those involved as "different" and not just the "other. " The search for dialogue and promotion of teaching that really reaches the "other" should be the ultimate goal. With respect to geography and cartography, we were proven that there are ways to do this, it behooves us all go on researching and looking for ways to promote a truly inclusive education.

References

Albres, N. A.: Surdos & Inclusão Educacional. Rio de Janeiro: Editora Arara Azul, 2010.

Almeida, R. D; Passini. E. Y. O.: espaço geográfico: ensino e representação – São Paulo: Contexto, 1989. – (Repensando o ensino)

Aranha, F. S. M.: Desenvolvendo competências para o atendimento às necessidades educacionais de alunos surdos/Coordenação geral: SEESP/MEC – Brasília: Ministério da Educação, Secretaria de Educação Especial, 2005.

Boddan, R.C; Biklen, S.K.: Investigação qualitativa em educação. Porto Editora, LTDA, 1994.

Brasil. Secretaria de Educação Especial. Deficiência Auditiva/organizado por Giuseppe Rinaldi et al. Brasília: SEESP, 1997.

Brito, L. F.: Integração social e educação dos surdos. Rio de Janeiro: BABEL, 1993.

Cabral, E; Coelho, O.: Uma língua nas nossas mãos: argumentos para uma educação bilingue dos surdos. In Rosa Bizarro, & Fátima Braga (Orgs.), Formação de professores de línguas estrangeiras: Reflexões, estudos, experiências, (p. 215–22). 2006. Porto: Porto Editora.

De Paula, L. T.: Mapa mental e experiência: um olhar sobre as possibilidades. Porto Alegre: XVI Encontro Nacional de Geógrafos, Julho 2010.

Fernandes, S. F.: Surdez e linguagem: é possível o diálogo entre as diferenças? 1998. Dissertação (Mestrado) – Universidade Federal de Santa Catarina, Florianópolis, 1998.

Freitas, M. I. C; Lombardo, M. A; Ventorini, S. E.: Do mundo ao modelo em escala reduzida: a maquete ambiental como ferramenta de formação do cidadão. Mercator, v. 12, p. 90–102, 2008.

Godoy, H. P.: Inclusão de alunos portadores de deficiência no ensino regular paulista: recomendações internacionais e normas oficiais. São Paulo: Editora Mackenzie, 2002.

Goldfeld, M.: A criança surda: linguagem e cognição numa perspectiva sócio-interacionista. 2º edição. São Paulo: Plexus Editora, 2002.

Irigoyen, N. P. O.: Educação ambiental: implementando a gingaca sociocultural como metodologia para alunos surdos. Tese de mestrado. ULBRA – Programa de Pós-Graduação em Ensino de Ciências e Matemática. Canoas/ RS. 2005.

Juliasz, P. C. S., Freitas. M. I. C. de, Ventorini, S. E.: Proposta diferenciada de elaboração de mapas táteis. In: XXIII Congresso Brasileiro de Cartografia e I Congresso Brasileiro de Geoprocessamento. CBC 2007 – cartografia como instrumento de preservação da integridade nacional. Rio de Janeiro, 2007. Rio de Janeiro: Sociedade Brasileira de Cartografia, 2007, 2475–2483.

Lacerda, C. B. F.: A inserção da criança surda em classe de crianças ouvintes: focalizando a organização do trabalho pedagógico. In: Reunião Anual da ANPED, 2000, Caxambú. Anais da 23ª Reunião Anual da ANPED, 2000.

Lacerda, C. B. F.: Os processos dialógicos entre aluno surdo e educador ouvinte: Examinando a construção de conhecimentos. Tese de Doutorado, UNICAMP: Campinas, 1996.

Marandola, J. A. M. S; Oliveira, L.: Desenhos e Mapas: representações e imagens do Urbano. In: XI Encontro de Geógrafos da America Latina - XI EGAL, "Geopolítica, globalização e mudança ambiental: desafios no desenvolvimento latino-americano", Bogotá, Colômbia, Universidade Nacional de Colômbia, 26 a 30 de março de 2007. [ISBN:SD] disponível http://observatoriogeograficoamericalatina.org.mx/egal11/Nuevastecnologias/Cartografiatematica/03.pdf

Oliveira, JR, W. M.: Desenhos e escutas. In: 29ª reunião da Anped. GT 12: Caxambu, 2006. 15 p.

Oliveira, JR., W. M.: Apontamentos sobre a educação visual dos mapas: a (des-) natureza da ideia de representação In: Colóquio de Cartografia para Escolares, 6., 2009, Juiz de Fora. Anais... Juiz de Fora : UFJF, 2009. CD-ROM.

Oliveira JR, W. M.: A produção da escuta a partir de imagens. In: 8 Encontro Nacional de Prática de Ensino de Geografia, 2005, Dourados-MS. Anais do 8º Encontro Nacional de Prática de Ensino de Geografia, 2005. p. 1–25.

Parâmetros curriculares nacionais: terceiro e quarto ciclos do ensino fundamental: introdução aos parâmetros curriculares nacionais / Secretaria de Educação Fundamental. Brasília: MEC/SEF, 1998. 174 p.

Stoer, S. R., Magalhães, A.: A Diferença Somos Nós – A Gestão da Mudança social e as Políticas educativas e sociais. Porto: Edições Afrontamento, 2005.

Strobel, K. L.: A visão histórica da in(ex)clusão dos surdos nas escolas – Educação Temática Digital, Campinas, v. 7, n. 2, p. 244–252, jun. 2006.

THE ROLE OF OUTPUT DEVICES IN THE HIGHER EDUCATION OF CARTOGRAPHY

László Zentai
Department of Cartography and Geoinformatics, Eötvös Loránd University, Budapest (Hungary)
lzentai@caesar.elte.hu

Abstract: The rapid development of information technology affected cartography considerably in the last four decades of the 20th century. Traditional offset printing methods were developed neither by and nor for cartography. In the cartographic curriculum, however, these techniques were taught to let cartographers control/evaluate the final phase of map making. The first digital output device used by cartographers (and also by students in the higher education) was the pen plotter. Other type of early computer printers (line printers and dot matrix printers) were only used at large firms, but their output was of very poor quality for cartographic purpose. Colour dot matrix printers were able to print colour maps, but both the speed and quality was insufficient. This technology was soon replaced by inkjet printing, which is still the most common and most affordable method (even in large format).

In higher education curricula, the reproduction process was taught as an independent subject or a part of other related subjects. Cartographers should know the complete technical process to be sure that the maps will be reproduced as they were planned. In the second phase, when the digital output devices became wide-spread and higher education institutions could afford these devices, the course on map reproduction was completed with digital methods, and the necessary theoretical information about the process was also added. In the third phase, when the output device became easily available for even home users, the traditional offset printing method has seemingly lost its importance, and the students became rather interested in the digital printing methods. Nowadays, the most important output devices in cartography are the screen of the computer, mobile phone, and PDA, which again made us introduce changes in the curriculum.

Introduction

The first independent cartographic courses were established at the Moscow State University of Geodesy and Cartography (MIIGAiK) in 1923. Although there were several major institutions where cartography was taught (e.g. in Zurich and Vienna), these and other Western and Central European universities and high schools needed a longer time to establish their independent cartography programmes.

Looking at the curricula of the first cartography programmes, the difference between the early and modern structures is striking. Much fewer courses are offered now in cartography than 30-40 years ago: most of the courses are converted to courses named as GIS, geoinformatics or geomatics. The subject on reproduction has disappeared from the courses, although this subject used to be an important part of cartography courses (Salichtchev, 1979).

Traditional reproduction methods as an output "device"

The reproduction methods were always very important in map making. We can not simply consider these techniques scientific, because they are mostly artistic or industrial methods. We do not have reproduction techniques directly developed for cartography, but cartography selected the best available methods that fitted the needs.

The printing methods of the first centuries after Gutenberg are less important for cartographers. Most printing technology was based on letterpress, namely, the printing of images that were projected above the nonprinting areas.

The first method worth mentioning is lithography. In 1798, Alois Senefelder made a discovery of profound significance in the history of artists' prints and later of commercial printing too. He had been attempting for some while to print from limestone. What he came to realize is that the antipathy between grease and water can be used as a basis for printing. He found that an image, no matter how detailed, that was drawn with a greasy substance on the face of a water-absorbent stone and then inked could be printed onto paper with absolute fidelity. Lithography was ideally suited for illustration (like maps) and enjoyed a phenomenal popularity during the 19th century, especially for colour printing, which required a separate stone to print each colour. The discovery of lithography was significant to the history and development of cartography. Prior to the birth of lithography at the turn of the 19th century, most maps and atlases were produced by engraving – a technique that required much skill and labour. Engraved maps were rare and relatively expensive. Lithography offered a cheaper and quicker way to reproduce maps and other images. The early topographic map sheets were reproduced by engraving techniques. This method was suitable to reproduce the hachuring method of the relief representation.

Lithographic metal plates had only rarely been used for commercial printing, in part because the image on the plate was often worn through by the printing paper. In 1904, an American printer accidentally discovered that the lithographic image could be transferred, or offset, to a rubber cylinder that could then print as perfectly as the plate and would last indefinitely. This became the most popular printing process because of its economy, long plate life, and ability to print on many different textures.

The halftone colour printing, the process still used today to reproduce full colour, was introduced in the 1890s, but many years passed before its full potential was realized. Although colour reproduction theory was fairly well understood, the lack of colour film restricted colour work to studios where the necessary separation negatives had to be made directly from the subject, under the most exacting conditions. Reliable colour film became available in the 1930s and '40s, and colour reproduction grew both more common and more accurate.

The development of offset printing method was very important for cartographers. This was the first method that let the cartographers to reproduce their colour maps economically without any constrain on the used colours or lines. However, cartographers regularly used spot colour printing methods instead of the process colour methods, which were the most common methods for colour reproduction, especially for colour photographs. In the early years of colour offset printing, it was not unusual that a map was printed more than 10 spot colours, which made the printing process quite expensive and required special care and treatment on the technology and the printing paper itself.

With the development of photography, screening methods (halftone dots) were used to reduce the number of printed colours by using the tints of colours.

The foundation of ICA

The International Cartographic Association was established in 1959. The foundation followed the birth of a new era of rapid and substantial development of cartographic technology. In the 10–15 years after World War II, there was a continuously increasing worldwide demand for maps (including not only topographic, but mostly road, city and tourist maps as well thematic maps). An almost simultaneously occurring wave of innovations further revolutionized the map production process. Plastic drawing materials which were dimensionally stable were invented, new methods, like scribing on coated polyester material replaced the conventional ink drawing.

Typesetting machines were also very important in cartography because these machines could replace one of the most time consuming processes of map production: the hand lettering. The first mechanical phototypesetters involved the adaptation of existing typesetters by replacing the metal matrices with matrices carrying the image of the letters and replacing the caster with a photographic unit. The industrial application of this idea resulted in the Fotosetter (1947), a phototypesetter manufactured in the USA by Intertype. Very soon, French, German and Russian models were invented. Later models with a separate keyboard printed more than 28,000 characters per hour. The third generation of phototypesetters appeared in the 1960s, in which all mechanical moving parts were eliminated by omitting the use of light and therefore omitting the moving optical device responsible for operating in its field.

Dr. Carl Mannerfelt, from the Esselte Map Service (Sweden) initiated a co-operation of map production experts. He invited a number of foreign experts in different areas of map production to exchange information on the technological innovations (including map editing, compilation and reproduction). It was in 1956, and due to the Cold War period, only Western countries were invited. The main reason of the success of this first meeting was that the participants focused on a special area of cartography: the map production. There were no scientists; they were all practical cartographers, map producers. When ICA was formed the scientific aspects became more important (international co-operation in the field of cartography) than the technical aspects. (According to the final resolution of the Esselte Conference on Applied Cartography, the planned international organization should concentrate on such aspects of cartography as are not already covered by existing organizations, like IGU, FIG etc.).

On the first ICA General Assembly in 1961, 26 countries were inaugurated as member countries. The Statutes as adopted in 1961 did not represent either governmental or commercial cartographic interest. Its aims were the study of cartographic problems, the co-ordination of cartographic research involving co-operation between different nations, the exchange of ideas and documents (and later digital data), the training of cartographers and encourage the spreading of the cartographic knowledge. However, in the first years of ICA when the relationships between IGU and ICA was a part of a long discussion it was said that cartography as a technical science might be subject to commercial and governmental influences. It was really a fact that the Esselte Conference on Applied Cartography in 1956 and the other early meetings were initiated by private map producing companies so this was probably the main reason that socialist countries were not invited and started to become ICA members only after 1964 (nevertheless, it was again a political issue at that time).

The definition of the term cartography was also an important task of the early years of ICA (Stéphane de Brommer, the Vice-President of ICA and the chairman of the Commission on Education and Training has dealt this issue). The Multilingual Dictionary of Technical Terms in Cartography (edited by Emil Meynen in 1973) declared the term as "the art, science and technology of making maps, together with their study as scientific documents and works of art". This definition was a compromise after a long discussion inside the association, but Prof. Konstantin Salichtchev, the ICA President (1968–1972) still regretted that the final definition was concentrated too much upon the map production and did not concentrate enough on a scientific approach. The definition later has been changed due to the computer technology, but this issue still shows the importance of the output in cartography (Ormeling, 1988; Salichtchev, 1979).

ICA commission on map production

The initial statutes of the ICA only roughly described as to how the commissions should be established. The first ICA commission on focusing partly on the reproduction methods was the Special Commission on Automation. This commission was established in 1964 and in 1980 it was renamed to the Commission on Computer-Assisted Cartography. The commission had very general terms of reference, which later became more specific including the development of cartographic systems. The only objection to the commission's work was that it was usually highly based on the hardware elements of computer cartography (including output devices), but the cartographic presentation was often hidden in the background. This opinion on computer-assisted cartography was still valid in the 80s. The series of AutoCarto conferences (USA) had a strong influence on the technical development of computer cartography, but the results of this dynamic process were used only in the most developed countries.

In 1971–1972, a questionnaire result demonstrated that ICA member countries thought that there was a need for a commission to study practical map production methods and techniques. The Commission on Cartographic Technology was established in 1972 with the following terms of references:

1. To review current cartographic techniques and processes;
2. To disseminate information on these techniques and processes;
3. To organize commission meetings.

In order to avoid overlapping with the above mentioned Special Commission on Automation the new commission restricts its activities to study:

- colour proofing techniques (which is an important part of the map production process),
- register systems (these systems were developed to make the offset printing process smoother and to avoid mis-registering),
- an evaluation of techniques for the production of small editions of multi-coloured maps (this problem is still existing, but the digital printing methods are now easily available, which was a not a case when the commission was originally formed).

The commission was very active in the early years, and they continuously monitored the new development of the map production technology. However, due to the production of different written manuals and handbooks their activities were partly slowed down. The name of the commission changed several times and now it is called Commission on Management and Economics of Map Production. Although the subjects of the commission has changed comparing to the early years, matters like printing-on-demand, web publishing and archiving should be researched by the commission since the middle of 90s.

In 1984, the first volume of Basic Cartography for students and technicians was published (Figure 1). Altogether three volumes and an Exercise Manual were published. Volume 3 was published in 1996 and dealt mostly only with computer cartography. In the first two volumes there were altogether 10 large chapters. The Map reproduction chapter was written by Christer Palm in Volume 1 (Sjef van der Steen was a co-author in the second edition), but additional chapters like Techniques of map drawing and lettering, Map compilation and Computer-assisted cartography have also partly dealt (or at least mentioned) to the output part of cartography. The effect of the Basic Cartography volumes was important since the original formulation of the concept of the series cartography, like many other fields of activity within the general area of information technology, has undergone rapid changes in both form and character. Basic Cartography had an important role also in the higher education to make an internationally standardized teaching material for cartographers. However, the rapid development of computer cartography has made difficult and complicated to integrate the knowledge represented in these volumes into the curricula. In less developed countries where the use of computer technologies was late due to the limited financial resources Basic Cartography played an important role to represent an international standard of cartography. The Map reproduction chapter mentions only the traditional printing methods (offset print), but the chapter deals with other technical sub-processes (Ormeling, 1988).

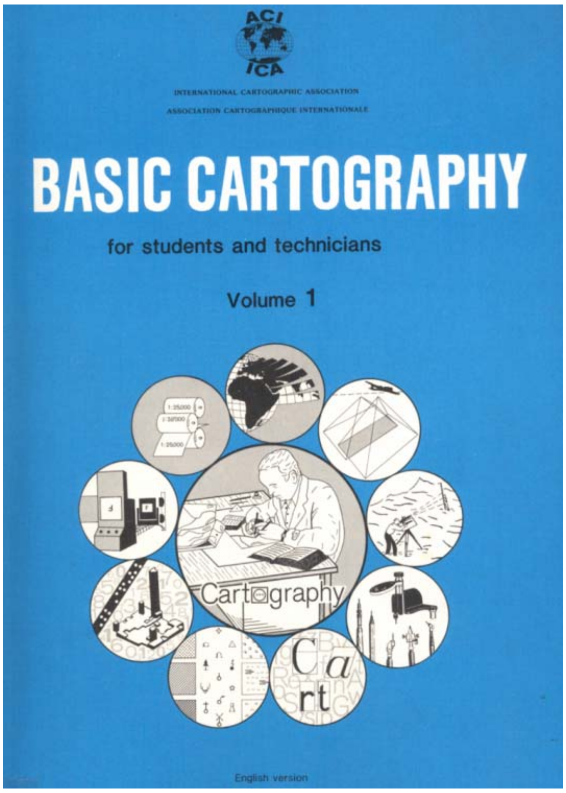


Figure 1. Cover page of Basic Cartography, Volume 1 (1st edition)

Traditional reproduction methods in the cartographic education

Cartographers had to understand the printing process, so the basics of the offset printing process were part of the higher education cartography curricula.

Erwin Raisz, one of the most important American cartographers of the 20th century felt that cartographers fell into two categories: "geographer cartographers", who wish to express their ideas with graphs, charts, maps, globes, models; and "cartotechnicians", who "help produce maps, models, and globes by doing the colour-separation or other technical works". He proposed the idea of different types of cartographers, including the cartologist, cartosophist, toponymist, map compiler, map designer, draftsman, letterist, engravers, map printers etc.

Of course, it may take time to establish independent cartography courses and before World War II practically these independent courses did not exist. The other important American cartographer of the 20th century was Arthur Robinson, who got his PhD right after World War II at the Ohio State University. In this university subject like Cartographic Production was part of the course. Raisz's General cartography and Robinson's Element of Cartography are probably the most important books in the 20th century of the American cartography, but we should mention that the cartographic education was most developed in Europe at that time (McMaster, R., McMaster, S., 2002).

In the Latin American and European traditions, the production techniques are certainly not considered part of the academic environment. They are much respected and much appreciated, but generally we will find them not in academia.

Without fully understanding the essence of offset printing, cartographers were not able to create a good symbology (which can be reproduced technically). They had to start the whole process with the definition of the printed colours, line widths etc. To increase the number of printed colours may considerably make the whole map production process more expensive (it was even more relevant around 1960–1970). Even the selection of the number of colour tints was a question of costs. It was very important in the education of cartographers (especially in the higher education where we have time to give complex knowledge and make the students understand the relationships) to clearly understand how the final phase of the map production process (offset printing) may affect the beginning phase of the map production (creating a map symbology). However, it is not obligatory to be an expert of the whole reproduction phase, but to understand its importance is necessary if we want to run our business efficiently.

At my university, the independent Department of Cartography was founded in 1953 and in 1955 we started the first cartography course. This was not an independent cartography programme, but was a specialization after the second year based on geography and geology courses. (We may call it a pre-Bologna system: 2 + 3 years). We had a series of lessons with a title Map technologies and the students had to understand the whole technical process of map producing: map drawing or scribing, all kind of technical works (photography, screening), proofing, offset printing (including binding, folding). These were not just theoretical lessons, but students had to practice all different areas. We had all technical devices (special camera for reproduction, frames for contact copies, special instruments for screenings, proofing devices, trial offset printing machine; as folding and binding were connected to book and newspaper publishing and we did not have such kind of machines, we visited printing houses to present these processes to our students). Of course, we also had similar practical lessons in the drawing part (ink drawing and scribing etc.). A student who made the whole process himself/herself was able to understand the potential errors. This is why they were able to manage the production line when they started to work at a mapping company or in the state cartography.

The first steps of digital cartography

The Geographic Information System simultaneously developed in America, Australia and Europe. The extraction of simple measures largely drove the development of the first real GIS, the Canada Geographic Information System (CGIS) in the mid-1960s. CGIS was planned and developed as a measuring tool (mostly to help the precise measures of areas), a producer of tabular information. At that time, the system could not be a mapping tool, because the most important input and output devices were not yet developed. Computer systems were unique, very expensive, and mainly used only for research or (secret) military purposes.

A second step of innovation occurred in the late 1960s in the US Bureau of the Census, in planning the tools needed to conduct the 1970 Census. The DIME program (Dual Independent Map Encoding) created digital records of all US streets, to support automatic referencing and calculation of census records. (The US Census was always very innovative: Hollerith built machines under contract for the Census Office, which used them to tabulate the 1890 census data using special punched cards.) The similarity of this technology to that of CGIS was recognised immediately by experts and led to a major program at Harvard University's Laboratory for Computer Graphics and Spatial Analysis to develop a general-purpose GIS. Early GIS developers recognized that the same basic needs were present in many different application areas, from resource management to the census.

In a largely separate development during the second half of the 1960s, cartographers and mapping agencies had begun to ask whether computers might be adapted to their needs, and possibly to make the map producing more cost effective. The UK Experimental Cartography Unit (ECU) pioneered high-quality computer mapping in 1968; it published the world’s probably first computer-made map in a regular series in 1973 with the British Geological Survey; the ECU also pioneered GIS work in education, and much else. National mapping agencies, such as Britain's Ordnance Survey, France's Institut Geographique National, and the US Geological Survey and the Defense Mapping Agency began to investigate the use of computers to support the editing of maps, to avoid the expensive and slow process of hand correction and redrafting. The first automated cartography developments occurred in the 1960s, and by the late 1970s most major cartographic agencies in the Western part of the World were already computerized to some degree. However, the magnitude of the task ensured that it was not until 1995 that the first countries achieved complete digital map coverage in a database (including digital state cadastral and topographic maps series) (Longley, 2005).

Remote sensing also played an important part in the development of GIS (and cartography), as a source of technology and more importantly as a source of data. The first military satellites of the 1950s were developed in great secrecy to gather intelligence, but the declassification of much of this material in recent years has provided interesting insights into the role played by the military and intelligence communities in the development of GIS. Although the early spy satellites used conventional film cameras to record images, digital remote sensing began to replace them in the early 1970s. At that time, civilian remote sensing systems such as Landsat were beginning to provide vast new data resources and to exploit the technologies of image classification and pattern recognition that had been developed earlier for military applications. Weather satellite images had also an important role especially in meteorology, where the low resolution of the early images was good enough to improve the precision of global weather forecasts. Nowadays satellite remote sensing provides the best quality large-area coverage database on Earth (Harris, 1987).

Although there is no close contact to the output side of the cartographic process, another important step of digital cartography has to be mentioned: the global satellite navigation systems such as GPS. However, GPS became widely used in the civil cartography only in the 21st century, although for military use it was already available around 1980.

Computer printers

There is no space to give a comprehensive overview of computer printing in this paper, so only the most relevant techniques will be discussed. The development of computer technology before the release of personal computers was focused on the calculation speed. This was the time when the theory of the geographic information systems was developed. In the 1960–1970 years, there was not too much focus on output devices in informatics. At that time matrix printers were nearly the only opportunities to make output from digitally stored data. These devices were produced to print text (characters) based on simulating the well-known "output device", the typewriter using a so called impact printing. However, these devices were driven by the computer at a much larger speed than any human could do. What was much more important in the cartographic point of view is the print size. In the industrial and scientific environment where financial resources were available such kind of large format line matrix printers and (later) dot matrix printers were used. This large output size (wider than the 80 columns of an A4 sheet) became available in the 70s. The Harvard Laboratory for Computer Graphics (and Spatial Analysis) developed an automated mapping application called SYMAP, to produce isoline, choropleth and proximal maps on a line printer around 1960 (Figure 2). This technology was used only in research institutes where line printers were available. This printing technology has never been used together with personal computers, however the technology was long time used in business environment (bulk printing), but finally the large speed laser printing replaced the old technology. This technology probably did not appear at that time in the cartographic education, but nowadays it is widely taught when we want to present the evolution of digital cartography and geographic information system.

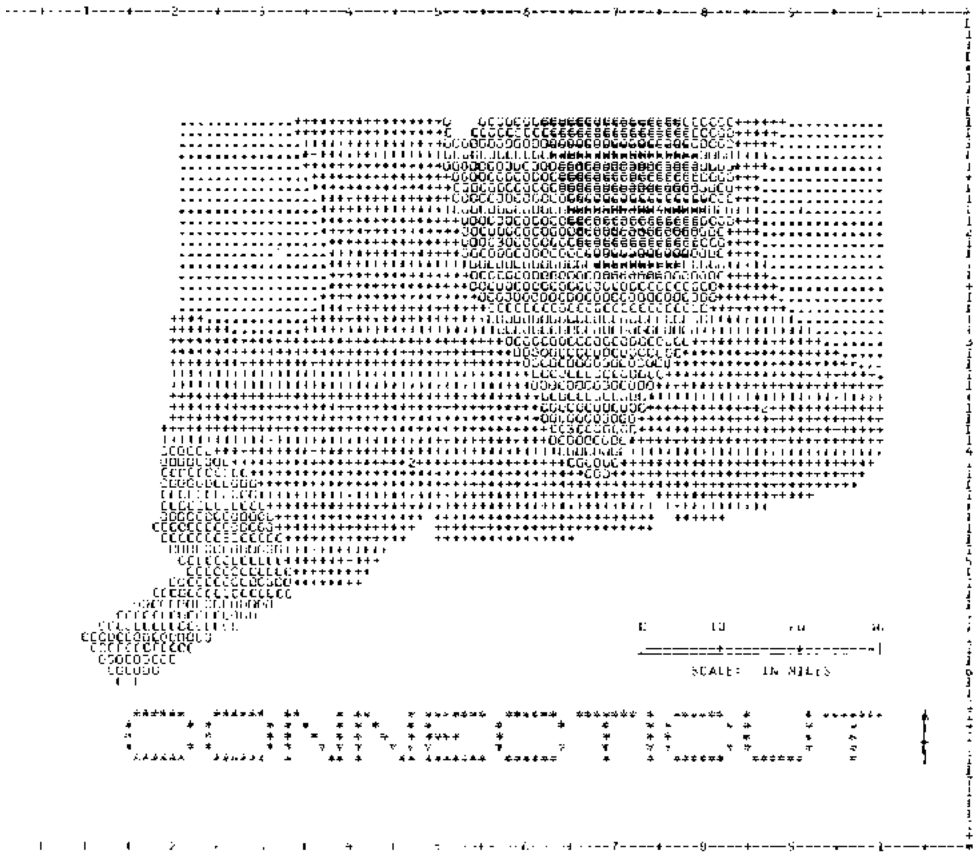


Figure 2. SYMAP example around 1965
http://www.math.yorku.ca/SCS/Gallery/milestone/thumb8/popup/bssn1_popup1-21.htm

Dot matrix printers were developed around 1970. The very first printers used 5 × 7 dot matrix to form the characters; later the 9 × 9 dot matrix became standard. In the 1970s and 1980s, dot matrix impact printers were generally considered the best combination of expense and versatility, and until the 1990s they were by far the most common form of printer used with personal computers. Early dot matrix printers were notoriously loud during operation, a result of the typewriter-like mechanism in the print head and they produced printouts of a distinctive "computerized" quality (the quality of text printing was far from the real typewriter text). Although the very first dot-matrix impact printers lacked the ability to print computer-generated images it has changed soon and encouraged the PC users to buy this relatively cheap output device. The speed and graphic quality was very poor, but users had no other opportunity to print their documents, including maps. This was also the first low-cost option for colour printing (although they were also 9 pin dot colour models). When the manufacturers wanted to improve the printing quality of their models, they invented a 24-pin dot matrix printer around 1985. The print quality was not comparable to the actual models, but these were the first printers to allow the users to print colour photographs (even such prints might take some ten minutes or more even in a small size). The colour dot matrix printers had no chance to become wide spread because a new technology, the inkjet was invented and in some years this technology replaced the dot matrix printers especially on the home market. The effect of colour dot matrix printers in cartography was nearly invisible due to the fact that only few manufacturers developed such models (Apple, Citizen, Epson, Panasonic), and the print quality was really poor (printing stripes remained visible on the paper, Figure 3). Some colour dot matrix printer models are still on the market, but only for printing receipts (Zable and Lee, 1997).

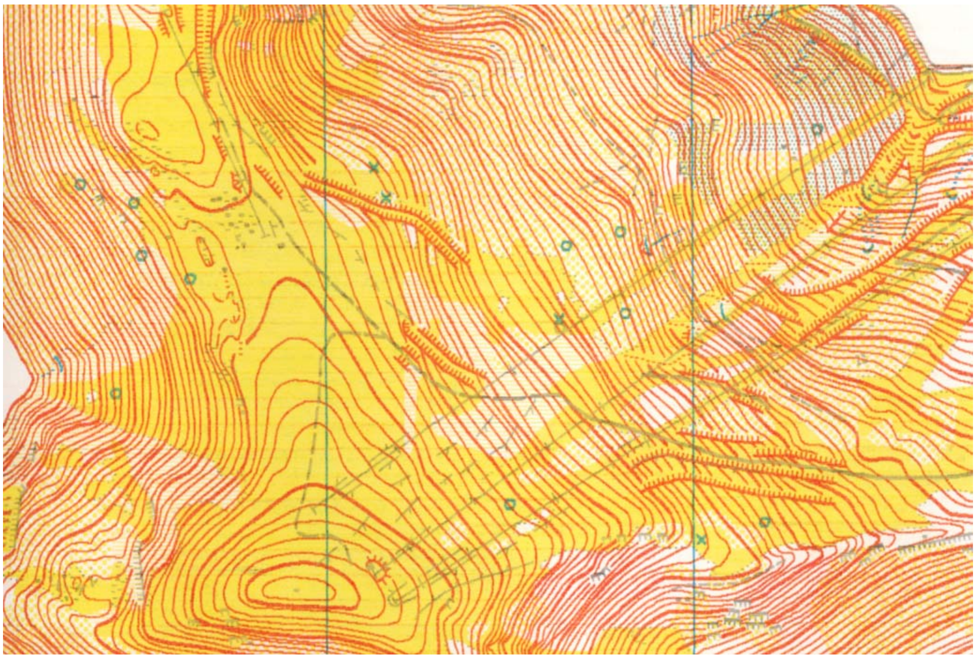


Figure 3. 24-pin dot colour matrix printed map

The very first special output devices used in cartography was the pen plotter. Compared to modern printers, pen plotters were very slow and cumbersome to use. Users had to constantly worry about a pen running out of ink. If one pen ran dry at the end of a plot, the entire plot had to be re-done, which was very time consuming. Plotters could only draw lines; they could not reproduce raster or photographic images. Despite these limitations, the high resolution and colour capability of pen plotters made them the colour hardcopy output device of choice until the late 1980s especially in technical drawings and CAD graphics, which consisted of simple lines like cadastral maps. Only the inkjet technology has made pen plotters obsolete.

In a drum technology papers were fixed and pen was moved in a single axis track and the paper itself moved on a cylindrical drum to add the other axis or dimension. Where the paper was fixed on a flat surface and pens were moved to draw, the image was called a flatbed plotter. This type of plotters regularly can use several different colour pens to draw with.

CalComp was incorporated in 1958. It was one of the first companies in the United States to market peripheral products designed specifically to work with computers. CalComp's appearance coincided with the first wave of acceptance of computers by such mainstream businesses as banks and insurance companies. In 1959 the company developed the world's first drum plotter, but few expected the instrument to grow into CalComp's strongest product line (Figure 4.). The company introduced a complete line of drum plotters in 1962. During the mid-1960s computers continued to advance and become more user-friendly through the addition of peripheral products such as keyboards, monitors, printers, and plotters such as those designed by CalComp. By 1968 between 80 percent and 90 percent of all plotters in existence were manufactured by CalComp (prices were between $3,500 and $50,000).

The other important plotter producing company of the early years was Versatec. They produced the first commercially successful electrostatic writing technique plotter that produced information on paper directly from digital data sources in 1970.

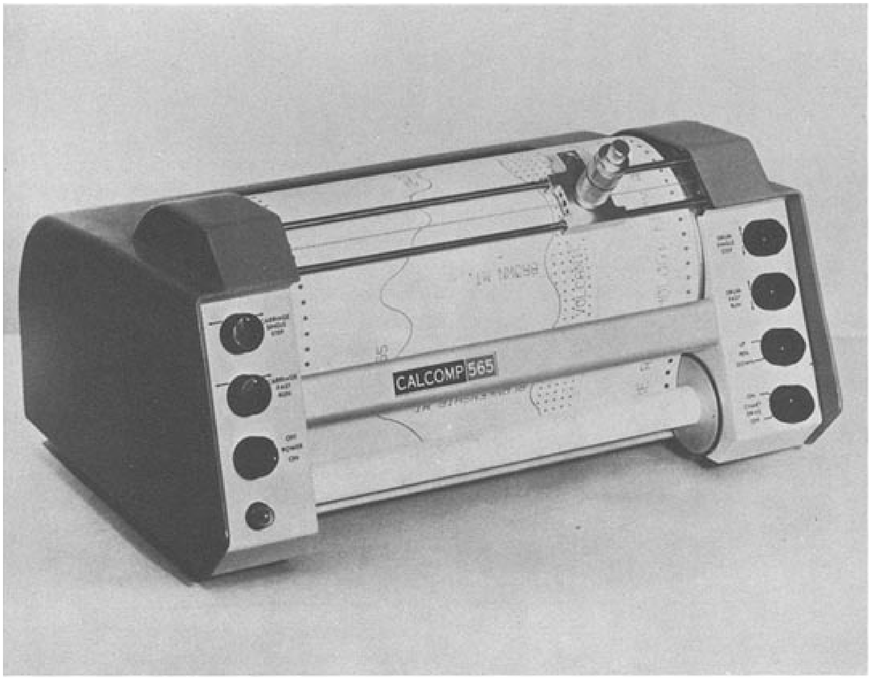


Figure 4. CalComp model 565, a 12 inch drum plotter (1959)
http://design.osu.edu/carlson/history/images/pages/calcomp565_jpg.htm

Hewlett Packard and Tektronix produced small, desktop-sized flatbed plotters in the late 1960s and 1970s. The pens were mounted on a travelling bar, whereby the y-axis was represented by motion up and down the length of the bar and the x-axis was represented by motion of the bar back and forth across the plotting table. Due to the mass of the bar, these plotters operated relatively slowly. HP produced only flatbed plotters before 1980, but the model 7580A (released in 1981) was the world's first "grit wheel" pen plotter. This machine combined high speed and high line quality in a small package at a price less than half that of comparable products on the market at the time. Small grit-covered wheels move the paper along the X-axis of the 7580A, thereby replacing the heavy, bulky components used in other plotters with a low-mass, low-inertia drive mechanism.

Plotters were perfect devices in the early years of digital cartography, but their high price made these devices affordable only for large companies. When the price was reduced, these plotters were also used in the higher education because the programming was relatively easy (very simple instructions on the plotter graphic languages) and students could use it efficiently. It was also important in the higher education that the operational method of the plotter was theoretically easily understandable. The operational costs were relatively low (pen, paper) and the devices did not require special treatment, which was important in the higher education.

At our department the first real digital output device was a simple Numonics drum pen plotter, which we acquired in the beginning of 90s. Our students wrote computer programs that calculated the coordinate network of various projections, but due to the lack of suitable output devices students edited these drawings manually (buying the Numonics device we had the opportunity to use the digital technology, which made this project more interesting for our students).

Actual computer printing technologies

Since the graphic operation systems and graphic environments were released around 1984–1990 and graphic software also become available computer printers started to be a part of a cartographic workstation. Laser printers were fast and reliable, but colour models were very expensive in the beginning. This technology does not allow larger models than A3 size. The prices were falling down in the last few years so laser printers (including colour ones) are real options now even in the home market.

Inkjet technology replaced the dot matrix printing in the middle of 90s (Canon released their very first model in 1981 and HP did the same in 1984). Although black and white models were less expensive in the beginning, the price difference between colour and black and white models was not very high. In some years black and white models have totally disappeared. This was the first technology that reached the photo quality at a reasonable price. Although photo quality and colour accuracy was not necessary for cartographers, it helped to improve the technology (for example using more than four inkjet cartridges to be able to reproduce more colours). Before manufacturers reached this goal, they just had increased the resolution of their models up to 1200 dpi. Not only the photo quality was the issue of resolution, but also the quality of ink and paper.
The large format models were much more important for cartographers, although primarily the large format models were developed for CAD. This was the reason why the first large format models were concentrated on line drawing instead of filling area with homogenous colours.

Other technologies like dye sublimation, thermal vax, electrostatic printing were so expensive that only state cartography institutes were able to afford that. The operational costs were so much high that inkjet models replaced these special printers in some years. These special technology models are still available and they used where colour accuracy is a key factor, but colour management is also available for inkjet models.

Inkjet printers appeared soon in the higher education. A4 and A3 models were available at a reasonable price already in the first part of the 90s and the price range of large format models was also reachable for a higher education department. Even students could afford such printers in the second half of 90s (Zentai, 2009).

Computer printing in the education

Only when the digital printing became an affordable option in the higher education it was really important to teach not only the cartographic software, but also the digital printing process. Although the first printers were not really sophisticated, their appearance gave the users a freedom not to depend on the expensive, time consuming process of offset printing. In the beginning, digital printing was just treated as an additional proofing method, which substituted neither the offset print, nor the proof. The real advantage of this new option was the low cost and the speed. The speed was really slow compared to the actual capabilities, but it was much faster than any contemporary analogue method.

Students were very interested in the digital technologies (as the younger generations regularly did so) so they wanted to use these technologies as early as the higher education institutes could provide them with the opportunity. It was also important to teach the theoretical background of the digital printing process, which has considerable differences compared to the traditional offset printing. One of the most important differences was that colour digital printing used a CMYK colour model instead of using spot colours, which was very common in the traditional map printing. This difference is also influenced the composition of map symbols (colours, line widths etc.). In the early years of the digital era, we had to take into account the weakness of the technology. It was very important to make the students understand these characteristics of the printing process.

As the price of computer printers decreased, these devices become part of the home computer systems together with scanners. The Internet era has made the access of information (especially the IT information) much easier than any previous time. Such kind of knowledge was partly taught in secondary schools, but it is still necessary to teach the theoretical and technical background to the cartographers. It is similar to the offset printing era: some cartographers became the experts of the technology and they were responsible for that part of the process. Nowadays we also have only few cartographers who are experts and understand the process, and the rest of them (as any other user) just presses the print button and trusts in the software and hardware.

It is also necessary to mention the new output device: the screen. More and more maps are planned (or at least viewed) on the screen of computers, mobile phones, GPS devices, personal digital assistants. To visualize the digital information efficiently students have to be familiar with the characteristics of these new "devices", so such kind of subjects should be included in the curriculum.

Summary

As cartography became a science and independent cartography courses and curricula were implemented in the 20th century, the content of these studies has been developed continuously. After the International Cartographic Association was formed, they set up commissions to encourage the cooperation of the scientists and higher education experts of the member countries. The ICA Commission on Map Production was established in 1964 and played an important role in developing and standardizing the modern reproduction techniques of cartography. The teaching of map production techniques in the higher education was also influenced by the commission, especially in the less developed countries. However, as the computer printers became widely used this influence started to decrease. Cartography curricula tried to follow the development of these output devices. Even today, when digital maps are the most important products of cartography we have to teach the visualization on computer screens. Nevertheless, the development is continuous: 3D screens and other devices are coming making new challenges also for cartographers.

Acknowledgments

The project is supported by the European Union and co-financed by the European Social Fund (grant agreement no. TÁMOP 4.2.1/B-09/1/KMR-2010-0003).

References

Harris, R.: 1987. Satellite remote sensing, Taylor & Francis.

Longley, P.: 2005. Geographic information systems and science, John Wiley and Sons.

McMaster, R. McMaster, S.: 2002. A History of Twentieth-Century American Academic Cartography, Cartography and Geographic Information Science, 29 (3), p. 305–321.

Ormeling, F. J. ed.: 1988. ICA 1959–1984. The first twenty-five years of the International Cartographic Association. Elsevier.

Salichtchev, K. A.: 1979. Periodical and serial publications on cartography. The Canadian Cartographer, 16(2), p. 109–132.

Zable, J. L. and Lee, H. C.: 1997. An overview of impact printing. IBM Journal of Research and Development, 41(6), p. 651–668.

Zentai, L.: 2009. Change of the meaning of the term 'cartographer' in the last decades, XXIV International Cartographic Conference, Santiago de Chile, 15–22 November 2009. ICA.

Maps for the Future:
Children, Education and Internet
Joint ICA Symposium

Internet and Cartography

THE TILE-BASED MAPPING TRANSITION IN CARTOGRAPHY

Michael P. Peterson
Department of Geography / Geology, University of Nebraska, Omaha (USA)
mpeterson@unomaha.edu

Abstract: Arguably the major development of the first two decades of maps and the Internet is a method of map distribution that divides the map into smaller tiles. The tiling of maps along with a more interactive form of communication with a server called AJAX transformed the online mapping experience. Soon after the method was introduced through Google Maps, all other online map providers switched to the new form of map distribution. The introduction of Application Programmer Interfaces that allowed user information to be added to the maps solidified this form of online map presentation. Whether for good or bad, online mapping is currently in a tile-based mapping era and will likely be so for the foreseeable future. The method is examined more closely along with the potential for adding user-defined maps.

Introduction

Maps became a major component of the online information landscape in 1993 after graphical illustrations could be added to World Wide Web pages (Peterson 2003). All types of maps became easily available, from subway maps of cities to maps of the moon. Map users could even choose between alternative representations of the same environment and determine the one that best suited their needs. Interactive sites made it possible to center the map on an area of interest and include features requested by the user.

The nearly two decades since 1993 can be seen as a period of discovery as map providers tried different ways to make use of the new medium. Paper maps were initially scanned. Then, cartographers alternated between various vector and raster formats and forms of interactivity. A major goal was to increase the speed of map delivery. Map users did not want to wait for the map and a method was devised to appease the impatient online map user. This method involved dividing the map into pieces, or tiles. It is important to understand the tile-based mapping transition and what it means to cartography. We begin by examining server-based mapping.

Server-based mapping

Interactive server-based mapping began in 1993 within months after the introduction of the Mosaic browser in March of that year. The first interactive online mapping application was developed by Steve Putz (1994) at the Xerox Palo Alto Research Center (PARC). His Map Viewer program allowed the user's, client computer to create on-demand maps from a geographic database. Each interaction with Map Viewer would request a new map from the server that was zoomed in on a specific point (see Figure 1). Individual maps were generated in a graphic file and embedded into a web page.

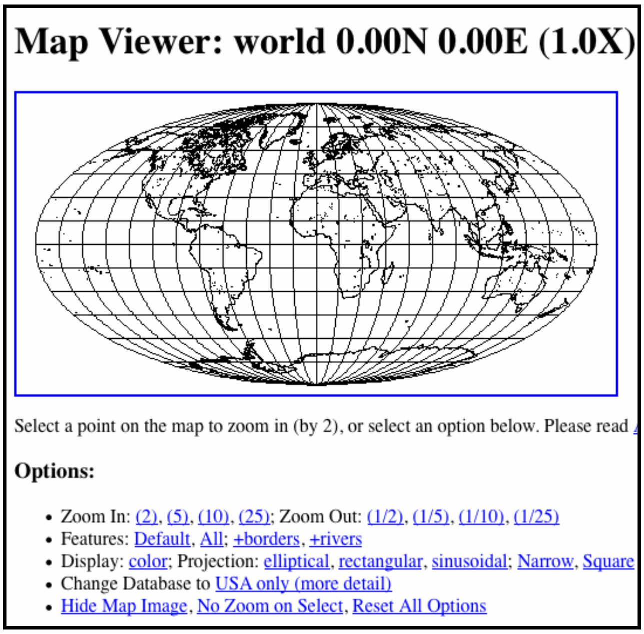


Figure 1. Xerox Parc Map Viewer was an early example of an interactive web map. By interacting with a mapping program on the server, the site made it possible to generate a map of the world at different zoom levels. The resultant map was converted into a graphic file and inserted into a web page.

MapQuest introduced its online mapping site in 1996 based on large database that included most streets in the North America. Within months, it was producing millions of maps every day and was the leading online map provider until 2009. The user's client computer would make a request for a specific map. MapQuest servers would respond to the request by drawing the map from a database of points and lines, converting this to a grid-based raster format and delivering the resultant map within a web page.

Each request for another map, at a different zoom level or centered at another point, would result in another server request that would produce another map that would be embedded in another webpage that would update the page on the user's computer. Although the process was fairly fast, there was always a wait for the server to respond. A simple zoom or pan required waiting for the server to produce another map that was inserted into another webpage. Server requests are also subject to Internet traffic so a request for a map might take considerably longer when traffic was heavy. Maps would be produced more quickly in the overnight hours when Internet traffic was lighter. This variability in response times was found to be more annoying for users than the generally slow response times. Figure 2 depicts a 2001 version of MapQuest along with three maps of southern Florida at different scales.

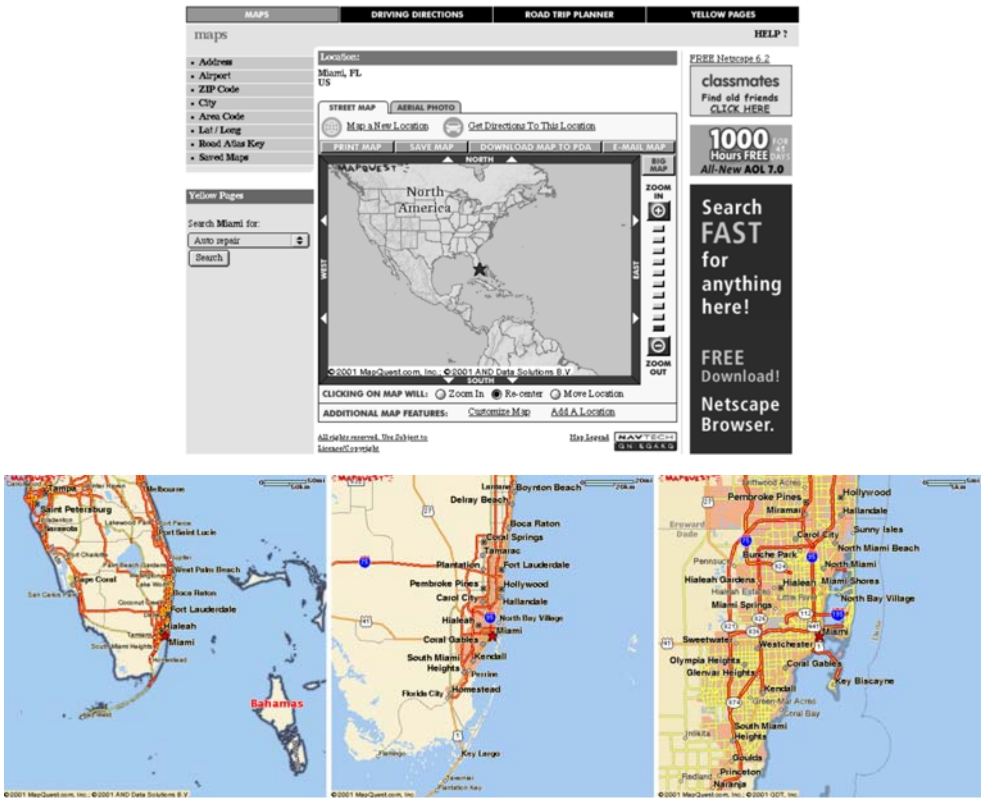


Figure 2. A 2001 version of the MapQuest webpage. Dominated by ads, the map constitutes only a small part of the webpage. Three different maps of southern Florida are also depicted. A total of ten zoom levels were available.

Tiled web maps

Google Maps, introduced in 2005, offered a more interactive street map interface (Peterson 2007). Google, known for its search engine, effectively added a map-based search engine through Google Maps and the stand-alone Google Earth. In the process, they found a more effective way to indirectly make money from on-line maps by charging businesses, much like the way they make a profit through their search engine. In addition, by not including ads around the map, like Map-Quest, they left more room for the map on the computer screen. Google Maps is based on two major ideas: 1. image tiling; and 2. AJAX.

Image tiling

Image tiling had been used since the early days of the World Wide Web to speed the delivery of graphics (Sample & Ioup 2010). In comparison to text, images require more storage and therefore take longer to download. A solution was to divide the image into smaller segments, or tiles, and send each tile individually through the Internet. These smaller files often travel faster because each can take a different route to the destination computer. On the receiving end, the tiles are reassembled in their proper location on the web page. With a moderately fast Internet connection, all of this occurs so quickly that the user rarely notices that the image is actually composed of square pieces. With a slower Internet connection, the individual tiles are clearly evident.

The basic street map is the most functional of all the views provided by these services. The map is provided in up to 20 scales called levels of detail (LOD). Each map at a particular level of detail is rendered from an underlying vector database consisting of points, lines and areas. This map is converted into a grid representation by placing the points, lines, and areas into a matrix of pixels. In the process, anti-aliasing is performed by adding lighter pixels around sharp edges to soften the stair-step effect. After the map is placed in a matrix that can be millions of pixels on each side, it is divided into tiles – usually 256 x 256 pixels (see Figure 3). This process is repeated for every LOD.

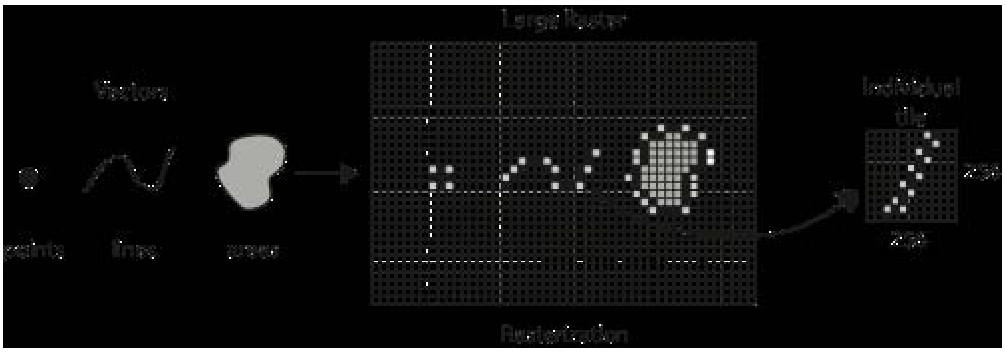


Figure 3. The process of making map tiles. A database of points, lines and areas is rasterized into a large matrix that is subsequently divided into 256 x 256 square tiles.

Figure 4 depicts a series of Google Map tiles at different scales. All tiles are 256 x 256 pixels and require an average of 15 KB a piece to store in the PNG format. Table 1 shows the number of tiles that are used in a tile-based mapping system for 20 levels of detail (LOD), or zoom levels, and the associated storage requirements and storage costs. With 20 LODs, there are a total of approximately 1 trillion tiles for the whole world. At an average of 15 KB per tile, the total memory requirements would be 20 Petabytes, or 20,480 Terabytes. No single client computer could have this much storage capacity. A data center is required to store this amount of data.

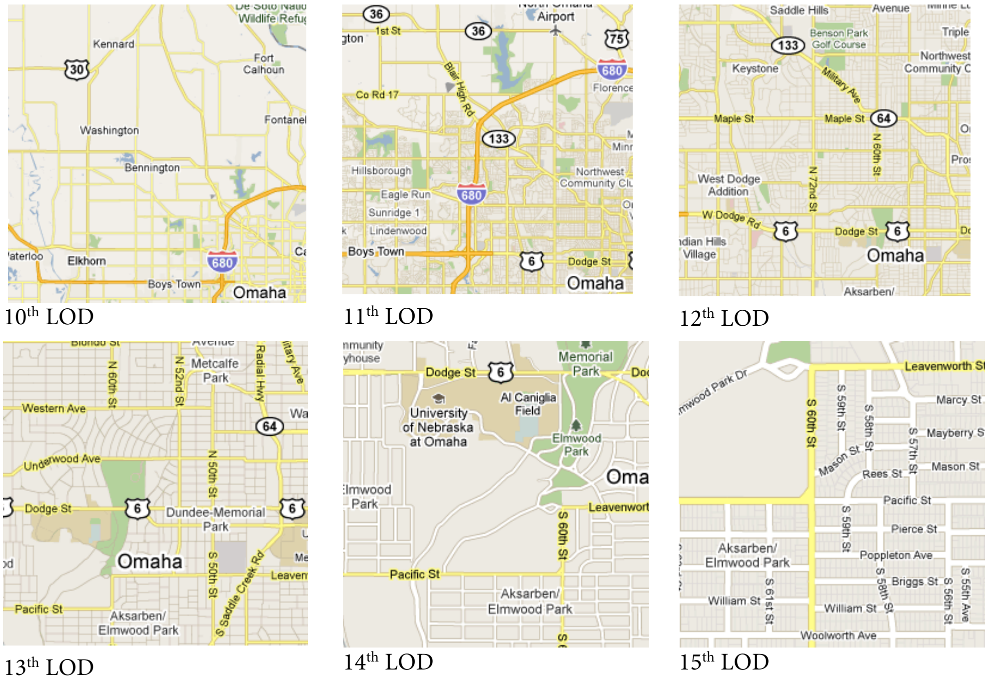


Figure 4. Individual map tiles from Google Map at six different levels of detail (zoom levels). In 2005, Google introduced a tiling system to deliver online maps. Over a trillion tiles are used for Google's 20 zoom levels.

The cost of storing this much data on hard drives can be calculated based on a cost of about $100 per Terabyte drive, a price that does not include the housing or computer connection. To store the entire one trillion tiles would be about $2 million ($100 x 20,480 Terabytes). In order to achieve faster response times, there is some indication that Google uses faster random-access memory (RAM) to store the Google map tiles. If the entire map of the world were stored in RAM, it would cost the company more than $629 million.

These data storage requirements and costs are only for the map. The satellite view, with tiles in the JPEG format, requires approximately the same amount of storage space. A terrain view is also provided with 15 levels of detail. Google maintains multiple data centers around the world and each would likely have a copy of the map and satellite image, and any other map that is provided.

Combining all of these data storage costs provides some indication of the importance placed on maps by Google and other companies. Even government entities would have difficulty justifying the initial and ongoing expense of maintaining an online map in this way.

Table 1. The number of tiles, storage requirements, and storage costs used by a tile-based online mapping system to represent the world at different levels of detail (LOD) or zoom levels.

Levels of Detail (LOD)	Number of Tiles	Ground distance per pixel in meters	Storage requirements at 15 Kilobytes per tile	Disk storage costs at $100 per Terabyte	RAM memory storage costs at $30 per Gigabyte
1	4	78,272	60 Kilobytes (KB)	$0.000006	$0.002
2	16	39,136	240 KB	$0.00002	$0.007
3	64	19,568	968 KB	$0.0001	$0.03
4	256	9,784	3.75 Megabytes (MB)	$0.0004	$0.11
5	1,024	4,892	15 MB	$0.001	$0.44
6	4,096	2,446	60 MB	$0.006	$1.76
7	16,384	1,223	240 MB	$0.02	$7.03
8	65,536	611.50	960 MB	$0.09	$28.13
9	262,144	305.75	3.75 Gigabytes (GB)	$0.37	$112.50
10	1,048,576	152.88	15 GB	$1.46	$450.00
11	4,194,304	76.44	60 GB	$5.86	$1,800.00
12	16,777,216	38.22	240 GB	$23.44	$7,200.00
13	67,108,864	19.11	968 GB	$93.75	$28,800.00
14	268,435,456	9.55	3.75 Terabytes (TB)	$375	$115,200.00
15	1,073,741,824	4.78	15 TB	$1,500	$460,800.00
16	4,294,967,296	2.39	60 TB	$6,000	$1,843,200.00
17	17,179,869,184	1.19	240 TB	$24,000	$7,372,800.00
18	68,719,476,736	0.60	960 TB	$96,000	$29,491,200.00
19	274,877,906,944	0.30	3.75 Petabytes (PB)	$384,000	$117,964,800.00
20	1,099,511,627,776	0.15	15 PB	$1,536,000	$471,859,200.00
Total	**1,466,015,503,700**		**20,480 Terabytes or 20 Petabytes**	**$2,048,000**	**$629,145,600**

In a transformation that shows that imitation is the sincerest form of flattery, all of the other major interactive map providers – MapQuest, Yahoo, Microsoft (Bing) – converted from the standard server-client to the AJAX, tile-based method of map delivery within a short time after the introduction of Google Maps.

AJAX

The second major innovation brought by Google Maps was the incorporation of Asynchronous JavaScript and XML (AJAX) in the relationship between the server and client. This was the culmination of many years of effort to re-shape interaction on the Internet. Essentially, AJAX maintains a continuous connection with the server – exchanging small messages in the background even when the user has not made a specific request. This allows for faster server responses when the user does make a request. AJAX might be thought of an application that works in the background of a browser to anticipate what the user might want and be ready to communicate with the server to respond to a request. Operations in Google Maps that are particularly assisted by AJAX include zooming and panning, a common form of interaction with maps.

Asynchronous JavaScript And XML (Ajax) is a technique that combines JavaScript and XML to create very interactive, server-client web applications. Ajax is not a programming language in itself, but a term that refers to the use of a group of different technologies together. The technique uses a combination of HTML, Cascading Style Sheets (CSS), Document Object Model (DOM), and the eXtensible Markup Language (XML). These are all freely available technologies. Asynchronous communication is used to exchange data with the server while the user is idle so that the entire web page does not have to be reloaded each time the user makes a change (see Figure 5). The result is increased interactivity, speed, and an improved user interface.

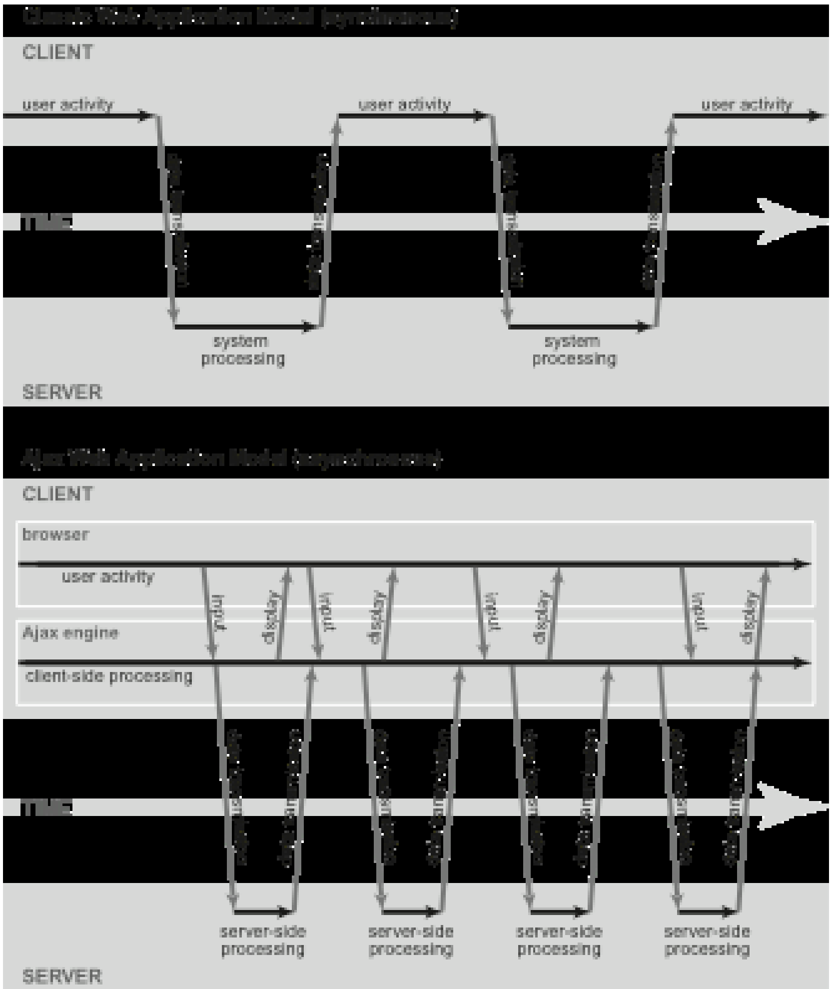


Figure 5. The typical client-server communication is synchronous (top illustration). Ajax uses asynchronous communication between the client and the server. A connection is maintained to the server to speed interaction.

Ajax eliminates the usual start-stop-start-stop type of interaction. When the map is scrolled, additional map tiles are automatically downloaded. The tiles are added almost instantly because a connection is maintained to the server so that additional tiles can be quickly loaded. As the user scrolls, more of the map or satellite image is downloaded from the server without the user making a specific request for additional tiles.

Asynchronous communication is made possible by the Ajax engine, JavaScript code that resides between the user and the server. Instead of loading the webpage at the start of a web session, the Ajax engine is initially loaded in the background. Once loaded, the JavaScript code downloads data from the server without refreshing the web page. A user action that normally would generate an HTTP request to the server becomes instead a JavaScript call to the Ajax engine. If the engine can respond to a user action, no response from the server is required. If the Ajax engine needs something from the server to respond to a user request – such as retrieving new data – the engine makes the request without interrupting the user's interaction with the application. Ajax has transformed the online client/server experience and is used by many different types of applications.

Mashups and the application programmer Interface

Mashups are an integral part of what is commonly referred to as Web 2.0 (Batty, et al, 2010). Beginning in about 2004, Web 2.0 represents a variety of innovative resources, and ways of interacting with, or combining web content. In addition to mashups, Web 2.0 also includes the concept of wikis, such as Wikipedia, blog pages, podcasts, RSS feeds, and AJAX. Social networking sites like MySpace and Facebook are also seen as Web 2.0 applications.

Central to mashups are Application Programming Interfaces (APIs), online libraries of functions that that are made freely available. Many different API libraries have been written for the user-driven web. APIs are the tools that facilitate the melding of data and resources from multiple web resources by providing tools to acquire, manipulate and display information from a variety of sources. In a strict sense, map mashups combine data from one website and display it with a mapping API. The term has come to be used for any mapping of data using an API, even data supplied by the user.

APIs are used for many different types of applications but the creation of maps is one of the major uses. This should no be surprising because there is a great deal of data that has a location component. The relative ease of overlaying all types of information with online mapping tools has further transformed cartography from a passive to an active enterprise with all types of data being mapped.

Introduced in 2006, the Google Maps API consists of a series of map-related functions. These functions control the appearance of the map, including the scale, position, and any added information in the form of points, lines or areas. The purpose of the API is to make it possible to incorporate user-defined maps on websites, and to overlay information from other sources.

Map layers

Google and the other online map providers have a large number of pre-defined layers. These layers have also been tiled – like all of the tiles that make up the map and the satellite image. Table 2 shows the available layers provided by Google.

Table 2. Standard layers provided by Google. All layers are tiled.

Traffic	Current traffic conditions.
Photos	Locations of available photographs.
Labels	Street, city, and boundary names.
Webcams	Locations of cameras with live imagery.
Videos	Locations of YouTube videos.
Wikipedia	Wikipedia pages for locations on map.
Bicycling	Biking paths and trails.
Buzz	Postings to Google Buzz.
45°	45° degree angle bird's-eye view.
Terrain	Shaded relief map.
Transit	Public transportation network.

These overlays consist of a series of tiles that have the same size and dimension as the base tiles. Most of the overlay tiles are made transparent so that you can see the tile underneath. Whatever part of the tile is opaque becomes superimposed on the underlying map (see Figure 6). Overlaying transparent tiles in this way is faster than overlaying individual points or lines. Most maps supplied by these services are transparent tile overlays and have a particular theme such as traffic, webcams or photos.

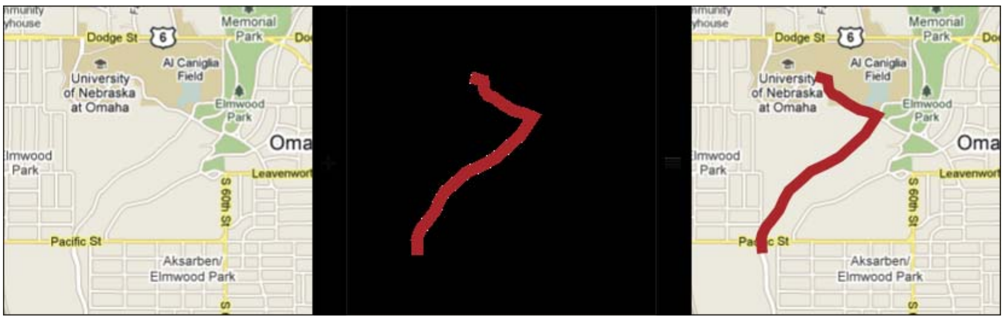


Figure 6. The tile overlay method. A map tile on the left is overlaid with a transparent PNG file with an opaque line. Combining the two tiles produces the display on the right.

Most of the layers that are offered by online mapping services are updated only occasionally. An example of a frequently updated layer is traffic (see top map in Figure 7). This layer shows the speed of traffic for major streets in the larger cities of the world and is updated continuously throughout the day. The maps are also tiled at multiple levels of detail for faster download. Only those tiles are replaced that need updating. The bottom map in Figure 7 shows a bicycle path map that completely covers the underlying street map, at least in urban areas. It is updated only irregularly.

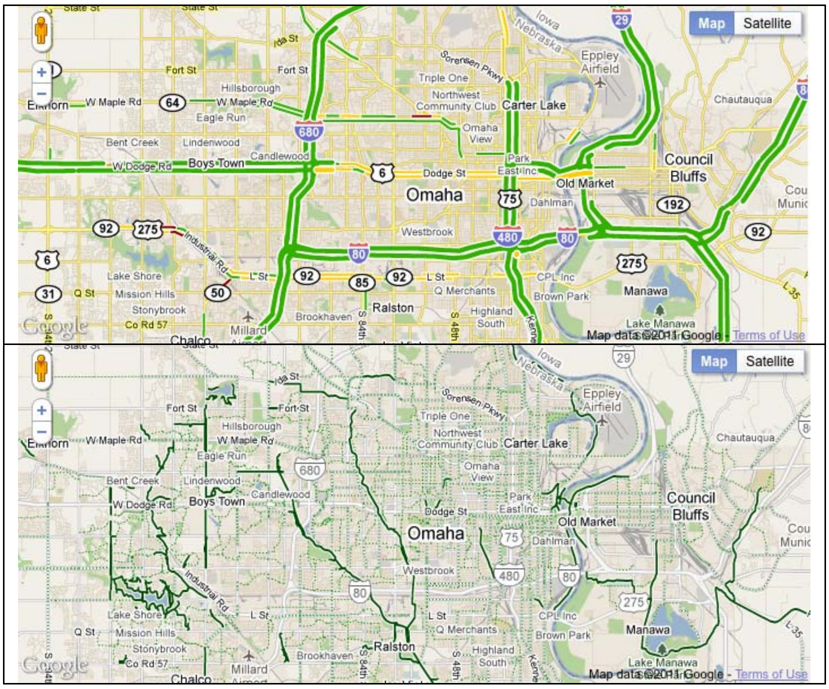


Figure 7. Comparison of two different overlays. The top map showing traffic is transparent allowing the underlying street map to be visible. The bottom map showing bicycle paths is opaque, at least in urban areas. Both overlays are supplied in multiple levels of detail.

An example application of the overlay is the campus map for the University of Nebraska at Omaha (see Figure 8). Here, a map of the campus was first constructed with vectors in Adobe Illustrator. Subsequently, the map was converted to the raster png format and tiled through an online tiling service. Three different levels of detail of tiles were created and combined with the Google Map as a layer. Layers were also created for parking and the shuttle transportation network.

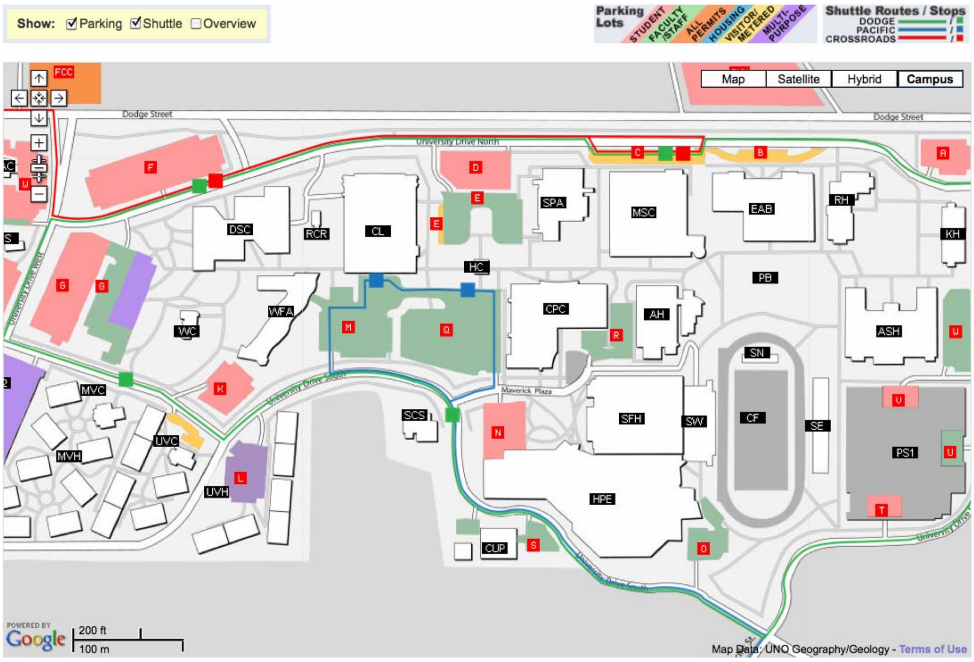


Figure 8. Campus map overlay for the University of Nebraska at Omaha. The tiled representation is supplied at three levels of detail and overlays over a standard Google Map.

Figure 9 shows how the parking and shuttle layers are integrated within Google Maps to provide to provide an overall view of the campus. All Google Map functions are active, such as searching for a specific location or travel routing.

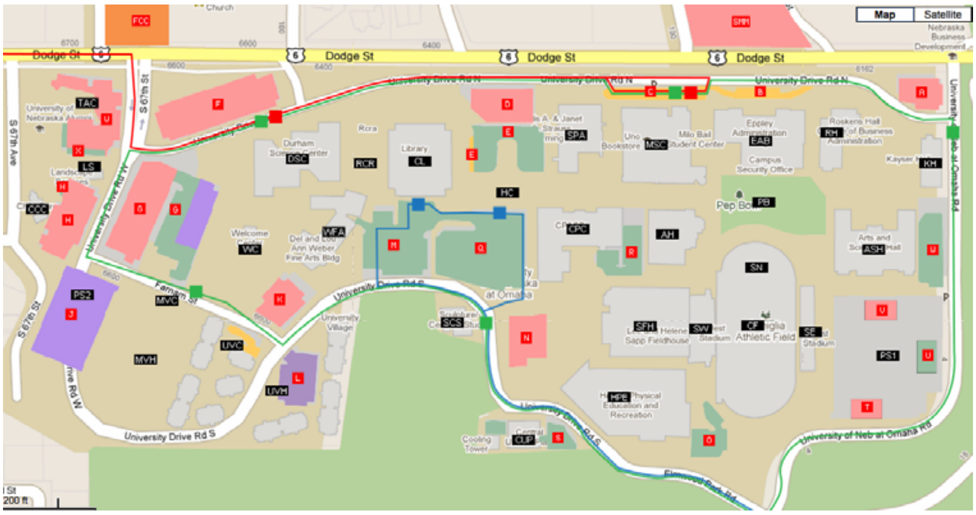


Figure 9. Parking and shuttle layers superimposed on a Google Map of the University of Nebraska at Omaha campus.

Summary

The advantage of using a major online mapping site is that the maps represent a common and recognizable representation of the world. Overlaying features on top of these maps provides a frame of reference for the map user. A particular advantage for thematic mapping is the ability to spatially reference thematic data. For simplicity, thematic maps have limited the display of spatial reference data such as the location of cities and transportation networks. This has made it more difficult for map users to spatially reference thematic data.

Storing the online map represents a major expense for online map providers. Depending upon the method of storage, the cost for simply store the map may be as much US $630 million. Maintenance of the database and a variety of other costs would represent significant ongoing costs. A non-profit agency or government entity would have difficulty justifying this expenditure. Application Programmer Interfaces represent a way to integrate information with the online map. For a variety of reasons, this form of map delivery is the most cost-effective way of making maps available to the online map user.

References

Batty, Michael et al.: (2010) Map mashups, Web 2.0 and the GIS revolution. Annals of GIS. Vol. 16, No. 1, p. 1–13.

Peterson, Michael P.: (2007) International Perspectives on Maps and the Internet. Berlin: Springer.

Peterson, Michael P.: (2003) Maps and the Internet. Amsterdam: Elsevier.

Putz, Steve: (1994) Interactive Information Services Using World-Wide Web Hypertext. Computer Networks and ISDN Systems 27 (2) 273–280, Berlin: Elsevier Science.

Sample, John T. and Elias Ioup: (2010) Tile-Based Geospatial Information Systems: Principles and Practices. New York: Springer.

**Maps for the Future:
Children, Education and Internet**
Joint ICA Symposium

Internet and Cartography

UPDATING A HUNGARIAN WEBSITE ABOUT MAPS FOR CHILDREN

José Jesús Reyes Nuñez[1], Csaba Szabó[2]
Department of Cartography and Geoinformatics
Eötvös Loránd University (Hungary)
1 jesus@ludens.elte.hu , jesus@map.elte.hu
http://lazarus.elte.hu/hun/dolgozo/jesus
2 bahama@map.elte.hu
http://mercator.elte.hu/~bahama/index.html

Abstract: The first website in Hungarian language dedicated to the presentation of basic cartographic concepts for children and young people was made in 2000. The making of this homepage was preceded by a study about the basic map concepts learnt by Hungarian pupils in Elementary and Secondary Schools, when (in which grades) these concepts are taught, and which subjects include the map concepts and the use of school atlases and other maps in the teaching of their themes. This research was completed with the study of international experiences during the creation of websites presenting scientific themes for pupils.

After more than 10 years from the publication of the original website, the time has arrived to update the website, considering that Internet and in particular the Web has had notable changes along this period of time and also considering possible changes in the teaching of the map concepts in the Hungarian Educational System. This decision implied not only the possible revision of the themes presented in the original website, but also the analysis of compulsory changes in the structure of the website, namely, which new programming and design tools can be used to develop the new site and which new graphic tools can be added to develop a new Web based environment.

1. Original research (1997–2000)

1.1. Theoretical research

The project was begun with the study of curricula, textbooks, workbooks and atlases used in the subjects related to Geography in the Hungarian Educational System, to determine which cartographic concepts were learnt by the pupils. The conclusion was that the majority of the cartographic concepts were taught between the 3rd and the 5th grade of Elementary School, and the posterior use of maps and school atlases in the classroom (including High School) is based on this knowledge.

Parallel to this research a study was also made about different methods of publishing educational materials on the Web, paying special attention to finding international experiences in the presentation of concepts related to maps. In the last years of the 90's, the number of homepages designed to fill this aim could be considered still low. By this reason the research was extended to homepages designed for children in interest of presenting concepts related to different sciences.

The next step was to classify the map concepts for their presentation on the Web, first dividing them into general themes, followed by their detailed description, the definition of smaller units and finally completing the themes taught in schools with other concepts.

The list of general themes presented in this website was: Map and reality, Orientation with and without maps, Map history, What kind of maps are there?, Representation of relief, Rivers and lakes on maps, Other colours on maps, Symbols on maps, Latitude and longitude, Some words about the geographical names.

1.2. Planning, design and making of the website

During the design of the website the decision taken was to follow the structure of a Web portal, not only to present the map concepts but to complete them with other options that could make more interesting the site for pupils and teachers. The title of the website was “All about maps…” and the structure was determined as follows (Figure 1):

Figure 1. "All about maps…" website welcome page

- Summing up… (Previous works related to this theme)
- As you are learning and even more… (Presentation of basic map concepts)
- What can you find on the Web? (Links to websites related to Maps and Children)
- Try out! (Demos, examples, etc. that were found in other websites)
- News and events (Information about activities related to Cartography: organization of exhibitions, Barbara Petchenik Award, meetings, interests on TV programs, etc.)
- Not only for you … but for teachers too! (Open forum for the exchange of opinions and questions)
- Learn and play! (Tasks and games related to Cartography)
- Curiosities (Section including old maps, imaginary or fantasy maps, etc.)

The website was programmed using HTML language and some JavaScripts for specific solutions (e.g. opening a separated window to show a short animation). After testing it, the website was made accessible for Hungarian pupils and teachers from July 2001.

2. Update of the website from 2001 to 2011

During the last ten years, the structure and design of the website remained changeless, but it was periodically used to keep pupils and teachers informed about activities related to cartography; especially about the annual organization of GIS Days and the organization of the Barbara Petchenik World Map Award every two years.

Between 2004 and 2006 new websites were created to complete the content of the chapter dedicated to present basic concepts. This decision was taken considering the results of a survey filled by pupils of Elementary Schools that included a question about their preferred cartographic themes. Based on their answers the two most popular themes were the history of maps and the computer cartography. Three websites were made on these topics: Map History, GIS and Multimedia Cartography (including Thematic Cartography). Its structure and design was similar to the "All about maps…" website, to be inter-connected and to create a collection dedicated to cartographic themes for children and young people. The content of this collection was composed as shown below (Figure 2).

Figure 2. Examples of pages about Map History, GIS and Multimedia Cartography

Map History website (six chapters containing 39 themes):

1. Maps from the Ancient Age: Town Plan from Catal Hüyük, rock map from Bedolina, Mesopotamian world map from Nuzi, Mesopotamian town map of Nippur, Babilonian clay tablet, Turin Papyrus.
2. Hellas and Rome: Pythagoras and the spherical Earth, Aristotle and Dicaearchus, Eratosthenes, Ptolemy, Tabula Peutingeriana, the first T-O maps.
3. Early Middle Ages: Maps from the Middle Ages, monastery maps, climatic zone maps, the Islam Atlas, Al-Idrisi's works, portolan maps, Catalan atlas, translations of Ptolemy's works.
4. The Great Discoveries: Portuguese discoveries, Christopher Columbus, discovery of the New World, Cosa worldmap, Cantino worldmap, Waldseemüller and America, Piri Reis worldmap, Magellan and the circumnavigation of the Earth.

5. The first atlases: Mercator and Ortelius, Gerhard Mercator's works, Abraham Ortelius' works, Waghenaer's atlas.
6. The first Hungarian maps: the English Saxon map, Dulcert's portolan map, Cusanus and Fra Mauro, Lázár secretary's map of Hungary, details on the first Hungarian map, actual Hungarian limits on the Lázár's map, János Zsámboky.

GIS website (six chapters containing 35 themes):

1. About GIS history: What is GIS?, the first steps, analogue GIS, the beginnings of computer sciences, Canada Land Inventory, SYMAP soft-ware, ESRI & Intergraph, MapInfo & Autodesk, GIS Day.
2. GIS data: Vector data model, raster data model, layers on the maps, fundamentals of databases, geocoding, multimedia databases.
3. GIS data sources: Surveys, aerial photos, satellite photos, GPS, source maps, thematic databases.
4. GIS processes: data collection, data input, data analysis, data output.
5. Data analysis: Overlay, buffer, classification, fuzzy.
6. Graphic outputs: webmaps, 3D models, animations, Geography Network, Hungarian websites.

Multimedia in maps website (six chapters containing 35 themes):

1. Stories about data visualization: Catalan Atlas, John Graunt, William Playfair, Alexander von Humboldt, making the diagrams popular, Bertin and the graphic theory
2. The first thematic maps: Halley's map, Valentin Seaman, early geological maps, Humboldt and Berghaus, French influence, John Snow
3. Thematic maps today: Sciences on maps, drawing symbols, drawing areas, isolines, diagrams on maps, drawing with points, choroplets and cartograms, representation of movements
4. Traditional multimedia on maps: Before the multimedia of today, what is multimedia?, maps and multimedia, multimedia in atlases, the first animated maps
5. Digital multimedia on maps: Introduction, beginnings of digital multimedia, digital maps, digital multimedia atlases
6. Multimedia in webmaps: maps in the Web, interactivity in the Web based atlases, Geographic Network, learning with outline maps, settlements on Lázár's map, "All about maps…"

3. Creation of a new website

3.1. Theoretical research

After more than 10 years from the presentation of the original website, the time arrived to update the content if needed, and to modify the structure and design of the website, considering the development experimented by the Internet and in particular by the Web during this period of time. In October of 2010, the authors decided to begin the preliminary tasks to make these changes. First of all, we studied again the content related to Geography subjects in the Hungarian Educational System, paying special attention to the basic level (Elementary Schools). This analysis began with the reading of textbooks related to Geography to determine if there were any kind of significant changes during the last 10 years. It was completed with the study of some of the School Atlases used in the Elementary and Secondary Schools of Hungary to determine the basic cartographic concepts presented or at least mentioned in the introductory pages of these atlases (Table 1).

After 2000, the number of hours/week dedicated to the teaching of Geography subjects remained the same: 3 hours at basic level (Elementary Schools) and 4 hours at secondary level (Secondary and Vocational Schools). In grades 4 and 5, Hungarian pupils learn a subject entitled "Basics about Nature", combining knowledge mainly from Geography and Biology. The concepts related to cartography have not been modified considerably, but in numerous schools the teaching of these concepts has been moved to later grades in respect to our previous research in 1997–2000. The more detailed explanation of these concepts follows being presented in the textbooks written for the 5th grade ("Basics about Nature", see Table 2), but some regional curricula planned the teaching of them in grade 6.

After revising the themes presented in the original version of the website and comparing them with the content of textbooks and school atlases, we decided to use the same map concepts without any considerable change. Based on this decision, the structure of chapters remained the same and the detailed content of the website is as follows:

- Map and reality (7 themes: Earth and former worldviews, shape of the Earth, what can we find on a globe, from the globe to a plain: how to make a map?, what is a map?, what makes a map a map?, graphic scale)
- Orientation with and without maps (8 themes: How could a cave man orient?, the first compass, compasses in Europe, cardinal points, using compass, orienteering with the Sun, in the forest and at night)
- Map history (9 themes: the first maps, maps on rocks, on clay and papyrus, Greek scholars, Roman maps, maps of the Middle Ages, portolans, maps of Discoverers, Mercator and Ortelius, the first Hungarian map)
- What kind of maps are there? (4 themes: classification of maps according to their scale and content, thematic maps, city, road and topographic maps)
- Representation of relief (3 themes: basic shapes of relief, contour lines and hypsometry, shading)
- Rivers and lakes on maps (2 themes: how to draw rivers and lakes on a map?, special features related to hydrography)
- Other colours on maps (5 themes: colours on a political map, how to draw the frontiers and roads?, colours on a topographic map, colours on a thematic map, other topics represented on maps)

- Symbols on maps (3 themes: what kind of map symbols do you know?, symbols drawing hydrography and relief, symbols in the school atlases)
- Latitude and longitude (4 themes: geographic coordinate system, latitude, longitude, orientation on the globe)
- Some words about the geographical names (5 themes: what is a geographical name?, grammar of geographical names, using fonts and placing names on a map, hydrographical and relief names, the interest of a better map reading)

At same time, we also kept the themes explained in the websites dedicated to Map History, GIS and Multimedia maps, which were developed between 2004 and 2006.

Table 1

Basic concepts related to Cartography in Hungarian School Altases		
My First Atlas (Cartographia, 2008)	**School Atlas for 10–16 year-old pupils (Cartographia, 2008)**	**Secondary School Atlas (Cartographia, 2008)**
1. Our world Rotation and translation of Earth, planets of the Solar System, Moon, coordinate system, Sun's path in the sky, cardinal points. **2. Map symbols** Legend explaining symbols used in the atlas **3. From a sketch to a map** Illustrations: the school building, the classroom, panoramic view of the school, sketch of the school and classroom, aerial photography and map of the school and surroundings. **4. Basic geographical concepts (image, map, colour and symbol)** Plain and hurst, hill, mountain, valley, plateau, basin, island and peninsula, sea and bay, river, affluent and canal, delta and estuary. Representation of relief on a map (sea, depression, plain, hill, mountain) Landscape and map **5. Maps and scales** Panoramic view, tourist map (1 : 40 000), topographic map (1 : 100 000), maps at 1 : 550 000, 1 : 1 500 000 and 1 : 20 000 000	**1. Representation of relief on a map** Panoramic view, cross-sections, contour lines, hypsometry and relief shading **2. Comparison of maps at different scales** Fragments of maps at 1 : 25 000, 1 : 50 000, 1 : 100 000, 1 : 500 000, 1 : 1 250 000 and 1 : 20 000 000 **3. Satellite image** Image at 1 : 500 000, Budapest and surroundings **4. Map symbols** Legend explaining symbols used in the atlas **5. Cartographic projections** Cylindrical, conic and azimuthal projections **6. Basic astronomical concepts** Structure of the Universe, planets of the Solar System, the visible side of the Moon, solar and lunar eclipse, the Earth and the Moon orbit, Earth bound, the Sun's apparent motion, the Earth from the Moon. **7. Types of Hungarian settlements on maps at 1 : 30 000** One street settlements, chessboard-structured settlements, conglomeration, ircular-structured settlements,	**1. Representation of relief on a map** Perspective image, cross-sections, striping, contour lines, hypsometry and relief shading **2. Comparison of maps at different scales** Fragments of maps at 1 : 25 000, 1 : 50 000, 1 : 100 000, 1 : 500 000, 1 : 1 250 000 and 1 : 20 000 000 **3. Satellite image** Image at 1 : 500 000, Budapest and surroundings **4. Map symbols** Legend explaining symbols used in the atlas **5. Cartographic projections** Cylindrical, conic and azimuthal projections **6. Basic astronomical concepts** Structure of the Universe, planets of the Solar System, the visible side of the Moon, solar and lunar eclipse, the Earth and the Moon orbit, Earth bound, the Sun's apparent motion, the Earth from the Moon.

Basic concepts related to Cartography in Hungarian School Altases		
My First Atlas (Cartographia, 2008)	School Atlas for 10–16 year-old pupils (Cartographia, 2008)	Secondary School Atlas (Cartographia, 2008)
6. Orientation on a globe Satellite image, Earth globe and geographic coordinate system **7. Orientation in Nature** Determination of cardinal points **8. Representation of relief on a map** Methods of representation on maps: contour lines, hypsometry and relief shading **9. Satellite images** False colour satellite image of Budapest: explanation **10. Types of settlements** Cíty, town and farm in an aerial photo and on a map. **11. Physical and political maps** Hungary, Europe and Earth **12. Other thematic maps** Climate, soils, political, economic, nationalities, ethnographic	settlements connected by bridge, planned industrial settlements. **8. Tourist map at 1 : 40 000 (Danube Bend)** Legend **9. Other thematic maps** Climate, soils, political, economic, nationalities, ethnographic	**7. Types of Hungarian settlements on maps at 1 : 30 000** One street settlements, chessboard-structured settlements, conglomeration, circular-structured settlements, settlements connected by bridge, planned industrial settlements. **8. Maps of landscapes** Estuary, glacier and fjord, agglomeration, agricultural and industrial region on maps **9. Tourist map at 1 : 40 000 (Danube Bend)** Legend **11. Typical weather conditions in Europe** **12. Other thematic maps** Climate, soils, political, economic, nationalities, ethnographic

Table 2

Basics about Nature (Cartographic concepts in the textbook for 5th grade)			
Title of the chapter/ themes	National Publishing House (2002)	Mozaik Publishing House (2004)	Apáczai Publishing House (2004)
	Our important partner: the map (p. 104–122)	Orientation on maps (p. 34–50)	Orientation on maps and in Nature (p. 69–84)
1. Map definition	Simplification, reduction, faithful representation	top view, reduction, projection to a plane	Reduction, base plan, top view
2. Scale	Scale	Large and small scale	Scale
3. Graphic scale	Explanation about its use	Explanation about its use	Explanation about its use
4. Earth globe	The reduced image of the Earth	–	–
5. Orientation	Direction, distance, cardinal points, compass, its use and principle (magnetism), Sun based orientation	Cardinal points, compass, its use and principle (magnetism), orientation of a map, orientation with the North Star	Reference system and index of names. Orientation of a map. Kilometre grid. Principle and use of a compass (magnetism) Orientation with a watch.
6. Relief	Plains (Great Hungarian Plain), hills (valley, ridge) and mountains. Regions of Hungary. Contour lines and height values.	Plains (Great Hungarian Plain), hills (hilltop) and mountains (valley, basin, peak). Regions of Hungary. Contour lines and height values.	Plains (Great Hungarian Plain), plateau, hills and mountains. Contour lines and height values.

Basics about Nature (Cartographic concepts in the textbook for 5th grade)			
Title of the chapter/ themes	National Publishing House (2002)	Mozaik Publishing House (2004)	Apáczai Publishing House (2004)
	Our important partner: the map (p. 104–122)	**Orientation on maps (p. 34–50)**	**Orientation on maps and in Nature (p. 69–84)**
7. Colours on physical maps	Height values (blue, green, light and dark brown) Representation of hydrography (spring, brooklet, stream, creek, river, estuary, canal, affluent, flow, left and right riverside, lake and marsh)	Mountains: brown Hydrography: blue Representation of hydrography (creek, river, canal, affluent, flow, left and right riverside, lake, reservoir, sea, ocean, marsh). Depth values	Legend (blue, green, light and dark brown) Representation of Hydrography: river, lake, sea, ocean. Depth values
8. Types of maps	Political, physical, tourist, road, city, historical, military, meteorological, phyto- and zoogeographical map. Maps of population density and dialects	Map of provinces, political map, road map, city map, tourist map, thematic maps, atlases	Thematic maps, tourist maps and road maps
9. Map symbols	–	Country and province border, settlement symbol, roads and railroads. Mining (coal, lignite, petroleum, natural gas, iron ore, bauxite) Industry (heavy, light, food)	Legend, symbols of routes for excursionists
10. Map History	–	–	Stick maps, Egyptian map of gold mines, Eratosthenes, Ptolemy, Tabula Peutingeriana, T-O maps, discoveries, Mercator, Lázár secretary, János Zsámboky
11. Others	satellite, aerial photograph, computer	satellite image as illustration	Basic rules for excursions in Nature

3.2. Technological questions developing the website

After taking the decisions related to the structure of the new website, we faced another not less important question: which environment can be most appropriate to develop the site? Our first choice was to select PHP (Hypertext Pre-processor), which is a widely used general purpose scripting language suited for Web development and which can be inserted into HTML (HyperText Markup Lanuage) too. Searching for other possible options the use of a Content Management System (CMS) was considered a better choice, because this kind of environment facilitates the development of a website offering pre-programmed tools, whose use is easy to learn. The next question was: which CMS should be selected? At present, there is a big number (more than 100) of freely downloadable CMS in the Web: Wordpress, Drupal, Custom CMS, Joomla, Moodle, Typo3, e107, PHPX, PHP SiteManager, PHP SiteManager, etc. Our first condition was to choose a CMS with Hungarian support and the second one was the security that the CMS can offer, preventing our server from possible hacking attacks across the Web. Considering the different options in the market, our decision was to develop the new website in the CMS named Plone.

What is Plone? Why Plone?

Plone is an open source content management system (CMS), whose heart is the Zope (Z Object Publishing Environment) application server. Zope is an open source, object-oriented Web application server. A Zope website is usually composed of objects stored in a Zope Object Database (ZODB) and not by files in a traditional file tree system. Zope can be managed using an interactive built-in interface via a Web browser.

Plone was developed using Python and other programming languages (JavaScript, XML, CSS, etc.). It is multifunctional and can be used for the design of different Web content, e.g. blogs, Web shops, internal sites, etc. Platform-independent (available on Windows, Mac and Linux/Unix) and all its features are customizable, being easy to personalize a website using CSS (Cascading Style Sheets) and add-ons. At same time Plone is one of the fastest open-source CMS platforms on the market.

Plone has also a visual HTML editor and a “drag and drop” reordering and editing tool to create and update content. It supports the creation of backups to avoid data loss. The system has multilingual content management, portlet engine, graphical page editor and so many helpful features. Its use is totally free. These advantages were enough to choose this CMS.

Some noted users of Plone are the Federal Bureau of Investigation (FBI), Brazilian Government, Chicago History Museum, DISCOVER magazine, United Nations, European Environment Agency, NASA Science and Defending Children’s rights (Figure 3).

Figure 3. Other websites created with Plone

3.3. Changes in the structure of the website

The structure of the website had to be changed too, to adapt it to the conditions derived from the use of the Plone CSM. The title of each main part was abbreviated (shortened) and the menu points were also modified and reduced from eight to six (some of them were joined and others were put under new titles), to fit into the superior section of the website (Figure 4):

- Basic concepts (As you are learning and even more…) (Alapismeretek)
- Digital collections (Curiosities and Try out!) (Digitalis gyűjtemények)
- Games (Learn and play!) (Játékok)
- Events (News and events) (Rendezvények)
- Links (What can you find on the Web?) (Hivatkozások) – including previous works in Hungarian language
- News (News and events) (Hírek)

Figure 4. Welcome page of the new website

Asking the pupils about the handling of the website, we could conclude that short texts help to keep awake the children's and young people's interest in the content, re-affirming the principles followed during the development of the first website. However, pupils also remarked that the high number of short pages (almost hundred) causes difficulties to access a determined theme within a chapter. Considering this situation, we decided to introduce some changes in the organization of pages within the website, designing longer pages (one by each general theme) and placing more interactive fast links to the main headings (Figure 5).

Other important change made was the addition of a search tool, which is constantly accessible from the top of the website, to seek and locate information within the homepage. This is a useful tool asked very often by the user children in our meetings during the last years. Other, a most visual innovation was the graphic and dynamic (real-time) presentation of the number of visitors to the website, using an Earth globe and/or map designed and maintained across the www.revolvermaps.com website.

Figure 5. Some pages of the website

The online-glossary created in 2000 was also changed, adapting it to the new environment, but keeping the same content and assuring the fast access to the information when the user moves with the mouse over an unknown concept. The use of a glossary fills two aims:

- to explain concepts related to other sciences, concepts that children could not learn between 3rd and 6th grade of Elementary Schools (e.g. magnetite, used in the explanations related to the compass)
- to explain concepts presented in other themes, avoiding the links between different pages and themes, to keep the continuity of reading the actual page. E.g. Equator, a concept mentioned in the first theme ("Map and Reality"), but explained in more detail in the 9th theme ("Latitude and Longitude").

4. Future plans

4.1. Testing the grade of acceptation

Participants in the present project are interested to know the critics, suggestions, etc. from pupils and teachers. The more directly way of contacting us is across the website, sending their messages to our email addresses. We are also considering the option of creating at least two Web based questionnaires, one for pupils and other for teachers. These questionnaires will ask about the design (emphasizing this aspect in the questionnaire for children) and content (emphasizing this aspect in the questionnaire for teachers) of the website.

4.2. Versions in other languages

The Plone CSM includes a choice to make an automatic translation of the pages into other supported languages. The translation can be made using LinguaPlone, a tool that in March of 2009 supported more than 40 languages apart from English (French, German, Spanish, Italian, Portuguese and others).

The main difficulty of translating the original Hungarian text into other language is not the translation itself, but the correct interpretation of the text related to cartographic concepts. Other difficulty can be that children from various countries speaking the same language can use the same words with a different meaning or can name the same object using different substantives that have different meanings in each country. Specialists should also consider that a considerable percentage of the illustrations containing maps have to be substituted, because these figures were designed for Hungarian pupils after being selected from Hungarian School Atlases.

4.3. Connecting the website to social networking websites

Social networking websites play a very significant role in the more effective communication with the younger generations, which are growing living in a virtual community grouped within websites such as Facebook, Tagged, hi5, Hungarian Iwiw, etc. and websites offering social networking and microblogging services, like Twitter. Considering our interest to keep Hungarian pupils informed about the newest updates to the website, we are considering seriously to create profiles in Facebook and Twitter as “indispensable” tools to maintain young people informed.

4.4. Accessibility

The structure of the website created with Plone CSM lets us widen the content with new themes if needed and to keep the information updated in the server of the Department of Cartography and Geoinformatics (Eötvös Loránd University).

At next future, we plan to add more examples developed at the Department and more interactivity to the website, taking advantage of the choices offered by CSM as well as considering the suggestions to be made by Hungarian pupils and teachers in the interest of maintaining a website that increasingly meets their learning and teaching needs.

The project is supported by the European Union and co-financed by the European Social Fund (grant agreement no. TÁMOP 4.2.1/B-09/1/KMR-2010-0003).

References

Horváth, M. Molnár, L. Szentirmainé, B. M.: 2003. Természetismeret az 5. osztály és a 11 éves korosztály számára. Celldömölk (Hungary): Apáczai Publishing House.

Horváth, M. Molnár, L. Szentirmainé, B. M.: 2003. Természetismeret munkafüzet az 5. osztály és a 11 éves korosztály számára. Celldömölk (Hungary): Apáczai Publishing House.

Reyes, J. J.: 2002. Iskolások számára készített honlap a térképekről. Földrajzi Közlemények, Vol. CXXVI.(L.), number 1–4., p. 130–38.

Reyes, J. J.: 2006. A website about map history for Hungarian pupils. In: Proceedings of Digital Approaches to Cartographic Heritage. Thessaloniki, Greece 2006, p. 77–82.

Reyes, J. J.: 2006. GIS site for Hungarian pupils. In: Digital Proceedings of the First International Conference on Cartography & GIS. Borovets, Bulgaria 2006.

Reyes, J. J.: 2006. Multimedia Cartography for Hungarian pupils. In: Modern technologies, education and professional practice in Geodesy and related fields Proceedings. Sofia, Bulgaria 2006, p. 240–48.

Reyes, J. J.: 2002. Térképészeti alapismeretek bemutatása a weben. PhD. Hungary Eötvös Loránd University.

Tompáné, B. M.: 2002. Környezetismeret 4 (Élő és élettelen környezetem. Élet a ház körül. Környezetismeret tankönyv 10 éves tanulók részére). Celldömölk (Hungary): Pauz-Westermann Publishing House.

Plone CSM, 2011. [online] Available at: <http://plone.org/ > [Accessed 18 April 2011]

Maps for the Future:
Children, Education and Internet
Joint ICA Symposium

Internet and Cartography

INTERNET MAPPING EDUCATION: CURRICULUM TECHNOLOGY AND CREATIVITY

Rex G. Cammack
University of Nebraska, Omaha (USA)
rcammack@unomaha.edu

Introduction

In the process of educating students in the area of Internet mapping, faculty must choose systems and tools that work in tandem with their educational goals. The number of options for these types of education technologies is almost unlimited. How does one choose an environment that will provide education flexibility and comprehensiveness without having students change from one technology to another for each project? There are numerous ways to approach this question. This case study will go through the tasks of setting educational goals, implementation assessment, technology assessment, exercise plan and creativity possibilities. This approach is not deterministic in the sense that there is only one possible solution or even a solution that meets all the criteria. One of the goals for this research is to identify most of the specific issues in regards to educating students in the area of Internet mapping in the current environment. A second goal of the research its to look at the education technology in two ways. First is the whether the technology can provide a learning environment for specific learning of generic learning goals, while the second part examines the ability of the technology to foster creative ideas.

Education Goals

In the university education environment the term curriculum development and management is used. For many faculty members and program groups this concept is only a managerial task that must be done. Looking deeper in to this practice one learns that there are many facets to examine and consider. There are three-principle parts of curriculum to consider within the university environment:

- University Education Outcomes
- Programs Outcomes
- Course Outcomes

Most of the time faculty and teachers look solely at the latter of these outcomes because it's the one that has direct control over the time of the course. Faculty members develop a plan of study for the course that meets the needs of the course with little to no consideration of the other learning outcomes that the university and program need. The bottom up approach has been employed widely throughout universities and has served well for the most part. One of the reasons for this is that faculty members and course content can change rapidly. In the United States of America (USA) university systems, most courses have a curriculum structure found in a university catalog (University of Nebraska Omaha, 2010). These consist of a title, number of credit hours, a course description of around 80 words in length and prerequisites for the course. These course catalog entries can be used for years with no change or update. As a curriculum tool, it is evident that they are not all that effective yet this method is the primary direct contact with perspective students.

In this age of higher education there is a need to go beyond the current state of education delivery and focus on a new approach. One approach changes the concept of curriculum from static to a "living curriculum" (Bath, Smith, Stein, and Swann, 2004). In this context curriculum is seen as vibrating and changing, much like the changing world we live in. Bath, et al (2004) examine living curriculum in the Australian higher educational system. Not unlike the USA higher educational system, there is a debate on how to educate students for an ever-changing world. The focus of this debate is on program knowledge verses generic skills. Universities as a whole identify that the primary task is educating students to communicate, problem solve, analyze, integrate and think creatively. The argument is how to achieve this. One approach is to focus on these skills specifically and have all students master these generic skills in assignment courses (Havery 1993, Gash & Reardon, 1998 De La Harpe & Radloff, 2000). Others have argued that only through effective disciplinary education will students learn and apply these generic skills (Boyatzis, Cowen & Kolb, 1995, Kemp & Seagraves, 1995 Diamond 1998, and Drury and Taylor 1999). These two extremes in curriculum approaches have been bridged, but neither side seems to like the options (Gash & Reardon, 1998). Ideas like tacked-on afterthoughts, (Bowden et al. 200, Pearson & Brew 2002) and checklists are seen as failing to deliver acceptable educational outcomes.

The latter approach does have appeal at both at the program and course outcomes level. In a closely related context, the efforts by DiBiase, DeMers, Johnson, Kemp, Luck, Plewe and Wentz, (2007) to review and establish the merits of the Geographic Information Science and Technology Body of Knowledge (GIS & T BoK) (AAG, 2006) shows a exhaustive set of disciplinary skills that students should learn and master. These skills are closely related to web mapping and one might think that all of web mapping is covered in the GIS & T BoK. But as Dibiase, et al (2007 p. 119) say "that disruptive new technologies, innovative sciences, imaginative applications, and the dynamics of human and physical landscapes that give rise to the GIS&T field in the first place, will continue to drive changes".

In the field of Information Systems Gorgones et al. (2002) developed a comprehensive curriculum of undergraduate programs. The curriculum like the GIS & T BoK was a discipline outcome focused approach. This middle ground approach to curriculum development focuses on assessment of market demands for graduates. This special consideration for the need of the employment market does focus a program to continually update its educational system. However, one can argue that this approach will only develop time sensitive vocational skills and graduates will be ill prepared to handle changes in the work place.

Designing a course focused on web mapping technologies, how does the faculty member approach this education? Web mapping requires some very specific skill sets. By choosing a development environment, vocational training looms and universities are quick to say they are not vocational by nature in the USA. One approach is to use a wide variety of development environments. In this environment students are forced to learn not a system but a method of problem solving. Here the student must create a knowledge set that answers, "How do I do this in this new system?" An example would be to ask how do I declare a variable type? In every programming language declaring variables is a basic concept. So by switching environments multiple times within the course, students will develop a method for learning the next system. This problem-solving outcome fits nicely in all three learning outcomes. Yet this outcome result is extremely difficult to achieve. It takes a long time to develop this knowledge, even for professionals in the field for decades, and many times professionals really never develop this skill.

At the end of this process for developing educational goals, a pragmatic approach was selected. First a comprehensive look at university education outcomes was completed. The following outcomes were identified as follows:

- Critical Thinking
- Problem Solving
- Communication
- Diversity
- Cooperative Learning
- Team Building
- Social Values
- Creative Thinking and Expression

The second phase of learning outcomes looked at degree program goals. In this case study the University of Nebraska Omaha degree program in Geography was considered. This program consists of a Bachelors' of Arts and a Bachelors' of Science program. The course was designed to meet the needs of both disciplinary programs. These two program are similar in education outcomes goals but with variances in importance of the goals:

- Understanding of Physical Process
- Understanding of Human Behavior and Societal Variances
- Relationship Between Environment and Humans
- Analysis of Spatial Events
- Environmental/Human Landscapes
- Resources and Human Interaction
- Geospatial Representation and Analysis
- Regional Difference
- Social Acceptance
- Qualitative and Quantitative Spatial Methods

The course outcomes will be discussed in more detail later in the paper.

Implementation Assessment

The process of implementation assessment is difficult. At the level of university education outcomes, most choose a post hoc approach by looking at the success of students graduating from the university's programs. Issues like professional certification and accreditation are procedural methods of assessment. Additionally, universities will interview students nearing graduation to determine whether they are successfully finding employment. These methods are helpful, but most of the time does little to assess the generic skills for students. Bath, et al (2004) employed a survey approach that focused on students after a major change to a music degree program at the University of Queensland. The focus of the research was to examine the effectiveness of doing a complete review and change to music school programs that specifically combined the learning outcomes for the university and the discipline within each course. The results of the research showed that students from the updated program were doing better than other students at the university.

In this project a different approach was taken. A single class was used. The course was an advance Geographic Information Science course. The course outcomes where reassessed and more emphasis was placed on incorporating aspects of university and degree program goals. Some of the changes to the course were:

- Team Projects
- Alternative Demonstration of Work, i.e. Poster Presentations
- Quantitative Analysis
- Visualization (Conceptual and Numerical)
- Comparative Solutions

- Creative and Limited Guided Tasks
- Independent Problems
- Solution Integration
- Critical Self Evaluations

Many times the new tasks were assigned in a way that they covered several generic skills. Also, students did new assignments that were unique combinations of the learning outcomes. The goal was to have students doing these learning outcomes several times without directly focusing on them. The method of integrating several learning outcomes and repeating of reinforcement was questioned, but this was the approach chosen.

Technology Assessment

In this part of the project specific discipline skills were considered. The Advanced GIS course was reorganized around the core concept of Geographic Information Services. Nyerges and Jankowski (2010) explain that Geographic Information can be explained as a system, science or service. In a previous version of the course, aspects of advanced systems and science were the focus but changes in GIS in the last 5 years have lead to the development a professional need for the better understanding of information services. Within the redesign the focus was on these GIS skills:

- Spatial Data
- Spatial Data Services
- Implementation Issues for Services
- Topic Specific Geographic Services
- Service Design
- Service Deployment
- Services on a Network
- Services on the Internet
- Service Use
- Standard Clients for Service Use
- Custom Clients for Service Use
- Multiple Spatial Data Services
- End User Clients

The approach here was to select a combination of web mapping technology and development environments. Students would use these technologies and develop projects to showcase their understanding to these disciplinary skills. A second consideration was to have students use technologies that are common within the USA geospatial professional workplace. The basic design of web mapping services is shown in Figure 1. The basic element of a GI service starts with a network, most commonly the Internet. A server on the network hosts a GI service and clients or other services consume the data for the GI services. Within the server, any number of designs can be deployed, but the simple structure is that

GI server is hosted directly or through a web server. The GI server will store within or get from external devices the spatial data and/or spatial processing functionalities.

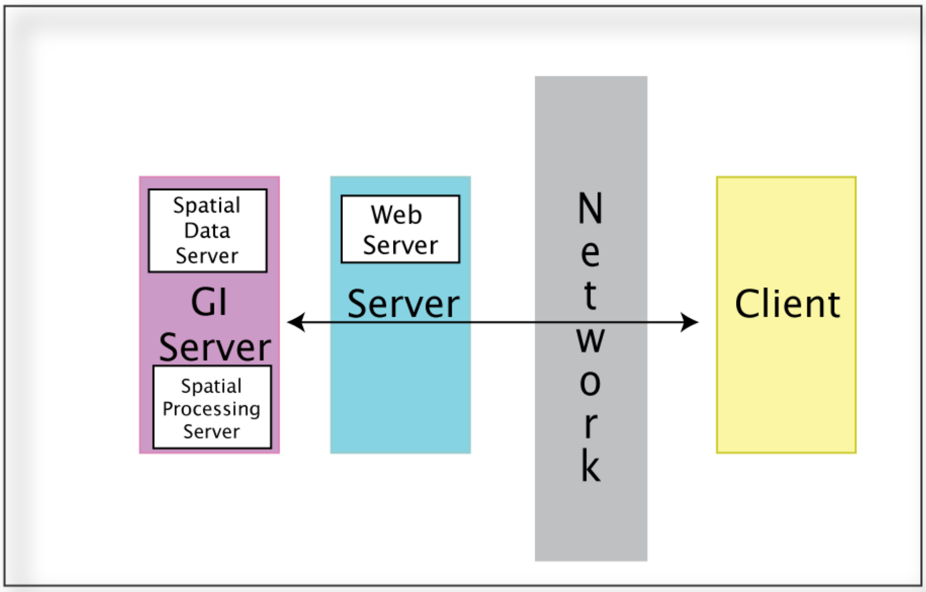


Figure 1: Conceptual Structure of Web Mapping Environment

In the course, issues like servers, networks, web servers, database services, and middleware were explained but the students did not work with them. The main focus for the students was on the building of the GI services and clients.

The GI server software used in the course was ArcGIS server 10.1 deployed on Microsoft Internet Information Web server with the DotNET framework. Students were asked to design both, services and web applications, using the ArcGIS Server application. For the more detailed client development for specific Internet mapping applications, students used the combination of Adobe FLEX 4 and Adobe Flash Builder 4. This development environment was selected for several reasons:

- Integrated Development Environment (IDE)
- FLEX Framework Functionality
- API for Google and ArcGIS Server
- Skinablility
- Modularity
- Multiple Platform Capabilities

Client development is the fastest growing part of Internet mapping. Mostly this is due to the availability of large GI servers open to anyone. Google GI servers host several different worldwide mapping databases such as Google Maps and Google Earth (Google 2011). With this type of service available, numerous mapping clients are developed either for wide user or focused users. One of the many aspects of developing client Internet mapping applications is the deployment environment. One of the major advantages for Adobe Flex environment is that it builds applications for the computer desktop and web applications that run within a web browser. These are two of the three main client deployment environments. The third environment is the mobile environment such as Android iOS. The mobile environment is the most complex and varied of these three. Mobile computer is the newest of the three, so there is still a large amount corporate maneuvering at the time of this research. In the future (such as the next time the course is taught) a reviewed implementation will need to be considered.

Exercise Plan

All the exercises in the course were designed to consider all three learning outcomes discussed so far within the research. This list of exercises for the course shows the wide differences in tasks student did within the course. At first glance the effect of the university and program outcomes are not apparent.

- Multi-Layered Environmental GI Service
- Multi-Server Demographic GI Service*
- Desktop Client for GI Service
- Desktop Client for Multiple GI Services*
- GI Service Standardization for Integrated Internet Mapping Website*
- Topic Based Client Web Application*
- Interactive Client Applicants
- Desktop Client Application for Corporate Task*
- Final Project Student Focused GI Services and Client Application
- Group Assignments

The course was divided into five-hour blocks each week of the 15-week semester. The first hour was devoted to lecture on core ideas and concepts. A second hour was devoted to technology issues regarding GI services and management. The third hour focused on the client development environment and the final two hours was laboratory time for students to work on their assignments.

With each assignment, students developed new disciplinary skills that they would use in following assignments. Skills in both, GI services and client development, progressed until the final project that students had created based on their own ideas. This final project is considered a demonstration of knowledge and could be used for a detailed analysis of the learning outcomes for the university, program and course. The topic of the assignments focused on program outcomes so while students worked to develop their systems, they had to understand and consider broader program issues.

Creative Possibilities

Generally the idea of creativity in higher education is identified with the fine and liberal arts disciplines of the university. Yet in Geography, creative expression with maps has long been understood. This creativity has led to some great maps and also some bad ones. Visual representation, as in writing, is not just a static concept but has a sense of expression that cannot be over looked. As each assignment was defined to the students, fewer and fewer details of the final look of the work were provided and students were asked to think not only of function but also form for their project. Design was given value within the assessment of projects and students with creative solutions were given opportunities to show them to the rest of the class and explain the ideas behind their creative solutions.

Conclusions

The process of assessing and re-designing a university course no longer can be done in the vacuum of an individual faculty member's interests and desires. Universities are integrating student learning across the programs and courses students take. The model of learning outcomes will have a greater influence on course structures and activities. Currently the model of learning outcomes suggests that the best outcomes are achieved by excellent course content and education that considers within its delivery, issues of program and university outcomes. In this case study an Advanced GIS course was re-designed with special consideration made to outcomes for both the university and program. The selection of education technologies led to the use of robust but a limited number of technologies. Students were asked to repeat aspects of GI services several times during the length of the course to reinforce concepts and to consider closely the effect of their decisions on the overall technology implementation and societal importance.

References

Bath, D., C. Smith, S. Stein, and R Swann: (2004) Beyond Mapping and Embedding Graduate Attributes: bringing together Quality Assurance and Action Learning to Create a Validated and Living Curriculum. Higher Education Research & Development 23(3) p. 313–328.

Bowden, J., G. Hart, B. King, K. Trigwell, and O. Watts: (2000) Generic Capabilities of ATM University Graduates: final report to DETYA. Melbourne Australian Technologies Network Teaching and Learning Committee.

Boyatzis, R. E., S, Cown and D. Kolb: (1995) Innovation in Profession Education. San Francisco: Jossey Bass.

De La Harpe, B. and A. Radloff: (2000) Supporting Generic Skill Development: Reflections on Providing Professional Development for Academic Staff. Paper presented at the International Lifelong Learning Conference, Yeppoon Australia.

Diamond, R.: (1998) Designing and Assessing Courses and Curricula. San Francisco: Jossey Bass.

Dibiase, D., M. DeMers, A. Johnson, K. Kemp, A. T. Luck, B. Plewe, E. Wentz: (2007) Introducing the First Edition of Geographic Information Science and Technology Body of Knowledge. Cartography and Geographic Information Science. 34(2) p. 114–120.

Drury, H. and C. Taylor: (1999) Providing the discipline Context for Skills Development: Report on the Production on an Interactive Video for Oral and Visual Communicaiton in the Biological Sciences. Paper presentated at the HERDSA Annual International Conference, Melbourne, Australia.

Gash, S. and D. F. Reardon: (1998) Personal Transferable Skills for the Modern Information Professional. Journal of Information Science, 14. p. 285–292.

Google (2011) Google Maps. http://maps.google.com

Gorgone, J., G. B. Davis, J. S. Valacich, H. Topi, and D. L. Feinstein: (2003) IS 2002 Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems. Communications of the Association for Information Systems: 11(1) p. 11–233.

Harvey, L.: (1993) Quality Assessment in Higher Education: The collected papers of the QHE Project. University of Central England: Qaulity in Higher Education.

Kemp, I. J. and L. Seagraves: (1995) Transferable Skills can Higher Education Deliver? Studies in Higher Education. 20 p. 315–328.

Pearson, M. and A. Brew: (2002) Research Training and Supervision Development. Studies in Higher Education. 27, p. 135–150.

Nyerges, T. L. and P. Jankowski: (2010) Regional and Urban GIS: A Decision Support Approach. New York: Guilford Press.

VISUALISATION OF GEOLOGICAL OBSERVATIONS ON WEB 2.0 BASED MAPS

Gáspár Albert[1], Gábor Csillag[1], László Fodor[1], László Zentai[2]
1 Geological Institute of Hungary
2 Department of Cartography and Geoinformatics, Eötvös Loránd University, Budapest (Hungary)

Abstract: The method of geological mapping has changed during the last decades and the collected data have been recently stored in the records of databases instead of handwritten notebooks. In the Geological Institute of Hungary, a special database structure was designed for primarily scientific purposes, but also for storing and classifying the geological observations according to their importance for geo-tourism. The relational database of the geological observations can be queried by different subjects and transcribed into KML files, which are useful for the dissemination of geological data via web 2.0 map applications like Google Earth.

Introduction

Before the digital era, the methods and main objectives of a geological description during mapping were worked out in details by several authors (e.g. Compton 1985, Barnes 1995). These methods were both restricted and unobstructed at the same time. Restrictions pre-defined those criteria that were indispensable for the understanding and for the localisation, but the details and lengths of the description were up-to the documenter.

Working out the requirements of a database, which would store the field observations, is usually problematic. The problems originate from the contradiction between the logic of the traditional documentation system and the uniform methods of the technical processing of the data. People, who want to use a common database, think differently, and the database would be usable for them only in the case the logic of the querying methods corresponds with their own logic.

Creators of geological databases worked out different methods to reduce the conflict between the two different logic (e.g. Laxton & Becken 1996, Brodaric 2004, Clegg et al. 2006, Dei & Gosh 2008). All of these contributors attempted to collect and store field observation data, however, the developed methods and the structure of the database were different, because the mapping conditions and the prorities were also different.

The field observations are the primary data that make the compilation of geological maps possible for the geologists. These observation data are mostly surveyed traditionally, with paper maps and hand-written notebooks (Figure 1), and stored in archives for the geological survey organizations. The techniques of the digital geological mapping (DGM) developed only during the latest decades. Although several author discussed the methodology and applications of DGM (e.g. Struik et al. 1991, Briner et al., 1999, Kramer 2000, Jones et al. 2004, McCaffrey et al. 2005), international standards still do not exist for this technology.

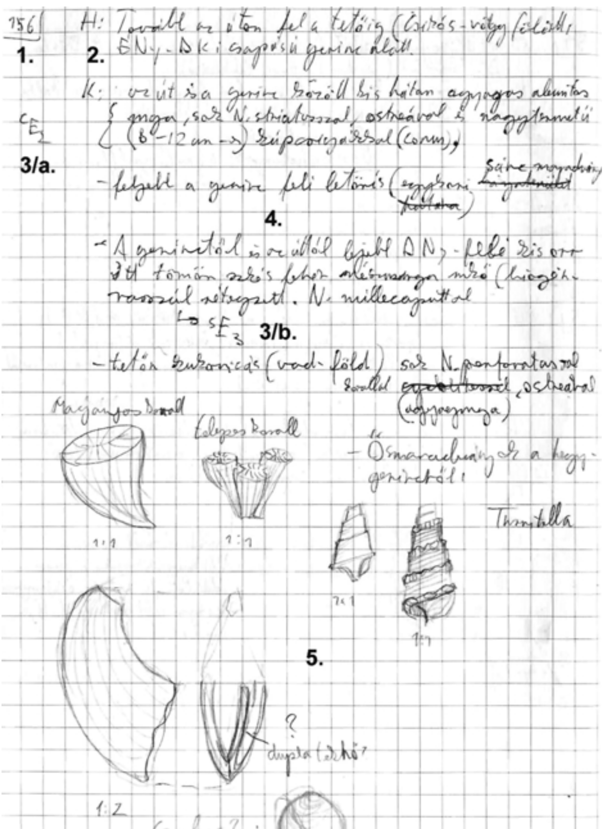


Figure 1. Hand-written geological observation. 1 = Number of the observation point; 2 = Description of the location; 3/a and 3/b = Geological indexes; 4 = Description of the geological formations; 5 = Drawings and list of fossils (after the notebook of G. Albert 2005)

Some of the observed sites have not only scientific, but also attractive value. It is obvious for the friends of the natural heritage of the world that many picturesque and visited landforms mostly have geological significance. For geo tourists, these spot-like points of interest are best known as geosites (synonym for geotops). Hungary is also full of geological curiosities. Well known geosites, like the Baradla Cave of the Aggtelek and the Slovak Karst, which was inscribed on the UNESCO World Heritage List in 1995 (WHC 1995), have wide publicity, but the minor sites are mostly unknown except for the geologist.

The Geological Institute of Hungary have been collecting the documentation of geological sites for more than 140 years. Although the number of documentations may exceed many thousands, only a few dozen of the documented outcrops would attract the attention of the geo tourists. These sites usually have both scientific and attractive value and thus deserve the name, “geotop”.

How can one access these observation data? It became obvious during the last decades that the most effective way of accessing the archives of the old manuscripts is the digitization of them. Therefore, the digitization of the manuscripts of the documentation was one of the aims of the authors’ work.

The selection of possible geotops from the swarm of data was another aim. The method that was worked out for these aims comprised two main phases: in the first phase the structure of a relational database was worked out, which would contain the archive documentation of the geological observations. In the second phase, the process of visualisation and dissemination of the selected outcrops was carried out.

Methods

The way of geological documentation in the field was worked out by generations of geologists. The following method can be considered as a novelty only because it represents a new data structure, which is suitable either for reconstructing and digitalizing archive data, or for processing new observations into a relational database. Furthermore, it is applicable for digital field instruments such as PDA (Personal Digital Assistant) or tablet PC.

The experimental application of this method was carried out during the current Regional Mapping Project of the Geological Institute of Hungary in the Gerecse Hills (Northern Central Hungary). The aim was to work out and “fine tune” the general data processing method and the data structure of the observations. It was a basic requirement that the data structure could be processed and queried, but the recorded data should be explanatory and not restricted by the recording methods. It was also necessary to prepare the data structure to receive data from handwritten manuscripts either as typed in as ASCII texts, or scanned as raster images. The data structure was designed to satisfy three functionalities:

1. Recording newly observed but “traditionally” documented data in a structured database (in office);
2. Rapid digitization of archive data (in office);
3. Recording new observations directly in the database (in the field).

The first approach of the data digitization in the Geological Institute of Hungary used the MS Office Applications in the 1990's. Technicians used Excel and Word for recording and typing the handwritten manuscripts into files. It became a routine; however, the data structure changed many times. The firstly created files, especially the Word documents often contained only the explanatory data and the formatting of the documents was not suitable for executing data-mining processes (Figure 2). Therefore, it was necessary to rearrange the data in these documents.

1. p_2^m
North from the church of Vértesszőlős village and from the entrance of the museum, freshwater limestone was exposed in the abandoned quarry. The famous fossil (dated to 350–500 y.b.p.) of the skull fragment of "Sam" the Neanderthal man was collected from here. The memorial plaque of the finder, László Vértes is placed on a 5 m high, and 20 x 10 m wide mound in the middle of the quarry yard. Here the limestone is lamellar, slightly curving, with a sequence of 1–10 cm thick beds on the upper 1.2 m (A). Below, 2 m massive bedded, poorly cemented limestone can be found with quite many cavernous plant stem imprints in it (B). The lamellar limestone is friable along the plains of the beds, but consistent and yellowy-brown inside. Bended secessions can also be found locally.
Age: Middle Pleistocene

Figure 2. Archive digital documentation of an observation from 1991 in MS Word format. The capital letters (A and B) indicate parts of a hand-drawn figure. Note that neither coordinates, nor dates were recorded in the digitized description.

Experience showed that the reshaping (Figure 3) was most effective when the data remained in the same form (in Excel sheet or in Word document) until they could be data-mined and reconstructed in a database. It was also reassuring for the technicians who could work in a familiar environ. To carry out the most effective data-mining, a series of Visual Basic macros was developed to be executed on MS Office documents. These macros had the following functionalities:

1. Searching for data in Word documents and exporting them into a database;
2. Searching for missing or corrupt data fields in the created database;
3. Decoding data-fields using uniform names;
4. Correcting mistyping in selected data-fields;
5. Exporting the selected attributes into XML files.

The result of the data-mining and processing was a database of the geological observations, which was stored in MS Access tables. The XML (Extensible Markup Language) files were created for data exchange purposes. The following section gives a detailed description of the re-shaped document structure, which can be considered as fields or collections (queries) of the final database.

ID:	**LAB3-AG051**
Geo Index:	dT3, pJ1
Observer:	Gáspár Albert
Date:	1 August 2002
Coordinate:	611568, 260336
Latitude:	47.68572222 N
Longitude:	18.53552778 E
Elevation:	263 m
Type of outcrop:	in situ
Importance:	high (Jurassic limestone and cave sediments)
Location:	Cliff on a small spur on the western slope, in the curve of the Masina Valley
Lithology:	The 3-5 m rock face consists of massive, thickly-bedded, mic-ritic, Upper Triassic Dachstein limestone with lopher-cycles (dT3). The general dip direction of the limestone is towards the Northeast. There is a plenty of dripstone fragments in the debris around the cliff. Thinly bedded, Lower Jurassic Pisznice lime-stone, with bul-bous bed surface, ammonites and crinoids (pJ1) can also be found in debris on the eastern slope of the valley. There are also many rock debris from the Jurassic “ammonitico rosso” facies.
Stratigraphy:	dT3|pJ1
Measurements:	285/25 bed (dT3)
Fossils:	ammonites, crinoids
Photos:	drawings in the notebook; 4321-25
Samples:	LAB3-AG051/1 (ammonite)
Notes:	The presence of dripstone debris suggests that there was once a cavern here, which may have collapsed. It is very likely that the Masina Valley was once the cave itself. The Jurassic rock debris may fell into the cave through a sinkhole, but it is also possible that the Jurassic limestone was in situ nearby or tec-tonically transported to the present location. Eocene gravels and debris were not observed.
Alias:	

Figure 3. General geological documentation of an outcrop in the Gerecse Hills (Northern Central Hungary) in the pre-defined MS Word format, which was designed to easily execute data-mining processes on it.

Database of the geological observations

The geologist, who is responsible for the documentation, uses numbers and letters to create a code for each registered outcrop during mapping. It is the way of documentation now and it was the same a hundred years ago. During these many years, the codes naturally change and one code may often occur repeatedly, thus in creating the new database it was a primary requirement to work out a unique and easily understandable naming method for the database entries.

The mapping is carried out at large scale (1 : 10 000) state topographic maps. The projection of these maps is the official Hungarian National Grid (EOV – Uniform National Projection) system, but the coordinates can be recorded or transformed into latitudes and longitudes on standard WGS84 datum.

The database is represented by several main, sub- and code tables (Figure 4). The main tables contain genuine data, like the observation points themselves, or the maps of the region concerned. Sub-tables contain details of the observations, like the measurements and photos taken, or the samples and fossils collected. The code tables store the repeatedly occurring data, such as the objects measured (e.g. fault plane), the names of the fossils, and the observers.

Each record in the "OBSERVATIONS" main data table is identified by a unique key in the "OP_ID" field, which links this table with other sub-tables in the database. It was considered that the database would be better understandable for the geologists, if the unique identifiers are designed to contain real names and numbers. These kinds of identifiers are called natural keys. To produce a natural key field, a 4-letter code of the documented area was put together with the monogram of the documenter and the number of the observation point (e.g.: LAB3-AG051 is the natural key for the 51st site of Gáspár Albert on the map, which is coded as LAB3). The area codes are also natural keys, since they are abbreviations of the name of the topographic maps. For example, the code LAB3 is the third sub-sheet of the map called "Lábatlan", named after a little village in the area.

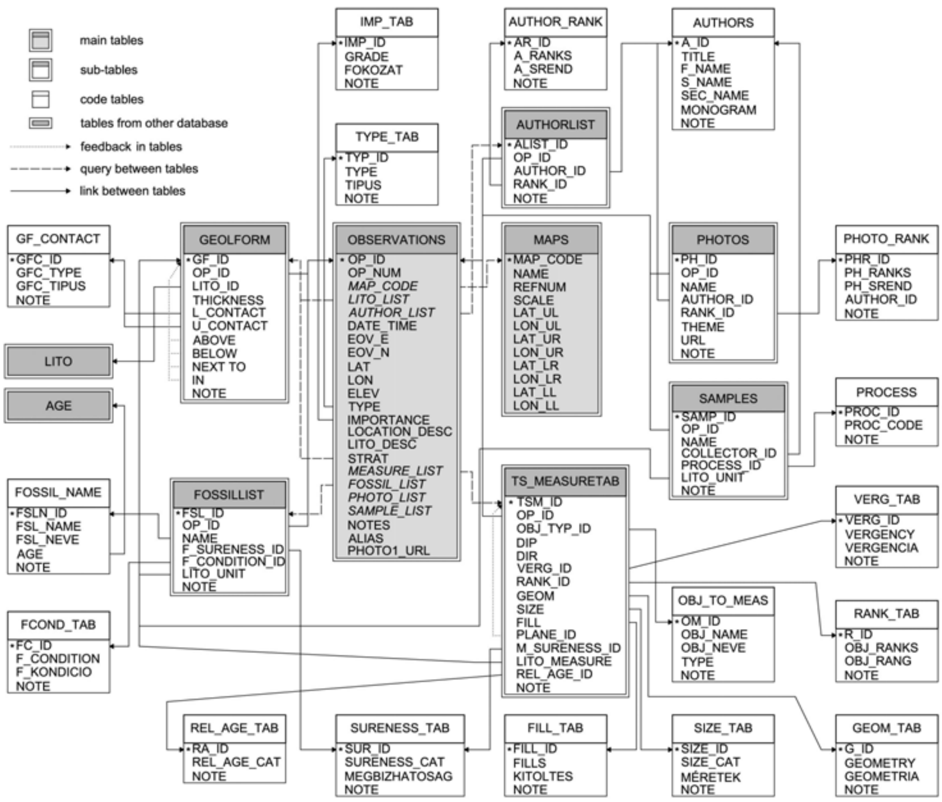


Figure 4. Structure of the relational database of the geological field observations. The code tables are bilingual (English and Hungarian), the language of the documentation is selectable. Field names in italics in the OBSERVATIONS main data table indicate that the data recording process may happen directly or through the linked sub-tables.

The rules of the documentation are strict. From the formatting of the identification numbers to the applicable characters in the string data of the geological descriptions, are all strictly defined. Without the restricting VBA (Visual Basic Applications) codes, hardly a few documenters would keep themselves to the formalities. These codes (macros) are built in the model Word document, and they also handle the link to the database.

The field documentation is slightly different, since these codes are not compatible with the mobile applications of the data recording device. Thus the data, which were recorded in the field, go through a syntax-controller program before the processing.

Data fields or categories?

If the data of the observation are collected in one form (Figure 3), each category represents one ore more records in the data tables. These forms are originally the Word documents themselves, created by the documenters, but the creation of these collections may work reversely if it is needed.

Creating the collections from the database is a question of querying the database. In a query, which produces the form of the Word document (Figure 3), the records are collected from the main or sub-tables of the relational database.

Both in the forward and in the reverse process, the categories are basically the followings:

1. Identification of the outcrop
2. List of the identified objects (with codes)
3. List of the documenters
4. Date and time of the documentation
5. Coordinates
6. Importance of the outcrop
7. Type of the outcrop
8. Location of the outcrop (with description)
9. Geological description of the observed formations
10. Stratigraphy and relation of the observed and identified objects
11. Measurements
12. Fossils
13. Photos
14. Samples
15. General notes
16. List of other documented outcrops from the same location or nearby

This categorized form is suitable for reviews and overviews of the observation, and represents a printer friendly form. Printed collections of the outcrops are often used in the fieldtrips and as appendices of written reports.

The categorization described above may reappear in visually enhanced form of the observed geological data, but in a visual representation of a query, only those data fields will be represented which have a value (Figure 5).

Archive documentations rather focus on the colour, the texture, and the type of the outcropping rock (e.g. Compton 1985, Barnes 1995). Although these characteristics are still important, field geologists have already worked out methods to classify sedimentological, tectonic, volcanological, etc. features in the field, which help to determine the genetics of the observed rock. These features can be recorded in the field both in DGM devices, and in traditional notebooks, but finally the data within the database will be stored in sub-tables.

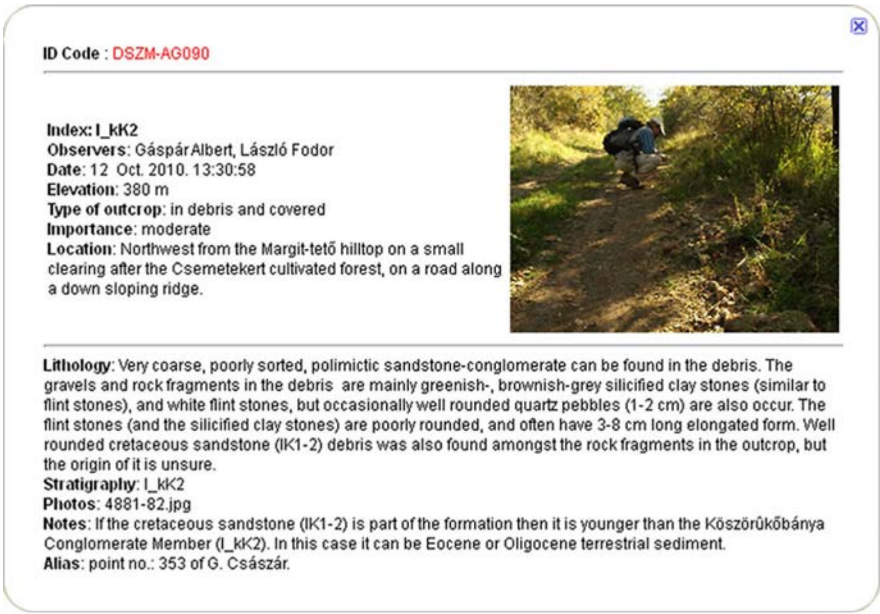


Figure 5. Visually enhanced representation of a geological observation as a Google Earth "bubble". The categories of the documentation were queried from the database of the observations and were transcribed into XML files.

Visualisation of the observed data on XML bases

The XML (Extensible Markup Language) was created to store documents in machine-readable form. It was developed by the W3C (World Wide Web Consortium) in 1998 from an ISO standard (SGML = Standard Generalized Markup Language) with the purpose to store and transfer data via Internet (ISO 8879: 1986, W3C XML: 1998). The structure of an XML file is defined in a schema document (XSD, or XMS), which, like an empty database, contains information about the data-fields and types. The KML files, officially named the OpenGIS® KML Encoding Standard, are also XML documents, but specialized for the description of geospatial data. Since both the XML and the KML are open standards, data collecting, processing and visualizing applications can be developed freely to imply these data structures. The KML is maintained by the Open Geospatial Consortium Inc. (OGC 2008), and was improved several times since its first publication. The KML standard became widespread along the expansion of Google Maps and Google Earth.

The structure and the content of the geological observation database were translated into KML files to create Google Earth compatible selections of specific outcrops. In the process, the "ogckml22.xsd" XML schema file was used. The criteria of the selection varied according to the purpose of the visualisation. Basically, the following criteria were used:

1. Outcrops of public interest
2. Outcrops of a specific area
3. Outcrops documented by a specific person

The first category was restricted to those outcrops which had high importance. Some of the KML files were used by the geologists of the Regional Mapping Project, some of them were published on the Internet to disseminate the geological knowledge (Albert and Csillag 2010).

Besides a wide range of documents, the KML format can also describe georeferenced images, spatial vectors, polygons and shapes. This allows one to transcribe maps in raster or vector file format into KML files. It is especially useful if the user interface – preferably a free software package for visual representation of the data – works with this kind of file structure. Thus, the documented geological data might be visualized together with the photos and geological maps (Figure 6).

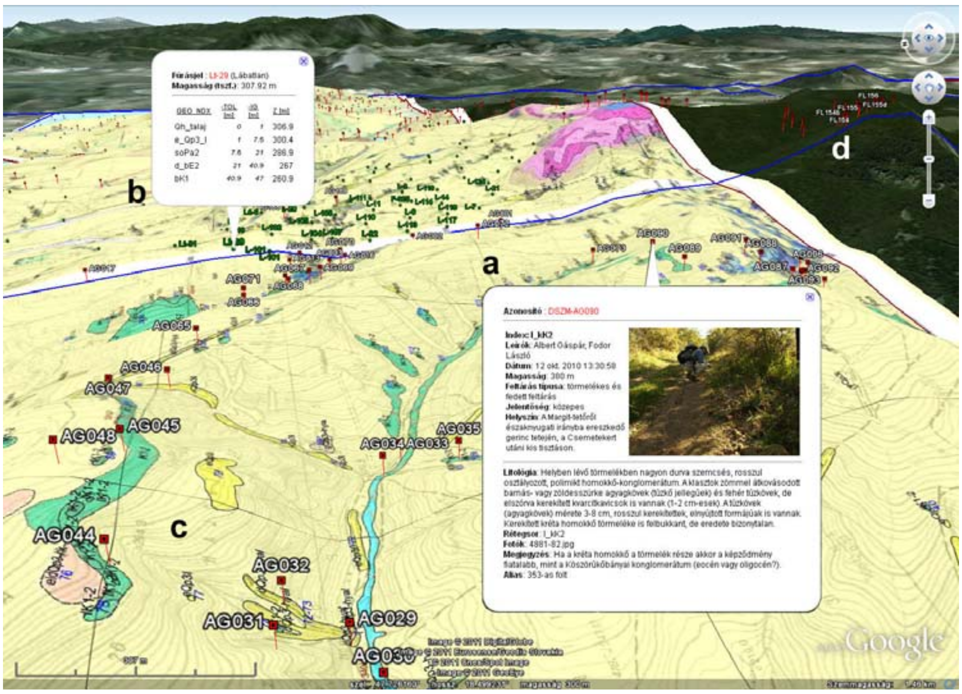


Figure 6. Screenshot montage of the GE interface showing: a) the data and photo of an observation point (lower right), b) a borehole log from the borehole database (upper left), c) a geological map draped on the DTM, and d) the boundary of the mapping areas (blue lines). These data together enable one to easily overview the spatial relations between the geological formations.

The transcription of the geological maps of selected regions was carried out with the Global Mapper 10 software. For the user interface the Google Earth 5.2 (GE) freely downloadable software was applied (Google Earth 2010), but any GIS software, which is capable to read the KML format, is suitable for this purpose. The free tool was selected for the visualization, because an unlimited number of users can access the files after creation and interpretation of the data-packages. Furthermore, the visual representation of the geological data in GE is enhanced with built-in background of satellite images, digital terrain models and a wide range of arbitrarily selectable themes. The following maps were displayed for geo-scientific purpose along with the observational database:

- Geological maps covered and uncovered by Quaternary sediments
- Geochemical maps
- Topographic maps
- Geophysical (e.g.: Bouguer anomaly) maps
- Geological maps for tourists
- Hydro-geological maps

The geo-scientific approach of the visualization of geological data brings up the necessity to visualize not only the observations, but, for example, the boreholes in a given area too (Figure 6). The borehole database as well as the observation database can be transcribed in KML format. For the querying of a database, different from the observations, a Visual Basic script was programmed. With the help of the script, the transcription of the query in KML files was carried out automatically from the selection of data fields, and the data were visualized ergonomically in the GE interface.

Results

The advantages of a relational database and the freedom of a traditional handwritten documentation were combined in the newly developed documentation system. This duality is represented in the authors' documentation methods, and in the structure of the database.

The number of photographs of an observed site has rapidly increased since the times of digital photography. These photos themselves formed quite large digital data, which were necessary to categorize and store in some kind of database. The expansion of the GPS usage in the field also led to the creation of sets of data. Although the created database structure follows the logic of the field notes, both the usage of the digital photography and the GPS represent such a technical background that is suitable for a connection between these data.

The method of the dissemination of the collected geological knowledge was the other achievement besides the construction of the geological database.

The increasing attempt to elongate the season for tourism was one of the main reasons for the development of the geo-tourism. Visiting geological outcrops practically needs only good weather conditions, and except for those latitudes where snow covers the geological formations in winter, any season would be suitable for this purpose. The establishment of new national parks and nature reserves and their widening profile give new challenges for the geoscientist, because the natural heritage in the concerned regions consists not only of the flora and fauna, but the geological background as well.

A national survey of geosciences has to deal with this new challenge and find ways to disseminate useful knowledge of the geologically interesting and scenic locations. These geosites may be located on already preserved lands, but often they are not. Abandoned quarries, collapsed caves on a construction site, or picturesque landforms in private forests are often the subjects of such curiosity. Some of them may be preserved only as memories, because the quarry would be recultivated, and the cave would be buried or covered on the construction site. These memories are the documentations and photos taken by the geologists.

The new database structure made it possible to classify the geological objects according to their significance whether they were recorded newly or data-mined from decades-old archives. The applied method for the visualisation made it possible to put selected sites (geosites) and maps on the Internet for public use. These two achievements are just a small part of the work, which needs to be done.

The legislation of the natural heritage is usually different in each country, but the non-living part of our natural environ is considered a subject of protection only recently even in the environmentally aware countries. On the long run, it is inevitable for the geological surveys to mark the reference locations of all known geologically interesting landforms and to select those that need legal protection to be preserved.

Discussion

Before and partly parallel to the development of the geological database and documenting system, some previous methods were applied and tried in various geological mapping projects. These methods were developed mainly by programmers, and the aim of the documentation was different. With the collaboration of the Geological Institute of Hungary, a research project was initiated. Exploration wells were drilled in order to find a safe location for the low and intermediate level radioactive wastes in Hungary (Balla 2003). For the on-site borehole documentation, handheld PDA and an XML-based data collecting application was used in this project (Gyalog et al. 2004).

Although at that time the XML format was quite modern, the database structure was rigid, and when the documentation was over, the data were not easily accessible for the geologists. Much of the effort spent on the input of the observed data was futile. On the other hand, a quite usable, user interface was developed to query the borehole data in an Internet browser (Gyalog et al. 2005). This interface was designed to query only a thin segment of the overall database, but this part – a simplified stratigraphic column of each well – was the most significant in some way (e.g.: enabled the correlation between the borehole data and the medium scale geological maps).

Despite the deficiencies of the results, it was an important step to apply and try preliminary documentation systems and user interfaces. It is futile to believe that a database structure for “all use” can be created. The database can be considered perfect when the stored data can be accessed easily and there are no redundancies in it. The users of a geological database also vary. Basin modellers search for the lithological data, while the palaeontologists are interested in the fossils.

The nature of the geological field observation is quite unique. The range of observation is usually limited because of time, weather and terrain conditions. The details of the described geological formations are limited to the eye and loupe range, and the number of collected samples is often limited by the physical condition of the collector.

The edification in the previous borehole documentation and querying system was that the documenters should not spend their time picking data from pre-defined lists and fill data fields which are not or hardly accessible later. The time consuming on-site documentation will lead to the simplification of the geological description, and thus to a decreasing scientific value. The pre-defined – often very long – drop-down lists on a data recording interface can also lead to the same result.

The digital representation of the database is usually only a question of the GIS background. If the financial conditions allow it, one can use several kinds of software, which not only create and manage, but also properly visualize the database background and the thematic maps of a region. However, this kind of complex GIS functionality is quite expensive and usually only a limited number of licences are affordable for a geological survey. The visualization of data on the web 2.0 using free licensed software solves the problem of the licence limitation and makes it possible to publish geological information freely and properly.

Publications of point-of-interests, satellite images and maps draped on a 3D surface serve as useful tools to disseminate scientific knowledge amongst those, who are interested, but not specialized in geology. The authors' experience shows that the map applications of the web 2.0 are useful tools for geoscientists as well.

Acknowledgements

The authors thankfully appreciate the efforts of the documenters who took care of using the prototypes of the database, and occasionally made suggestions and gave advice. An ergonomic documentation system and a well-structured database serve the benefit of not only the geologists of the Geological Institute of Hungary. On the long run, the base application can be widely used amongst the Hungarian and maybe the foreign earth scientists too.

References

Albert, G., Csillag, G.: 2010. Földtani tartalomszolgáltatás web 2.0 alapokon (Geological knowledge service on web 2.0 base – Fest of the Hungarian Science without boundaries – Protection, research and display of the geological heritage, (conference) 11. November 2010. Hungarian Academy of Sciences, Budapest.

Balla, Z.: 2004. General characteristics of the Bátaapáti (Üveghuta) Site (South-western Hungary – Annual Report of the Geological Institute of Hungary (2003), p. 73–91.

Barnes, J. W.: 1995. Basic Geological Mapping, 3rd Edition. Wiley, Toronto, 133 p.

Briner, A.P., Kronenberg, H., Mazurek, M., Horn, H., Engi, M., Peters, T.: 1999 FieldBook and GeoDatabase – tools for field data acquisition and analysis. – Computers & Geosciences 25 (1999), p. 1101–1111.

Brodaric, B.: 2004. The design of GSC Fieldlog: ontology-based software for computer aided geological mapping, – Computers & Geosciences, Vol. 30 (2004), p. 5–20.

Clegg, P., Bruciatelli, L., Domingos, F., Jones, R.R., De Donatis, M., Wilson, R. W.: 2006. Digital geological mapping with tablet PC and PDA: A comparison – Computers & Geosciences, Volume 32, Issue 10, December 2006, Pages 1682-1698.

Compton, R.R.: 1985. Geology in the Field. – Wiley, New York, 398 p.

Dey, S., Ghosh, P.: 2008. GRDM–A digital field-mapping tool for management and analysis of field geological data Computers & Geosciences, Volume 34, Issue 5, May 2008, Pages 464–478.

Google Earth 2010: version 5.2.1.1588: http://www.google.com/earth/index.html [accessed: 1st of September 2010].

Gyalog, L., Havas, G., Maigut, V., Maros, Gy., Szebényi, G.: 2004. Geological-tectonic documentation in the Bátaapáti (Üveghuta) Site – Annual Report of the Geological Institute of Hungary (2003), p. 171–201.

Gyalog, L., Orosz, L., Sipos, A., Turczi, G.: 2005. The uniform legend system, the borehole database and the web-based query tool of them in the Geological Institute of Hungary (in Hungarian, with translated abstract, and figures) – Annual Report of the Geological Institute of Hungary (2004), p. 109–125.

ISO 8879. 1986: Information processing – Text and office systems – Standard Generalized Markup Language (SGML) http://www.iso.org/iso/catalogue_detail.htm?csnumber=16387 [accessed: 4. May 2011].

Jones, R. R., McCaffrey, K. J. W., Wilson, R. W., Holdsworth, R. E.: 2004. Digital field acquisition: towards increased quantification of uncertainty during geological mapping. – In: Curtis, A. and Wood, R. Editors: Geological Prior Information vol. 239, – Geological Society of London, Special Publication (2004), p. 43–56.

Kramer, J. H.: 2000. Digital mapping systems for field data. In: Soller, D. R. (Ed.), Digital Mapping Techniques ’00 – Workshop Proceedings. U. S. Geological Survey Open-File Report 00-325, p. 13–19, http://pubs.usgs.gov/openfile/of00-325/kramer.html [accessed 2. May 2011].

Laxton J. L. and Becken K.: 1996. The design and implementation of a spatial database for the production of geological maps. – Computers & Geosciences 22 7 (1996), p. 213–225.

McCaffrey, K. J. W., Jones, R.R., Holdsworth, R.E., Wilson, R.W., Clegg, P., Imber, J., Holliman N., Trinks, I.: 2005 Unlocking the spatial dimension: digital technologies and the future of geoscience fieldwork – Journal of the Geological Society, London 162 (2005), p. 927–938.

OGC 2008: XML Schema Document for OGC KML version 2.2 http://schemas.opengis.net/kml/2.2.0/ogckml22.xsd [accessed: 4. May 2011].

Struik, L.C., Atrens, A., Haynes, A.: 1991. Handheld computer as a field notebook, and its integration with the Ontario Geological Survey's "Fieldlog" Program. – In: Current Research, Part A, Cordillera and Pacific Margin. – Geological Survey of Canada, Paper No. 91-01A, p. 279–284.

W3C XML 1998, orld Wide Web Consortium – XML Technology http://www.w3.org/standards/xml/ [accessed: 4. May 2011].

WHC 1995, UNESCO World Heritage Convention, Caves of Aggtelek Karst and Slovak Karst – http://whc.unesco.org/en/list/725 [accessed: 4. May 2011].

COMPARISON OF SPATIAL KNOWLEDGE ACQUISITION IN THE CONTEXT OF GPS-BASED PEDESTRIAN NAVIGATION

Georg Gartner, Haosheng Huang, Manuela Schmidt
Institute of Geoinformation and Cartography
Vienna University of Technology (Austria)
{georg.gartner, haosheng.huang, manuela.schmidt}@tuwien.ac.at

Abstract: This paper investigates the differences of spatial knowledge acquisition when using different presentation forms in the context of GPS-based pedestrian navigation. The acquisition of spatial knowledge based on mobile map, augmented reality (AR), and language (verbal instruction) is analyzed and compared in an empirical test in the city center of Salzburg (Austria). This paper presents the methodology and interprets the results. It is proposed that the results will give some hints for future mobile navigation system development, which might need to consider not only effectively assisting users' navigation tasks, but also how these systems affect users' spatial knowledge acquisition.

1. Introduction

Recent years have witnessed rapid advances in mobile pedestrian navigation sysems, which aim at effectively assisting pedestrians' wayfinding tasks in an unfamiliar environment. Different presentation forms can be used to commucate/convey route information (directions) to pedestrians, such as maps, verbal instruction, and images. Recently, augmented reality (AR), which enhances the real environment (e.g., via camera view) with registered virtual information overlays, is considered as another promising approach for conveying route information.

Spatial knowledge acquisition is needed to build mental representations that can be referred for wayfinding and other spatial tasks. Three levels of spatial knowledge can be distinguished (Siegel and White, 1975): 1. landmark knowledge comprises salient points of reference in the environment, 2. route knowledge puts landmarks into sequence (e.g., navigation paths), and 3. survey or configurational knowledge allows people to locate landmarks and routes within a general frame of reference. With sufficient spatial knowledge about an environment, especially survey knowledge, people can still find their way when navigation systems fail. Currently, more and more people are using pedestrian navigation systems. As a result, it is important to investigate how these systems affect the acquisition of spatial knowledge.

There is some research focusing on empirically studying the acquisition of spatial knowledge in the context of pedestrian navigation. Gartner and Hiller (2009) investigated maps with different display sizes, and showed that display size influences spatial knowledge acquisition during navigation. Ortag (2005) studied the differences of spatial knowledge acquisition with map and language when guiding wayfinders. Krüger et al. (2004) compared the impact of different modalities (i.e. audio and graphics, specially, images indicating route directions) on spatial knowledge acquisition during navigating in a zoo, and concluded that the acquisition of route knowledge is much better than that of survey knowledge. In Aslan et al. (2006), the differences in acquiring spatial knowledge with and without technology (i.e. mobile maps vs. paper maps) were studied. It is important to note that most of the above studies employ the "Wizard of Oz" prototyping (Wikipedia, 2011) (e.g. without using the GPS). Ishikawa et al. (2008) compared the acquisition of spatial knowledge with GPS-based systems, paper maps and direct experience of routes, and showed a poorer performance of subjects using GPS-based system.

The goal of this paper is to empirically study the differences in spatial knowledge acquisition with different presentation forms, comparing mobile maps, AR, and language (verbal instruction) in the context of GPS-based pedestrian navigaion. This research is part of the ways2navigate project, which is a cooperated project of Vienna University of Technology, Salzburg Research and another 3 institutes. It investigates the suitability of language and AR based navigation concepts in comparison to mobile maps for conveying navigation and route information to pedestrians. Three iterative field tests are planned in the ways2navigate project. For each field test, we are interested in the questions of how these technologies can help to reduce cognitive load during wayfinding, and how these technologies influence the acquisition of spatial knowledge. This paper will report the methodology and results of the first experiment, with a focus on comparison of spatial knowledge acquisition with these different presentation forms.

2. Methodology

A route in the city centre of Salzburg (Austria) was selected for our empirical test (Figure 1). The route was divided into three sub-routes, each with a number of way-points (decision points). The test was performed with 24 subjects of different backgrounds and different experiences with navigation systems (13 female and 11 male, age range 22–63, mean age 40). They were also divided into three groups. We used within subject design, i.e. for each sub-route, these three groups each used one of the presentation forms (mobile map, AR, and language). When they reached the next sub-route, they switched to another presentation forms. The whole test can be completed within 2 hours.

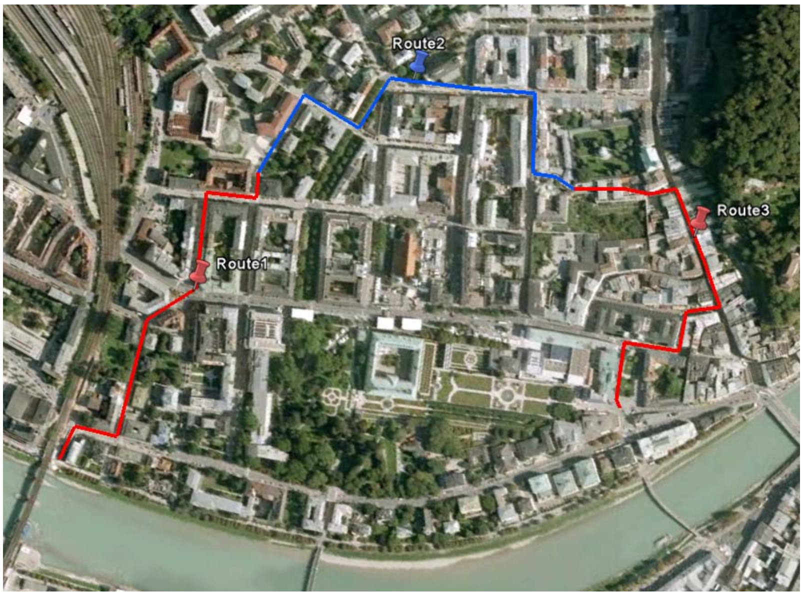


Figure 1. The three sub-routes in Salzburg (Austria)

The three presentation forms were carefully implemented and deployed on GPS-enabled mobile devices. The map application is based on OpenStreetMap, and the calculated route is highlighted and overlaid in the map view. The map center is continually updated when the position changes. The language application implements the results of our previous project SemWay (Rehrl et al., 2009). Landmarks and semantic information are enriched in route instructions. The AR application overlays route directions on the camera view.

At the beginning of every test, the test conditions were explained. During their navigation, subjects were observed by the instructor, and their movement and interaction with the navigation system were recorded by a logger. When reaching the end of each sub-route, subjects were asked to solve some tasks and answer some questions:

- Pointing task: to give an approximate direction to the starting point. It is measured in angle via a digital compass on mobile phones
- Sketching map: to draw a sketch map of the area they just passed as precisely as possible. Subjects were asked to focus on the route and landmarks when drawing the map.
- Marking task: To mark the half of the route on the sketched map
- Familiarity with the sub-route

3. Results and discussion

The field experiment was completed on Nov. 2010. The results were analyzed by focusing on sense of direction (the pointing task), sketch maps (focusing on topological aspects: sketched landmarks, errors in sketching turns [missing/wrong/ unnecessary turns]), and sense of distance (marking half of the route). We only considered the results from subjects who are unfamiliar with the sub-routes. In total, we got 24 subject/sub-route pairs (8 for mobile map, 8 for language, and 8 for AR). In the following, we present and discuss the results.

3.1. Sketched landmarks

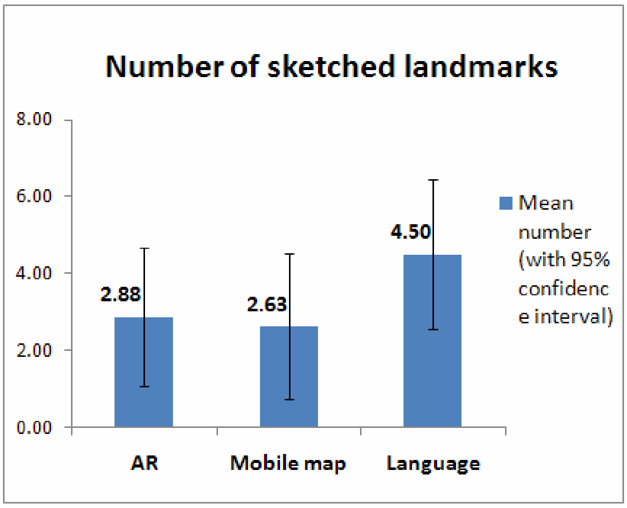


Figure 2. How the number of sketched landmarks differs among using different technologies

Figure 2 shows that subjects with the “language” application drew more landmarks in their sketch map compared to subjects using “AR” and “mobile map”. We also found that 78% of the landmarks sketched by subjects using “language” are mentioned/included in the verbal wayfinding instruction.

The reason why subjects using “mobile map” and “AR” drew fewer landmarks may be that for both applications, landmarks are not explicitly highlighted (for “mobile map”, landmarks are displayed in the background map, while for “AR”, landmark information are not visualized). For the “language” application, landmarks are explicitly included in the wayfinding instruction.

We also did an ANOVA (ANalysis Of VAriance) test. According to the test, there is no significant difference in number of sketched landmarks across different conditions ($F(2,21) = 1.63$, $p = 0.22$).

3.2. Errors in sketching turns (missing/wrong turns in sketch map)

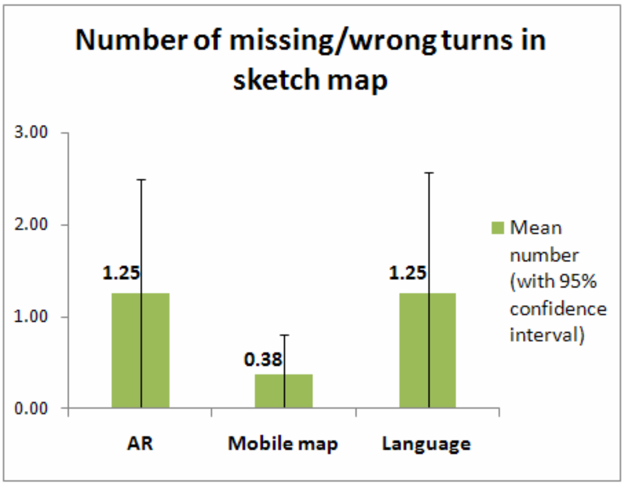


Figure 3. How the number of missing/wrong turns differs among different technologies

The results in Figure 3 show that subjects using "mobile map" made considerably fewer errors in sketching turns compared to subjects using "AR" and "language". This is consistent with our expectation: in the "AR" and "language" application, turns are not conveyed/presented in a spatial-related overview context. As a result, subjects using "AR" and "language" would make more errors in sketching turns.

However, according to the ANOVA test, the difference among these presentation forms is not significant ($F[2,21] = 1.60$, $p = 0.31$).

3.3. Sense of distance (marking the half of the sub-route)

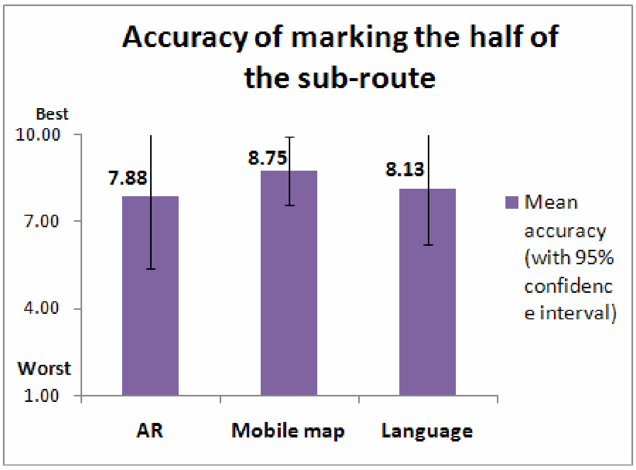


Figure 4. How the sense of distance differs among different technologies

Figure 4 shows that subjects using "mobile map" performed better in marking the half of the sub-route compared to subjects using "AR" and "language". However, the differences among them are not significant as our expectation. An explanation may be that subjects using "mobile map" did not make full use of the "mobile map" application (e.g. they seldom used the "overview map" function and the zooming function). As a result, for all presentation forms, the knowledge about sense of distance is mainly gained from sensual perception of the real world (without the acquisition of spatial knowledge from presentation forms, such as mobile map).

The ANOVA test also shows that the difference among these presentation forms is not significant ($F[2,21] = 0.3$, $p = 0.74$).

3.4. Sense of direction (Pointing to the starting point)

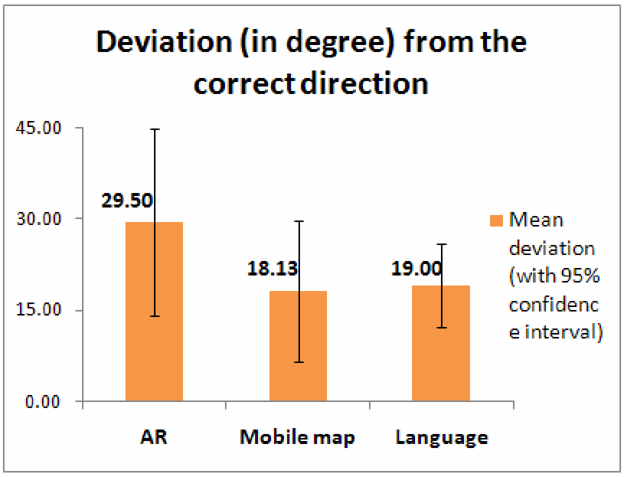


Figure 5. How the sense of direction (Pointing to the starting point) differs among different technologies

The results in Figure 5 show that subjects using "mobile map" and "language" peformed considerably better in marking the half of the sub-route compared to subjects using "AR". The results for "AR" are not surprising, because the "AR" application suffers from the poor GPS signal (compared to "mobile map" and "language") and poor compass accuracy, and thus brings some confusion to the subjects. However, subjects using "mobile map" did not perform considerably better than subjects using "language", which is inconsistent with our expectation. A possible explanation is that subjects using "mobile map" did not make full use of the "mobile map" application (e.g. they seldom used the "overview map" function and the zooming function).

It is also important to note that according to the ANOVA test, the difference among these presentation forms is not significant ($F[2,21] = 1.23$, $p = 0.23$).

4. Summary, limitations and work in progress

In summary, the results of the experiment confirm our hypothesis that: in the context of GPS-based pedestrian navigation, among different presentation forms (mobile map, language (verbal instruction), and AR), using presentation form “mobile map” leads to more accuracy in pointing the starting point (sense of direction), more accuracy in sketching turns, and more accuracy in marking the half of the route (sense of distance). However, it is important to note that no significant differences are found for the above aspects.

As landmarks are not explicitly highlighted in both the “mobile map” and “AR” applications, the results for sketched landmarks cannot really be used to prove/disprove the hypothesis on the aspect of sketched landmarks. More investigation on this aspect will be carefully investigated in the second field experiment. The following limitations about the above results have to be noted:

1. In total, only 24 subject/sub-route pairs are labeled as “unfamiliar”.
2. For most of the subjects, their marks of the half were somehow consistent with the half of the route in their sketch map. Thus, the sense of distance may not be accurately measured by their marks.
3. A digital compass on mobile phones is used to measure the pointed directions in the pointing task. Its accuracy is often affected by some other devices.
4. The use of sketch map to measure spatial knowledge acquisition is based on the assumption that people can draw more accurate sketch map when they have better spatial knowledge acquisition. However, sometimes this may be problematic.

Currently, we are improving the applications (“mobile map”, “language” and “AR”) and the methodology for the second experiment. We also plan to differentiate three kinds of spatial knowledge (landmark, route, and survey knowledge), and investigate how these presentation forms influence the acquisition of these.

Acknowledgments

This work was supported by the Way2navigate project, funded by the Austria FFG’s ways2go programme (2009). The project is a cooperation of Salzburg Research, TraffiCon, WalkSpaceMobilität, TU Wien, and FACTUM.

References

Aslan, I., Schwalm, M., Baus, J., Kruger, A. and Schwartz, T.: (2006) Acquisition of Spatial Knowledge in Location Aware Mobile Pedestrian Navigation Systems. In: MobileHCI ’06, p. 105–108. ACM Press, New York.

Gartner, G., and Hiller, W.: (2009) Impact of restricted display size on spatial knowledge acquisition in the context of pedestrian navigation. In: Location Based Services and TeleCartography II, Springer, p. 155–166, 2009

Ishikawa, T., Fujiwara, H., Imai, O., and Okabe, A.: (2008) Wayfinding with a GPS-based mobile navigation system: a comparison with maps and direct experience. Journal of Environmental Psychology 28 (1), p. 74–82.

Krüger, A., Aslan, I., and Zimmer, H.: (2004) The Effects of Mobile Pedestrian Navigation Systems on the Concurrent Acquisition of Route and Survey Knowledge. Mobile HCI, p. 446–450.

Rehrl , K., Leitinger, S., Gartner, G., and Ortag, F.: (2009) An analysis of direction and motion concepts in verbal descriptions of route choices, Proceedings of the 9th international conference on Spatial information theory, September 21–25, 2009, Aber Wrac'h, France.

Siegel, A. and White, S.: (1975) The development of spatial representations of large scale environments. In: Reese, H. (Ed.): Advances in child development and behaviour. 10, p. 9–55, Academic Press, New York, 1975.

Ortag, F.: (2005) Sprachausgabe vs. Kartendarstellung in der Fußgängernavigation, Master thesis, Vienna University of Technology, 2005.

Wikipedia (2011) Wizard of Oz experiment,
http://en.wikipedia.org/wiki/Wizard_of_Oz_experiment, accessed on 4. 2011.

INCLUSIVE EDUCATION IN GEOGRAPHY: MUNICIPAL ATLAS AND THE GROUP OF TACTILE MAPS IN UNESP OURINHOS

Carla Cristina Reinaldo Gimenes de Sena[1], Barbara Gomes Flaire Jordão[2], Cristiano Gimenez[3], Mariane Ravagio Catelli[4]
Universidade Estadual Paulista (Brazil)
1 carla@ourinhos.unesp.br
2 barbaraflaire@hotmail.com
3 cristianogimenez.geo@gmail.com
4 marianecatelli@gmail.com

Abstract: For the purpose of collaborating with reflections and attitudes that include the visually impaired in Brazil, is the responsibility of Geography creating methods and techniques that indicate a direction for inclusive education, orientation and mobility for these individuals. In the Unesp – Ourinhos we have a project entitled "Municipal Scholar Atlas of Ourinhos–SP and teacher training tutors' proposals for the study of location", the project proposes the creation of a scholar atlas with multiple languages, including Tactile Cartography. The group, born in this context in order to know about literature searches, representation techniques, discussions of texts and production, with various strands of research in order to embrace the diverse worlds of this science and to make the interchange of experiences and informations for mutual growth of the group and other researchers in pro of visually impaired individuals.

A brief history of inclusion in brazil

Worldwide, for a long time, the "different" was placed on the margin of education: students with disabilities, in particular, were attended only in separated or excluded from the educational process, based on normal standards; the special education, when it exists, also remained devialed from the organization and provision of educational services.

For that, special education in Brazil, modality of scholar education, as specified in the Law of Directives and Bases (LDB) and the recent decree No. 3298 of December 20, 1999, Article 24, § 1. becomes an instrument, because it is:

"(...) an educational process defined in a pedagogical proposal, providing a set of recourses and special education services, institutionally organized to support, complement, supplement and, in some cases, substitute the common educational services, to guarantee scholar education and promote the development potential of the students who have special educational needs, at all levels, steps and modalities of basic education."

Brazil has begun highlighting the special education recently. When we inquiry the national story, we realize that the experiences started in the nineteenth century, were based in model American and European's models, but with different characteristics from those observed in these countries, persisting the longest phase of negligence or omission, and the scarce production was concentrated, for the most part, in academic circles.

In the 70s, the evolution on special education in the developed countries with regard to Brazil continues to have an advantage. According to Miranda (2003) discussions and questions about the integration of disabled people in society in the other countries and in the national stage, come across the institutionalization of special education in terms of public policy planning with the creation of the National Center for Special Education (CENESP) in 1973.

The movement of social integration in the world stage had its biggest impulse from the 80's, as successful initiatives of rehabilitation services for people with disabilities and because the movements for disability people's rights. In Brazil, this decade also represented a time of social struggles led by the excluded population. Full Sena (2008):

"After being rehabilitated, physically and professionally, some people with disabilities were considered able to return to society (school, work, leisure, etc.). This process was originally known as reiteration, because it was applied only in people who were function in the society before acquiring a disability. So, it was not applied to children that born with a disability or have it in the first years of life. From the 1980s, the reintegration is now called integration and is used for anyone with disabilities." (p. 64)

These actions culminated with the obligation of the State to guarantee the specialized educational services to the handicapped, preferably within the regular school system, presents in Article 208, paragraph III of the Constitution (Brazil, 1988).

In the following decade, Brazil participated in the World Conference on Education for All, in Jomtien, Thailand, which begun the discussions about a scholar's model attending called inclusion. In 1994, Brazil signed the Declaration of Salamanca, in Spain, that proclaimed the principles of rights to education for people with disabilities, from a pedagogy centered in the student, and introduce the concept of inclusive education in national education.

Recognizing bases of 2000, collected during the census conducted by the Brazilian Institute of Geography and Statistics (IBGE), that using an ample definition of disability, identified in our population of 24,600,256 people, or 14.4% of population with some difficulty of hearing, seeing, moving or mental disability.

In this scenario, Geography – in principle related to visual perception, as a consequence of classical traditions – is allied to Scholar Cartography, also responsible for developing materials and techniques that take account of a minority that needs a non-conventional education, as blind and visually impaired, being called from there Tactile Mapping.

The Tactile Cartography in Ourinhos – Brazil

The map, a tool of undeniable importance inside Geography, is essential in the acquisition of geographic knowledge, and must be present in people's lives from an early age, to help in the recognition of space and social relations presents. When we reflect on this process of knowledge's acquisition and construction of citizenship – where maps can and should have a significant portion of contribution – we look at the importance of cartography, which must be present very early in people's lives. Therefore it is necessary since the early years of school, learning to read, analyze and interpret language and graphic representations.

The Atlas enables students, through a collection of maps, the study of places and different information, and even the same information seen by different authors. When it interlinks, can give the student an opportunity to understand the Geography in different scales, to understand the proper function of different scales, and realize that reality has not the same structure as a photograph, because depends on the viewpoint of those who mapped it.

The Brazilian legislation, gives importance to local and regional study in every city, in a process of spatial knowledge that goes from part to whole, from simple to complex, from near to far, and finally the neighborhood and the city in the world.

For this purpose, there is at Universidade Estadual Paulista (UNESP) Campus Ourinhos in the state of Sao Paulo, Brazil – under coordination of PhD Andréa Aparecida Zacharias, the project named "Development of scholar municipal atlas of Ourinhos–SP and training tutors teachers: Proposals for the study of the locality". This project proposes a scholar atlas with multiple languages that will lead to the students a conscience of the spatiality of their city and better understand the physical and social phenomenas that they experience.

For that, the design of the Atlas will have the following versions: Analogic Atlas (on paper), with 3D Digital Atlas Scenic Flights, Tactile Atlas, and a documentary film version of the city.

The group of Tactile Cartography in Unesp Ourinhos, born, so in that context, with the purpose of knowing and researching the Tactile Cartography, to contribute to the tactile version of the Municipal Scholar Atlas of Ourinhos and through the interest of graduate students of the Campus and experience of PhD Carla Cristina Reinaldo Gimenes de Sena.

Besides the library research, discussions of texts, research and production techniques of representation, inside the group emerged different topics of research to encompass diverse worlds of this science and make the exchange of experiences and information for mutual growth of the group in pro of visually impaired peoples.

The first topic deals with the study, construction and testing of thematic tactile maps, contributing for standardization inquired to tactile maps. As the study of thematic maps is quite large, were chosen for this job quantitative thematic maps. Maps were made by locating the Ourinhos in São Paulo, using the technique of collage with various materials of different textures, and the technique of drawing in aluminum sheets.

In October 2010, was realized in association with Project Colloid coordinated by PhD Maria Cristina Perusi, receiving a group of non-governmental organization, Association Jacarezinhense Care Deaf Service and Visually Impaired – Special Education School, Professor Carlos Neufert (AJADAVI) on campus, with about 20 people with hearing and vision, disability realized some activities, including a test stage of tactile cartographic representations developed. The maps were greeted with optimism by people with disabilities, who praised and suggested some changes and adaptations.

After the first stage of testing, the group began the construction of a topographic model of Ourinhos in cardboard locating its urban area. The intent of the model is that, beyond the perception of different altitudes, students recognize the urban area (which was represented with another texture) and establish a proportional relation between the size of the urban area and the total area of the city.

The model was presented at the 5th ENSIGEO held at UNESP / Ourinhos. People show interest in knowing the project. As the prospect of continuing the project, new features are being developed and aims to expand contact with other groups that work with people with disabilities to apply and evaluate these materials.

The intention is to present to visually impaired people the Thematic Cartography and thematic maps (mainly quantitative) to test its effectiveness and receive feedback to guide improvements, both in methodology and materials used to construct these maps.

The second topic, is also directly connected to the experience in the school environment. It is the participatory construction of a adapted globe based on visits made by the group on days 1, 2 and 3 December 2010, during participation in the 1st Seminar of Graphical Representations in Relief at the Institute Benjamin Constant (IBC), where were notice a need of a tactile globe more complete.

At the seminar it was possible to knew research about the topic and inclusion, besides techniques and materials developed at the institution. Detach the work done with people who have deaf-blindness, methods and materials used in production of other disciplines such as chemistry, biology and mathematics, and a software that support the visually impaired person.

Although the institution have national prominence and with a significant production of materials, the globes used by students are fragmented, such as globe to identify the continent, another for the representation of meridians and parallels to another. The systematization of information in just one globe is a challenge to be faced. Prominent among positive results in its use, the possibility of teaching content extremely abstract, so with a high degree of difficulty of assimilation by the students, such as geographic coordinates and enthusiasm caused by handling the globe by different students.

Figure 1. Tactile Globe with parallels

The third topic concerns about the orientation and mobility for people with visual impairments, developing tactile maps and tactile models that will be present in public places. These maps should have autonomy, so we emphasize the importance of education for that spatial concepts are well understood by users. Direct experience with mobility began with the production of a model of campus of UNESP Ourinhos These maps will also be present in touristic points helping promote inclusive tourism, in Barra Bonita, SP.

Final

The Tactile Cartography justified as scientific research when we analyze the large number of visually impaired people in Brazil. "The bases about the registration in special education show that students with visual impairments totaling more than 70,000 registered in 2006 (adding to the blind, low vision and deaf-blindness)." (Sena, 2008, p. 72). Often, schools and teachers are not prepared to receive these students. Not given the deserved attention to their need, they do not assimilate the content, as opposed to living the now-called "social inclusion".

Social inclusion is defined as "the process that society adapts to be able to include in their social systems generally, people with special needs and at the same time they prepare to assume their roles in society" (Sassaki, 1997, apud Sena 2008).

Vision is the main channel to capture the environment, helping us to understand the space and all the information it provides. The disadvantage that the visually impaired person suffers over the loss of information from space can be mitigated, if we use right resources for their educational process.

Thus, the Tactile Mapping shows extremely useful and promising, both for its scientific and didactic character or because its role as a catalyst for a true inclusion, executing its role as disseminator of knowledge, especially for those who are still in our society many physical, social and didactic obstacles.

References

Brasil. Constituição da Republica Federativa do Brasil, de 5 de outubro de 1988.

Brasil. Decreto nº 3.298 – de 20 de dezembro de 1999. Disponível em http://www010.dataprev.gov.br/sislex/paginas/23/1999/3298.htm>
Acesso: 15 fev 2011.

Brasil. Ministério da Educação. Programa Educação Inclusiva: direito à diversidade. Secretaria da educação Especial – MEC. Disponível em http://portal.mec.gov.br/index.php?option=com_content&view=article&id=288&Itemid=355> Acesso: 15 fev 2011.

Brasil. Ministério da Educação. Lei Nº. 9394, de 20 de dezembro de 1996. Diretrizes e bases da educação nacional. MEC, 1996. 26 p.

Brasil. Ministério da Educação. Parecer CNE/CBE Nº. 17, de 17 de agosto de 2001. Diretrizes nacionais para a educação especial na educação básica. Secretária de Educação Especial – MEC, 2001. 79 p.

Sassaki, R. K.: Inclusão: construindo uma sociedade para todos. Rio de Janeiro: WVA, 1997.

Sena, C. C. R. G. De: Cartografia tátil no ensino de Geografia: uma proposta metodológica de desenvolvimento e associação de recursos didáticos adaptados a pessoas com deficiência visual. Tese de Doutorado. Departamento de Geografia, FFLCH – USP. São Paulo, 2008.

Sena, C. C. R. G. Jordão, B. G. F.: A cartografia tátil para alunos deficientes visuais: a experiência do globo adaptado. Pôster apresentado no Encontro Nacional de Práticas de Ensino de Geografia – 2011.

Vasconcellos, R.: A Cartografia Tátil e o Deficiente Visual: uma avaliação das etapas de produção e uso do mapa. 1993. Tese de Doutorado. Departamento de Geografia. FFLCH–USP. São Paulo. 1993.

STUDY ON THE ACQUISITION OF THE CONCEPT OF SPATIAL REPRESENTATION BY VISUALLY IMPAIRED PEOPLE

Silvia Elena Ventorini[1], Maria Isabel Castreghini de Freitas[2]
1 Universidade Federal de São João del Rei, UFSJ (Brazil)
sventorini@ufsj.edu.br
2 Universidade Estadual Paulista, UNESP (Brazil)
ifreitas@unesp.br

Abstract: This article aims to present the results and analyses of research whose main objective was to investigate how visually impaired people are able to learn and draw. Furthermore what the importance is of acquiring the concept of spatial representation for reading, interpretation and analysis of tactile cartographic documents by this segment of the population. The data and analyses presented in this paper were collated from a Special School and a Children's Rehabilitation Center. In our research we concluded that a blind child develops this concept in the same way as any other child, acquiring the concept of the permanent object, acquiring semantic memory and graphic act, attributing sensory and physical meaning to the graphic act and showing difficulties to draw locations and objects that don't possess significance in their experience of life.

Introduction

Probably every teacher of the lower grades at Elementary School has already observed a student in the act of drawing and seen materialize on the paper graphic shapes similar to those of other children (Valente, 2008a). Through imitation and mediation of adults or other children, from the earliest age children without visual impairments are encouraged to develop graphical representations. In their act of drawing, they produce similar graphic forms on the paper, usually considered "stereotypical": the sun represented by a circle with rays emerging or set the house represented by a triangle on top of a square (Valente, 2008).

These drawings have been the subject of studies by many researchers, both nationally and internationally. Relevant research on how drawings express the children's perceptions of the living space as well as understanding of the mental and structural factors responsible for the process of producing these graphic signs, contribute to the development of methodological procedures that assist in expanding the cartographic and geographic concepts of these individuals.

However, note that there is insufficient research on the drawings by blind subjects and how they can express knowledge about a particular object or environment by means of graphic language. Many parents and teachers believe that the act of drawing is only possible through the use of a visual channel, for this reason they try not to encourage blind children to draw. Others (teachers) upon teaching blind children to draw, expect these to produce representations similar to those of children that can see.

In our research on the spatial organization of a group of blind students, we engaged them in an activity where they were to do render drawings. This option was considered when we observed that the students produced graphical representations of isolated objects. We also used as a basis, reflections about that which the authors of School Cartography divulge with respect to the importance of drawings for children to learn about standard maps and about how these children's drawings are representations of their thoughts about the world (Almeida, 2010). We also sought to investigate if drawings have the same importance for the blind. The study referred to on spatial organization was published in a book by Ventorini (2009) named, Experience as a determining factor in the spatial representation of the visually impaired.

However, there were unanswered questions in the aforementioned paper: how, for example, these students, particularly one who lost his sight in the early years of his life, acquired the necessary concepts to express themselves through drawings? What are these concepts and what is the process to acquire them? Why aren't all blind people able to draw, as we observed in theory and practice involving a blind student, who was 15 years of age?

In academic publications we discovered that drawing activities do not make up part of the everyday lives of blind people, perhaps, due to the fact that it's a visual activity. In our view there is no difference in the meaning of drawings produced by blind children and those who aren't if they are interpreted in the following way:

"A child's drawing is, thus, a system of representation. Not a copy of objects, but an interpretation of that which is real, done by the child in graphic language. Looking at a drawing in this way, it is possible to see beyond the infantile stages of the drawing, and analyze them as an expression of a language, which children appropriate to make their impressions visible, thereby socializing their experiences. In one representation, "X" does not equal reality "R", which represents this, and the connection can be either analog or arbitrary (author's emphasis). The drawing establishes an analog link with the object represented, as the visual signifiers are of the same nature as its meaning (our emphasis). [...]. The graphic image is not, therefore, a copy of the real. It depends on the systems of representation of the, its perception of the object and its graphical abilities." (Almeida, 2010, p. 27)

The considerations of the author, although they concern the drawings of children with normal vision, also apply to the drawings prepared by the group of blind students who participated in our survey. Their drawings are representation systems, not copies, they function as a means of socialization, as they are visible to the eyes of those who see them and visible to the touch of those who feel them.

Considering that for a blind child to render graphical representations, it is necessary to acquire the concept of symbolism – that something can represent another object or the same object- how does such a child develop this concept and represent it through drawings? The question is relevant, because it questions the association between seeing and knowing and refers to the questions made by Baptista (2005, p. 1), "What is knowing? To see is to know? Sensory feeling is to know? One of the responses current in psychology and in the educational environment relates to the act of knowing to the acquisition of concepts." This answer takes us back to the question: how does a blind child develop the concept of symbolism and represent it in drawings? Another question that crossed our minds was: could it be that when a blind person learns to draw, that this facilitates the acquisition of concept mapping?

Thus, the purpose of this paper is to present findings and analyses of the research developed, whose main objective was to investigate how blind people can learn to draw and how important the acquisition of drawing concepts is for reading, interpretation and analysis of tactile cartographic documents among members of this part of the public.

The data and analyses presented in this publication were collected from a Special School, whose name is EMIEE "Maria Aparecida Muniz Michelin–José Benedito Carneiro – Hearing Impaired and Visually Impaired", located in Araras, a city in the state of São Paulo from 5 students who participated and from the Princess Victoria Children's Rehabilitation Center, located in Rio Claro, state of São Paulo, in 2009, involving a 15-year old ninth grade student who has been blind since birth.

The context where blind students learn to draw

At the Special School the material used for drawing consisted of a board covered with thin fabric, crayons and A4 150 gsm paper. The fabric was attached to the back of the board by small tacks. One of the edges of the paper was attached by a clip, which is part of the board. When scribbling on the paper with the crayons, the thin fabric produces a high relief that can be felt by touch.

After drawing the first lines these blind students found a lot of pleasure in using this material and being able to feel by touch what they were scribbling. There are other variables that allow these students to continue with their drawings, as discussed throughout this document, but the satisfaction of the students upon feeling the effect of the movement of the crayons on the paper is evident.

The same was not observed at the Children's Rehabilitation Center during the collection of the data. The drawing activities were not included in the blind student's daily routine. The facility also lacked suitable material for this purpose. For the drawing activities a sheet of aluminum and a pen were used. After scratching a mark in the aluminum the line produced a low relief on the side where the drawing was being rendered and a high relief on the opposite side. So to feel by touch the lines etched into the sheet the student had to run their fingers over the opposite side of the drawing (Figures 1 and 2).

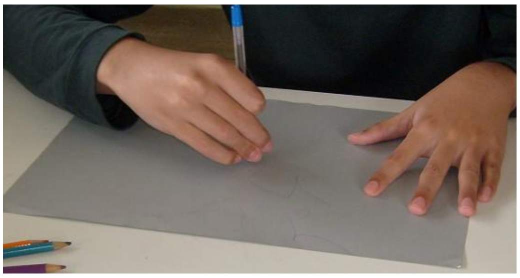


Figure 1. Material used for drawings at the Rehabilitation Center

Figure 2. Student feeling the lines on the reverse side of the sheet

(Collection of the Tactile Cartography Group, UNESP, photo: Juliasz, 2009)

In the first activity with this material it was possible to observe the student's discomfort in using a material that was so different from that of his colleagues, as well as a certain lack of interest in the material, which didn't allow him to effectively feel the movement of the pen. This material was replaced with a board covered with thin fabric, the same that is used at EMIEE.

Figures 1 and 2 show that the student does not have the motor coordination necessary to etch a scratch on the material, nor the coordination to "see" the lines drawn, even when the feeling the opposite sides of the sheet on which the lines were in relief. We also point out that even providing suitable material for this student to draw on, the results collected indicated a lack of manual motor coordination. The lines produced by the student did not have stand out enough to be felt by touch and show up very faintly on the paper. We put it down to a lack of bimanual coordination, and consequently of graphic memory.

Bimanual coordination and graphics memory

In the book Visual Impairment and Manipulative Skills, Rubayo et al. (2007) suggest activities and materials that aid in tactile stimulation. Many of the authors' suggestions were observed at the Special School, such as how to; make balls of paper, paint with your fingers using open molds, classify and sort a mixture of small objects, differentiate textures, recognize miniatures and figures in high relief, recognize geometric figures, differentiate sizes of objects etc.

The authors' suggestions are to increase the sensitivity of the fingertips, the pressure when closing and opening one's hands and fingers and bimanual coordination. The hand actions undergo a proper sequence of motions and for Rubayo et al. (2007) the principles of bimanual coordination are:

- Handle delicate and fragile objects differently from durable ones;
- Consider that the neurological maturity in itself is not sufficient for the development of manual skills, because opportunities are necessary for the hands to move in various situations;
- Know that each hand has an asymmetric function, and one is dominant and is more commonly used to the handle objects and in other activities and the other acts as a helper;
- Consider that the manual coordination serves to improve the efficiency and dexterity of the hands. The hands should be relaxed for any manual activity. The tension in the hands restricts the neuromotor reflexes that must be produced, causing stiff and distorted movements, affecting the activity to be carried out (ibid, 2007).

At the Special School we noted that the activities for mastering bimanual coordination were conducted with the students who lost their vision early in life and those who lost their vision later. In our observations we found that students who developed the impairment in adulthood demonstrated more difficulties in coordinating both hands in the activities, such as the activity where they used their non-dominant hand to feel the outline of the drawing. Moreover, we observed the tension in their hands as cited by Rubayo et al. (2007). This was caused by the trauma of having lost their vision.

Many of the activities developed at the Special School were aimed at braille literacy or learning. Simon, Ochaíta and Huertas (1991) and Ochaíta and Espinosa (2004), point out that, in general, the visually impaired read with the index finger of the dominant hand and use the index finger of the other hand to guide them when changing lines. In children's literacy development, the authors observed that a child only uses one finger, returning along the same line to start reading the next. They also emphasize the need for the development of tactile sensitivity and bimanual coordination. The drawing activity requires similar coordination, as the student draws with one hand and uses the other for orientation.

In order to hold and draw the hand and fingers need to undergo a series of exercises. Duarte (2008) points out that Marc Jeannerod calls this preparation, pre-training of the hand, which assists in the correlation between opening and molding of the hand to pick up the object and feel the size and shape of the object.

Little by little the child's mental memory develops of how to hold a pencil and produce the primary symbolic representation, which along with speech will allow it to express its repertoire from memory. In children who see, this occurs by imitation and mediation. In terms of the blind child this will need to be stimulated, since the lack of vision prevents it from observing and imitating the act of writing and /or drawing.

In work involving drawings we observed the importance of this memory. A blind 10-year-old student whose name is Luana was going through a phase of tactile development when we met her and as her field of vision before becoming blind was not sufficient to visualize the shapes of objects and draw them, her motor memory was not developed enough to render, for example, a square.

In our study, we didn't apply methods to teach the student how to draw, but educational situations in which the student understands how three-dimensional representations (models) may represent locations in their daily lives. In these situations, Luana would feel these models that represented known environments, exploring and comparing the real objects with the representations, then produced drawings of these environments. In other situations she would develop mental maps to solve problem situations. These procedures were adopted for all those who participated in the survey.

Figure 3 was the first drawing of the classroom produced by Luana, after feeling a model representing the place (Figure 4). The drawing was done a year and a half after the student began attending classes at the Special School. In the analysis of the drawing it is evident, even though the student is not proficient in graphic shapes, that almost all the existing objects in the room were represented-except for three chairs and the teacher's desk. The analysis also indicates that Luana had difficulties to represent objects in their correct locations, indicating that she still hasn't mastered the spatial organization of the classroom.

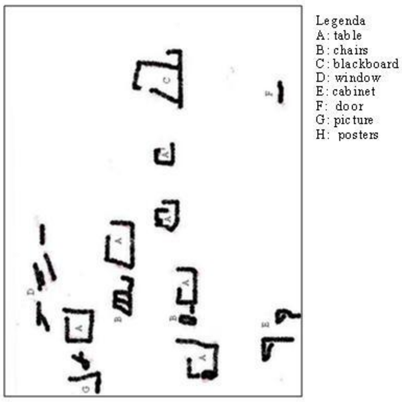


Figure 3. First mental map drawn by Luana

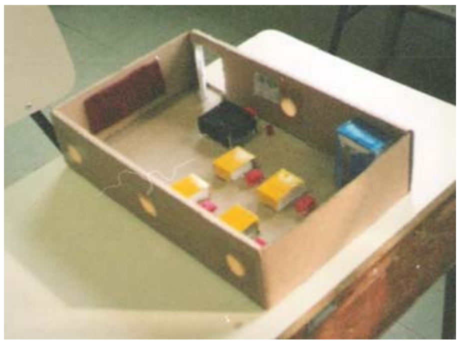


Figure 4. Model of the classroom

Figure 5 shows the student's drawing after exploring the classroom with our mediation. In this mediation we explained to the student the position of the objects in relation to each other as well as their different sizes. When exploring the environment the student pointed out that the doll's house was not represented in the model, which she played with and that the student desks were not positioned one after another, as represented in the model. The exploration of the room was held two weeks after the previously reported activity and there was a change in the positions of the furniture in the room and we thought it was better not to change them to check if the student would notice the differences.

The student's drawing was done soon after exploring the locality. In this drawing we discovered that there was an improvement in graphic shapes, but confusion in the spatial distribution of the objects, especially with respect to the distance between the chairs and desks. The student represents these objects one on top of the other. In her representation of the dollhouse we are able to see that Luana sought to represent the slope of the roof by drawing a triangle, and a chimney with a rectangle. The shapes attributed to the details of the house were not obtained from tactile pictures, but through interaction with the object. The graphic knowledge used to represent these characteristics was acquired in the drawing activities of geometric shapes.

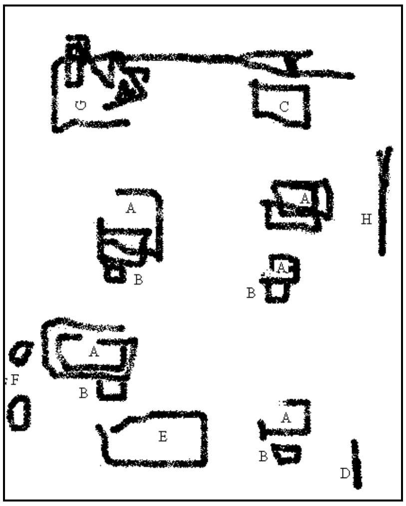
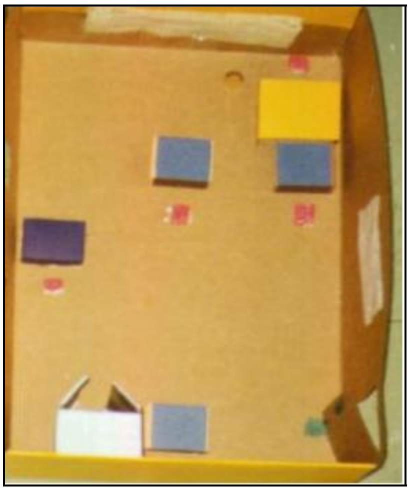


Figure 5. Drawing rendered by Luana after having explored her environment Legend: A) desks, B) chairs, C) board, D) notice board, E) cupboard, F) windows, G) dollhouse, H) door



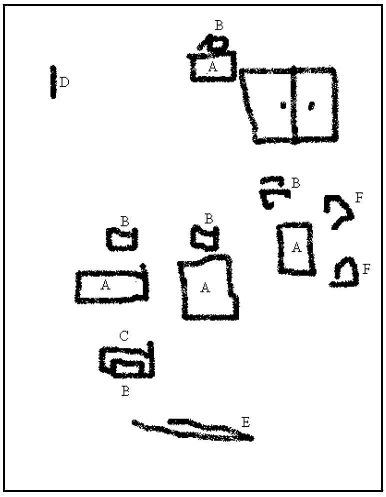


Figure 6/a. Luana's model of the classroom

Figure 6/b. Luana's drawing of the classroom

In extension activities, Luana built a model of the classroom where she attended classes at the Special School and then created a mental map of the site. There is evidence of the student's knowledge developing in this new drawing both in terms of the graphic and spatial organization. Figures 6/a and b show the model developed by student and figure 7 shows the drawing.

Advances in spatial distribution of the objects represented were generated by the activities involving the model and by exploring the everyday environment. The improvement, however, in graphical shape is the result of the work done at school, that is, of the drawing teaching and learning situations, which have also improved Luana's motor memory for graphical shapes.

At the Special School the student was encouraged to represent anything he/she recognized, for example the shape of a circle, by a drawing. This drawing task was slow and the main objective wasn't to teach the students to draw the same as children that can see, rather it was to contribute to them having their own personal brand, as well as allowing them to understand geometric figures.

The movement associated with drawing on paper assisted in motor coordination and helped the student to acquire the necessary grip to hold a pencil and/or a pen and write his/her name. Luana's improvement in presenting graphic shapes resulted from the activities directed at developing her literacy. The shape used to represent slope of the roof of the house is similar to the slope of the letter A, learned by the student.

When we look at how the student writes her name, beyond the concepts already discussed, it is evident that she needs to acquire the concept for rendering sloping lines to write the letter A, whose sloping lines are simpler when compared to the letter N. Moreover, the relationship of space between the letter and the relationship of size also require acquisition of concepts. When we looked at Luana's writing we found that there aren't any significant discrepancies between the letters (figure 7), showing that the student acquired the necessary concepts to write his name, as well as the necessary motor coordination.

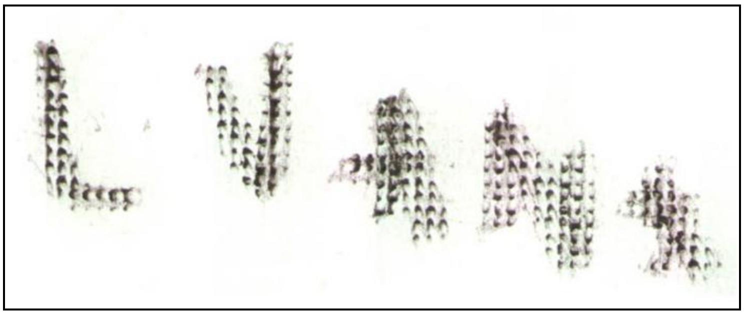


Figure 7. Luana's handwriting

The same did not occur with another student, Bruno from the Children's Rehabilitation Center. When he was asked to draw a mental map of the computer room, where Project activities took place, he used a crayon on paper and attempted to represent objects with which he had contact, such as the computers, floor and walls (figure 8).

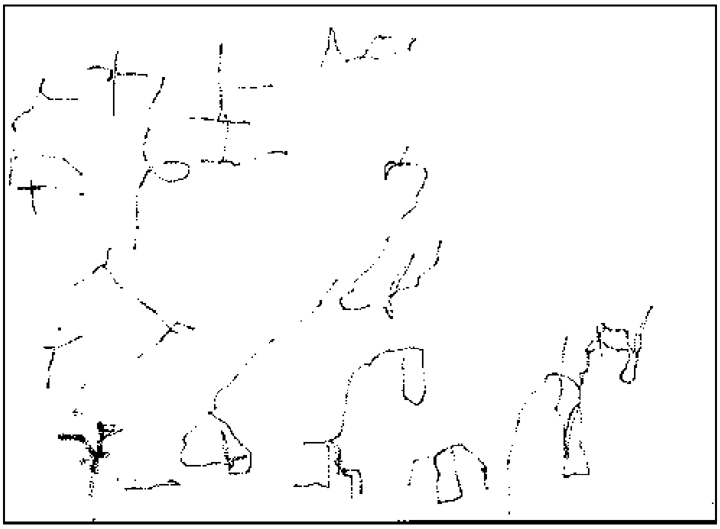


Figure 8. Bruno's mental map of the computer room

After Bruno had explored a model representing the environment, he was asked to do a second representation of the same place. In the second drawing we see that the student seeks to represent the floor (number one in the drawing) with a graphic shape that resembles the real thing, but he cannot spatialize this shape on the paper and distribute the other items on it (Figure 9).

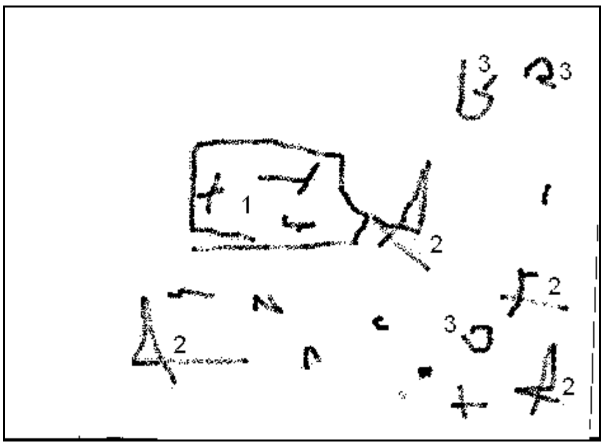


Figure 9. Drawing prepared after manipulation of the model
Legend: 1. floor, 2. walls, 3. computers

Another activity that was proposed was the theme of how to draw similarities between Brazil and Africa. The drawing was free and the theme proposed was based on work already done with students in Regular Education and the project. In his drawing the student ran the crayon over the paper again and explained that he had drawn hunger, a drum/cylinder, a ball symbolizing the World Cup in Africa and industries. The student demonstrates some knowledge of the two countries, but again just renders a series of scribbled markings (Figure10).

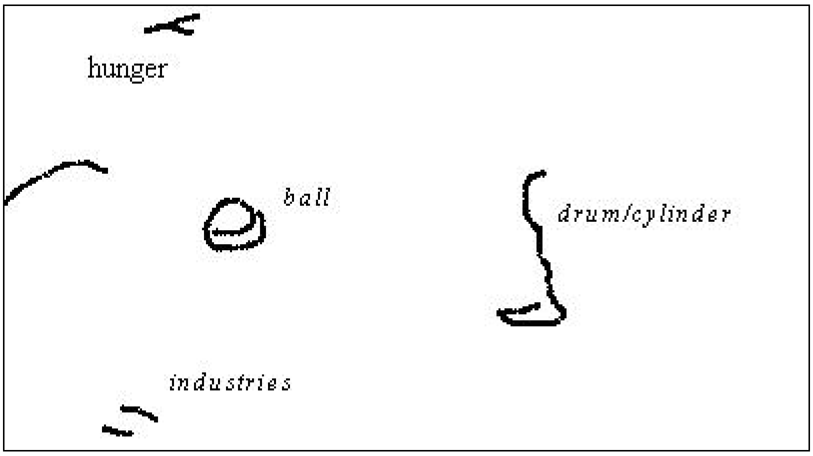


Figure 10. Drawing of the similarities between Brazil and Africa

In the study that we conducted regarding spatial organization with blind students at the Special School we had mixed results. In a representation done by Luana, there wasn't a representation of the shapes of the objects due to the need for successive integration of perceptions by means of touch, making it impossible to exploit them as a whole to understand their shapes. But we realized that in her drawing there weren't just crayon scribbles in the attempt to represent the objects, as we found in the representations done by Bruno.

In the drawing produced by this student there is a spatial logic represented that fulfills the verbal logic: "The student visited the area weekly to attend Sunday Mass at the main Church, located on this square. After Mass, the student would go down the steps of the church, walked to the ice cream parlor, just across the street, near the Church" (Ventorini, 2007, p. 101) and had an ice cream accompanied by her parents (Figure 11).

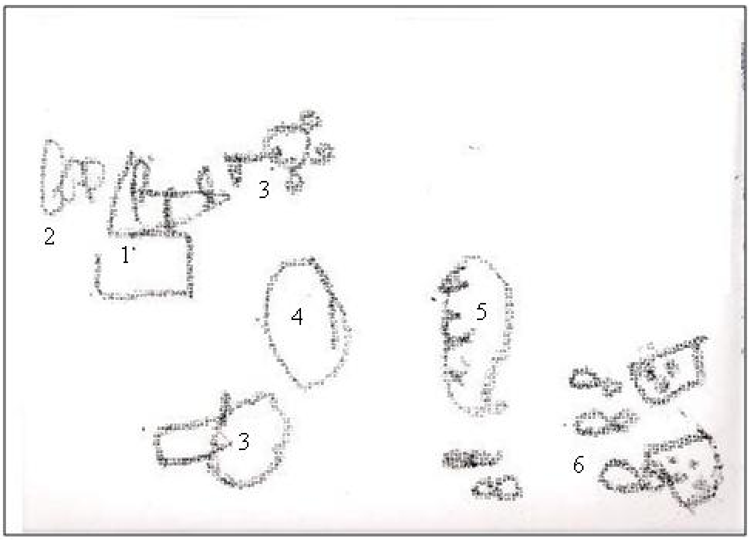


Figure 11. Luana's drawing of a route. Legend: 1. church, 2. steps, 3. garden, 4. street, 5. sidewalk, 6. ice-cream parlor

The Church is represented by a square and a semi-triangle. In this representation the student uses concepts of contour lines for objects and figures with which she had experience, for example figures of a house, of churches etc. In her representation of the church the analysis indicates the use of concepts acquired in manipulating figures, since it was not possible to explore the object such as occurred with the dollhouse, which the student seeks to represent the real shape of the object and not use symbols. The symbols are adopted for large objects, that can't be explored by feeling them.

To represent the trees in the square she makes use of a simple figure of a tree and for the garden she uses the symbol of a flower. To represent the ice-cream parlor she uses two squares, which in fact symbolize the ice-cream parlor tables. Besides this, there are three ice creams, which represent her mother, her father and her. The symbols used to represent objects on the route are representations of her experience in this place in addition to the motor coordination skills and graphic memory acquired during the drawing activities.

We believe that this student acquired her drawing concept by having applied the knowledge acquired in her previous experience in this locality and learning how to draw to the challenge presented (representing a place in the town that she lived in). In her drawing the shape and size of objects were not represented because they are large and it was not possible to explore them by touch. The symbols used by Luana are not crayon scribbles on paper, but application of the graphic representations learned at the Special School.

The students doesn't know how many trees there are in the square, or what their height and shapes are, but represents them with a symbol of a tree. In order to represent the street and sidewalk she uses nearly circular shapes, indicating the spacing of her body. She represents tables at the ice cream parlor with those that shed had contact, embracing the concepts for the development of squares. With regard to the steps she seeks to represent the differences in height, indicating the steepness of the place, and to achieve this she draws three almost elliptical shapes, one on top of the other.

This analysis coincides with the interpretation that we present about blind peoples' drawings in the introduction of this paper: "the child's drawing is, thus, a system of representation. It isn't a copy of objects, but interpretation of that which is real, done by the child in graphic language" (Almeida, 2010, p. 27). Luana interprets reality and represents it by adopting concepts of graphic language learned, it is not simple scribbling in crayon on paper, and nor they copies of objects or figures.

The student at the Children's Rehabilitation Center does not have these memories so he simply scribbles in crayon on the paper, without attributing a graphic shape to his mental image. Learning these memories is neither simple nor quick and does not just train motor skills, but it also gives sensory and psychic meaning to the mental act whose education and learning should be done in context.

In our research we concluded that the blind child develops this concept like any other child, acquiring the concept of permanent object, acquiring semantic memory and graphic act, assigning sensory and psychic meaning to the graphic act and demonstrating difficulties in drawing places or objects with which they have no significant experience.

References

Almeida, R. D.: 2010, Do desenho ao mapa. São Paulo: Editora Contexto, 4 ed. , 2 reipressão.

Batista, C. G.: 2005, Formação de conceitos em crianças cegas: questões teóricas e implicações educacionais. Psicologia: Teoria e Pesquisa, Brasília, vol. 21. 1, p. 7–15.

Duarte, M. L. B. 2008a. A imitação sensória-motora como possibilidade de aprendizagem do desenho por crianças cegas.Ciências e Cognição. v. 13, p. 14–26. Accessed july 2010.

Ochaíta, E.; Espinosa, M. A. 2004. Desenvolvimento e intervenção educativa nas crianças cegas ou deficientes visuais. In. COLL. C. Marchesi, A; Palácios, J. & Colaboradores. Desenvolvimento Psicológico e Educação: transtornos de desenvolvimento e necessidades educativas especiais. v. 3, 2. ed. São Paulo: Ed. Artmed...

Rubayo, S. C. et al.: 2007, Discapacidad y destrezas manipulativas. Madrid: ONCE. Accessed 6 October 2010.

Simón, C; Ochaíta, E. and Huertas, J. A.: 1995, El sistema Braille: bases para su enseñanza–aprendizaje. Aprendizaje. Comunicación, Lenguaje y Educación. Madrid, v. 28, p. 91–102.

Ventorini, S. E.: 2007, A experiência como fator determinante na representação espacial do deficiente visual. 2007. Dissertação (Mestrado em Geografia). Instituto de Geociências e Ciências Exatas. Universidade Estadual Paulista, v. 2, Rio Claro.

Ventorini, S. E.: 2009, A experiência como fator determinante na representação espacial do deficiente visual. São Paulo: Ed. UNESP, 2009.

TACTILE CARTOGRAPHY AND GEOGRAPHY TEACHING: LEMADI'S CONTRIBUTIONS

Carla Cristina Reinaldo Gimenes de Sena[1]
Waldirene Ribeiro do Carmo[2]
1 Universidade Estadual Paulista, Campus Ourinhos (São Paulo, Brazil)
carla@ourinhos.unesp.br
2 Universidade de São Paulo (São Paulo, Brazil)
walcarmo@usp.br

Abstract: This paper presents an overview of the experiences on Tactile Cartography that have been made at LEMADI (Laboratory of Teaching and Didactic material of the Geography Department, Faculty of Philosophy, Letters and Human Sciences, University of São Paulo–USP). This is an attempt at displaying the contributions of this work to Geography teaching.

LEMADI's researchers have been working for more than 20 years on producing, applying and evaluating geographic representations for teaching, orientation and mobility.

The results, from the first project, as well as the materials already produced (maps, graphics, plans, illustrations, models and others), led to the introduction of a permanent group that attend teachers, professionals on special education and visually disabled students. Experiences were shared by Brazilian and foreign researchers and institutions.

LEMADI became a reference in Tactile Cartography not only for its tactile didactic materials, used by students from elementary, high school and college, teachers from public and private schools, parents, specialized teachers and blind people in general, but mainly for the methods developed by its researchers.

Introduction

In 1989, Professor Regina Araujo de Almeida (Vasconcellos) started at LEMADI a pioneering work in Brazil in the area of tactile cartography. Her research, "Tactile Map Production and the Visually Disabled: an evaluation of the stages of production and use of tactile maps" (1993), proposes a new method on Geography teaching for visually disabled, pointing the role of graphic representations, mainly maps, in the process of space perception and in the acquisition of geographic notions.

In the period from 1990 to 1998, with the financial support of VITAE Foundation and from the University of São Paulo (Pró-Reitoria de Pesquisa), several projects were carried out at LEMADI, under the coordination of Professor Regina Araujo Almeida. The group counted on the participation of geographers and students from the Geography course, including some who had support from a studentship called "Bolsa-Trabalho", from the Social Assistance Coordination, COSEAS–USP.

The main objective of these researches was to arouse visually disabled students interest for the Geography and Cartography learning and, at the same time, to offer conditions for their assimilation of special concepts and information through touch, hearing and, occasionally, through residual vision. Thus, many didactic materials were made by associating colors with tactile language and using adapted writing for subnormal vision.

In the first project, Amazonia was used as a testing area to analyze the methodology. It was introduced in its several aspects, by pointing out its facts, problems and conflicts. This work included the construction of a set of didactic materials, such as maps, models, plans, history books, illustrated dictionary, activities and games, illustrated time-line and teacher's manual, together with a text on Amazonia and its historical occupation process, since the XVI century.

The methodology was evaluated through tests with students from public and private elementary and high schools. This contact with visually disabled students made it possible to verify the efficacy of tactile graphic language in geography teaching, as the perception of space and the understanding of basic concepts such as proportion and scale, placement and orientation.

In the second project, the State of São Paulo was chosen for the application of the same methodology, already tested with Amazonia. It was offered, at the same time, a training course to spread the work. In the third project, an Atlas of the Continents was created.

The positive results, from the first projects and the tactile didactic materials developed, led to the introduction of a permanent group to give support to teachers, professionals on special education and visually disabled students. Experiences started to be shared by Brazilian and foreign researchers and institutions.

International Projects

In 1994, a group of researchers from Chile, Argentina and Brazil started a work on the production, evaluation and application of tactile didactic materials. Firstly, it was carried out a large bibliographic survey on the subject, which enabled the construction of a theoretical landmark. From that it was possible to present proposals on the making of cartographic materials adapted to visually disabled children from elementary school and teachers from special education. With the financial support of institutions such as IPGH (Panamerican Institute of Geography and History) and OEA (Organization of American States), several projects were carried out. Among these projects it will be displayed the more recent experiences developed by the international group.

The project "Diseño y Producción de Cartografia para las Personas Ciegas de America Latina" was developed in the period from 2002 to 2006 by researchers from Argentina, Brazil and Chile, with the financial support of OEA. It was coordinated by Professor Alejandra Coll, from the Cartography Department of the "Faculty of Humanities and Social Communication Technologies", Metropolitan University of Technology (UTEM), Santiago, Chile. On the production of didactic materials and on the organization of courses for teachers, in order to contribute to the improvement and diffusion of production and reproduction techniques of tactile graphic representations, the project counted on the collaboration of researchers from Cuyo National University of Argentina and from the LEMADI–DG–USP, Brazil.

The main purpose of this project was to support visually disabled people in developing special abilities by the use of didactic and cartographic materials such as Atlas, maps, charts, tridimensional graphic systems and others, in an attempt to improve their formal education and mobility.

This aim was achieved by the making and distribution of thematic information representative products (ecosystems, social, economic and cultural aspects) in several scales (global, continental, national, regional and local).

For the development of the project it was formed an interdisciplinary group, composed by geographers, educators, sociologists, designers and others, from the three participating countries. The whole group has met at least one time a year to exchange experiences, present results and defining next stages. The Metropolitan University of Technology (UTEM – Santiago, Chile) founded, with part of the Project resources, the Latin America Tactile Cartography Center (CCAT). This Center became the place of coordination and developing of part of the tactile graphic materials proposed.

Throughout the four years (2002–2006) it was produced several tactile didactic cartographic materials, in several scales, followed by manuals, resulting more than 150 tactile graphic representations:

- set of physical, political, population density, vegetation and climatic maps (Representations of the world, of Latin America and of the several countries members from OEA),
- didactic materials for geography teaching,
- planet Earth general characteristics plan (water cycle, tectonic plates and others),

- models for the teaching of geographic concepts,
- handbook on geographic concepts, printed and in Braille, with the definitions of each concept,
- urban plans from Latin American capitals,
- braille alphabet and printed maps.

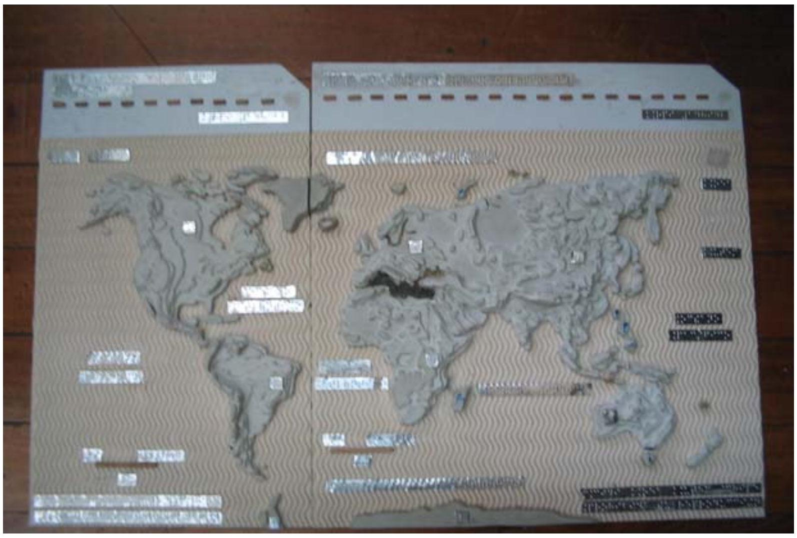


Figure 1. Example of material produced by the Project: World Physical Map

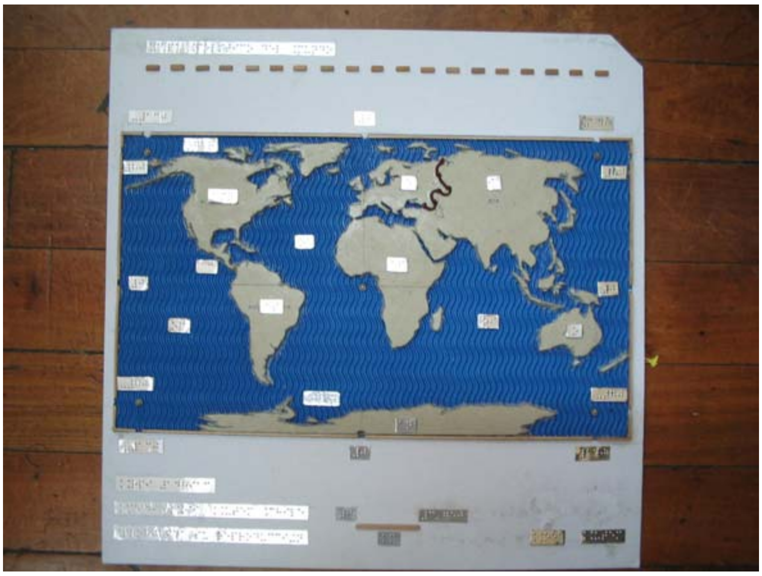


Figure 2. Example of material produced by the Project: World Political Map

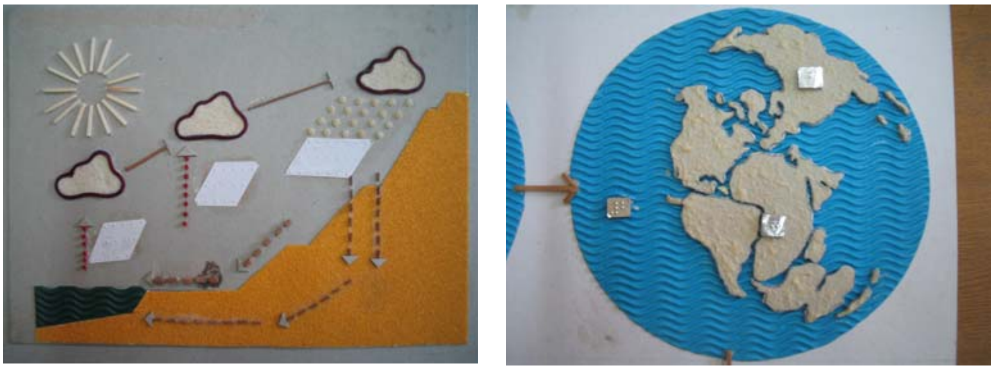


Figure 3. Example of materials produced by the Project: Water Cycle and Continental Drift

One of the biggest challenges at the initial stage of the project was to define standards for geographic representation. The discussions were based on the professional's experience and on the existing bibliography. Some of the patterns were defined by the limits of the thermophorm machine, available at CCAT, that is, 42 cm longer, 42 cm wide and 5 cm high.

For that reason, it was decided that some standards would be applied in all maps of the project, in order to make the reading and the evaluation of visually disabled students easy. These standards define the sort of tactile graphic representation produced at CCAT and distributed among OEA members and project collaborators. It was established, for instance, that the North would be indicated by a dashed horizontal line, placed in the height of the map. The maps were oriented to, as frequently as possible, representing the North in this position, facilitating students reading and comprehension of this variable or geographic notion.

As the convention for printed maps defines that the North (magnetic and geographic) is represented by an arrow – considering that it is a point on Earth's surface – throughout the project, the Brazilian group proposed the keeping of the arrow for identifying the North. In this case its representation would happen with the confection of a vertical straight line segment added by an arrow in relief, with the letter N in Braille or yet a variation suggested by Vasconcellos (1993), in which the dashed line is complemented by an arrow.

However, after the evaluation of some maps with specialized in visual disability teachers, all the group researchers reinforced the idea of the use of the dashed line, confirming, then, the linear representation of the North, as it is showed by Figure 4.

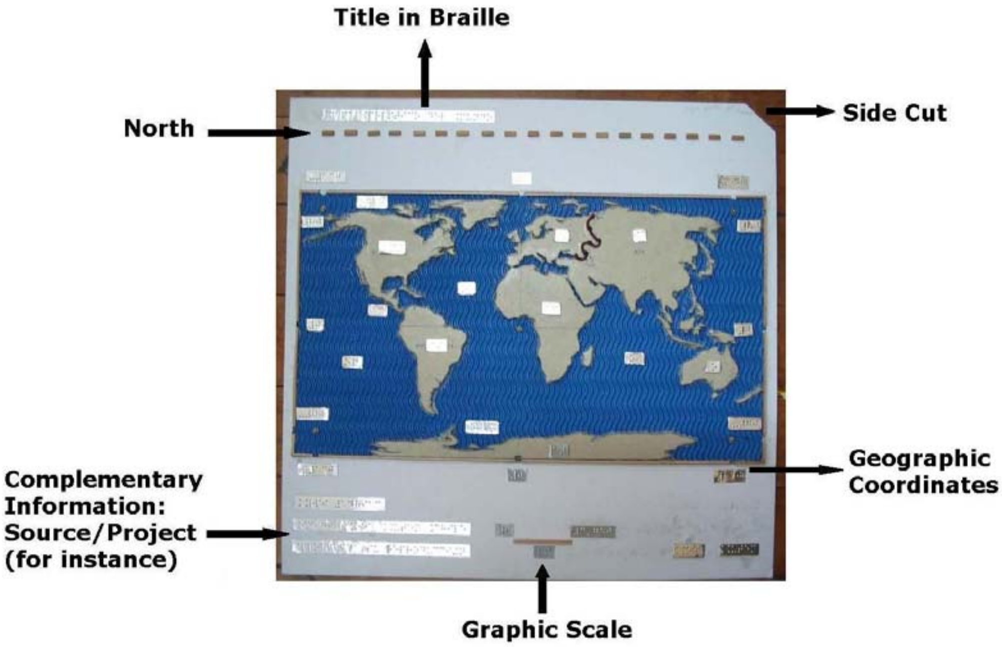


Figure 4. Tactile map with the standardization proposed

It was decided that the scale would be graphically represented. The efficacy of graphic scale in tactile maps has already been confirmed by Vasconcellos' research (1993). Taking into consideration that the concept of scale is abstract and its representation in a numerical form (proportion between real space and the represented one, using centimeters) makes it difficult to understand the idea of reduction of the map and demands another concept – the transformation of measures; simplifying scale representation may make the reading of the map and the comprehension of the concept of scale easy.

With the graphic scale, the user can explore the map with both hands: one of them fixed at scale, and the other searching distances. This way, one can establish a relation of proportion between the line segment of the scale and the represented distances.

Besides, it was defined that all written information needed for reading the map would be made in Braille - title, scale values and the keys.

After the definition of the final originals for each participating country, it were searched data about its population and climate for the construction of graphics that complement maps already produced in order to help the teaching of these subjects.

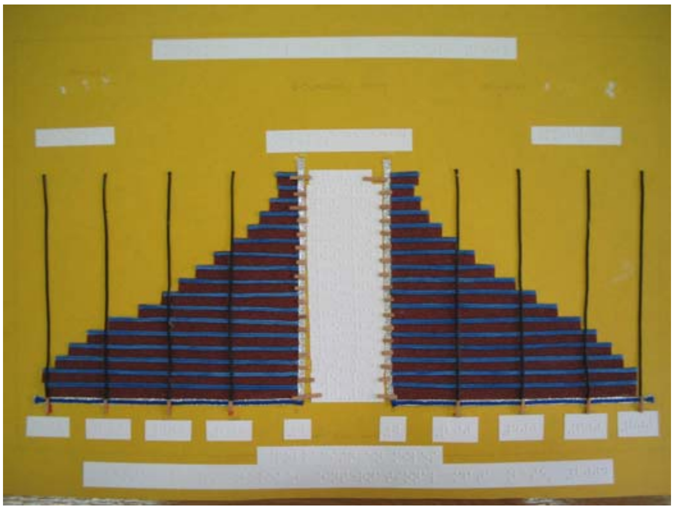


Figure 5. Representation of the Equatorial Pyramid (collage)

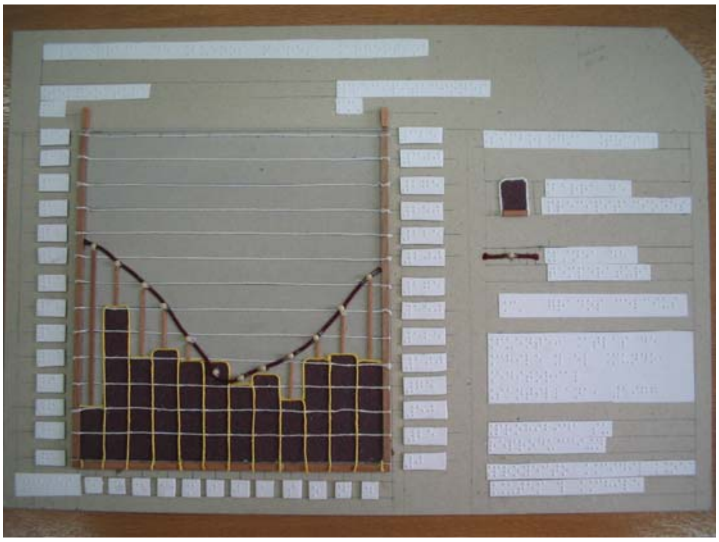


Figure 6. Representation of Buenos Aires' Climatogram (collage)

The last stage was focused in the search of cartographic bases for producing at least one urban map, from downtown or from the most relevant area of the cities from the 18 Latin America countries of the first stage maps. These maps were made for the orientation and mobility and, for that reason, were produced in large scale, by identifying important buildings. In all countries, it was chosen a central area of the Federal Capital, excepting for Brazil, which had part of São Paulo downtown represented.

The maps were made in collage and copied in transparent plastic in order to add the printed information to the whole. Beyond the urban maps, it were built models of classrooms from schools that collaborated to the evaluations of the first stage and offered to give graphic information. The result was 18 urban maps, 4 enlargements of these maps (La Paz, São Paulo, Quito and Lima) and 16 maps from schools participating in the classroom project.

For constructing the tactile graphic representations tests on the several materials durability and heat resistance were made. (The thermophorm machine which reproduces the maps works with a vacuum and heat system, therefore, the originals must be resistant). Thus, the originals can make a large number of copies. After the tests, it were selected several types of card paper, metals, wood sticks, sandpaper and several threads for representing information in a tactile shape. Braille was firstly made in paper, but as its durability was low, it was replaced by aluminum foil, more resistant and durable.

The tests of the materials were made in schools that have visually disabled students in 16 from the 18 Latin American countries belonging to the OEA. These tests confirmed the efficacy of tactile graphic representations, especially maps and graphics, seeing that these are important elements in the teaching of Cartography, Geography and History, by helping the communication of special information. 85% of the participants considered the importance of the materials to their learning, stating that they are pleasure to touch, easy to handle, with clearly well represented information. (Coll e Pino, 2007).

A great number of students suggested the insertion of printed information in the maps in relief, in order to make easy the low-vision people's reading. This aspect was also pointed by the teachers who evaluated the material, emphasizing that maps in relief and paint help on the inclusion intensification, since the visually disabled student uses the same material as his "non-disabled" mate. It must be highlighted that the urban maps built in the last stage of the project considered printed information, being reproduced in transparent PVC.

In addition to the material making, it was offered five qualification courses to several Latin America teachers. The courses took place in Argentina (December 2004), Chile (2003, 2005, 2006) and Mexico (September 2004), providing an exchanging of information and experiences that was fundamental to the definition of methodologies for the application of the materials in classroom. More than 50 professionals were trained throughout the project. All the information acquired in the courses were took by these teachers to their mother countries.

As oriented for specialized in visual disability teachers who are not necessarily experts in Geography, it was necessary to introduce basic notions on cartography to deal with the techniques of construction and methodologies of the use of the materials.

The courses were organized in this manner: cartography basic notions (scale, geographic coordinates ans graphic symbology); techniques for the construction of tactile map (collage and aluminum), creation of games in EVA and tactile maps reading methodology.

Figure 7. Teachers producing materials during the course

The courses' participants gave a very important contribution to the development of the research on Tactile Cartography, by pointing out the difficulties on finding tactile graphic representations in their countries and also by identifying the students' necessities, like their need of specific graphic representations, such as the representation of an specific neighborhood where services considered important by them are placed (school, hospital, therapist and others). Or yet the detailing of a political map of their countries for the comprehension of their original state. That reinforces the importance of the teachers' qualification for the production and using of tactile didactic materials.

Considering that great part of schools which attend visually disabled students have access to few resources for the materials acquisition, the use of simple and low-cost materials was emphasized. The alternative use of different papers, recycled tissues and rests in general, made possible the improvement of the representations used in classrooms by some of the participating teachers.

The second project to be remarked is called "Integrando Los Sentidos en el Manejo de la Información Geoespacial, Mediante la Cartografía Táctil, con Especial Énfasis en las Personas Ciegas y Sordas de América Latina". It was developed in the period from 2007 to 2009 with the financial support of IPGH, in a partnership among the University of São Paulo (LEMADI, Brazil), the Metropolitan University of Technology (UTEM), Latin America Tactile Cartography Center (CCAT, Santiago, Chile), and also the School Nuestra Señora del Carmen (Cusco, Peru).

The general purpose of this project was the adaption of tridimensional cartographic material and the developing of new process for the construction of geographic information models to auditive and/or visual disabled people from Latin America. The project was followed by an intense discussion and the set up of a theoretical landmark on Geography teaching for visual and/or auditive disabled people by the use of Tactile Cartography.

Physical and political maps of the metropolitan regions of Santiago, Chile, Cusco and São Paulo, were made by the use of the collage technique. The bases were reproduced in transparent plastic and the representations were, afterwards, evaluated by visually disabled students from the three countries.

It is important to point out that the standardization discussed and evaluated in the previous projects was kept and the new evaluations reinforced the efficacy of the use of patterns to the tactile graphic representations. Besides, this project reinforced the necessity of the creation of resources that can be used simultaneously by visually disabled people and other sort of disabled people.

In this sense, it attempted at making the representations in transparent plastic, which superposes a printed copy with written information beyond the graphic ones. (Figures 10 and 11)

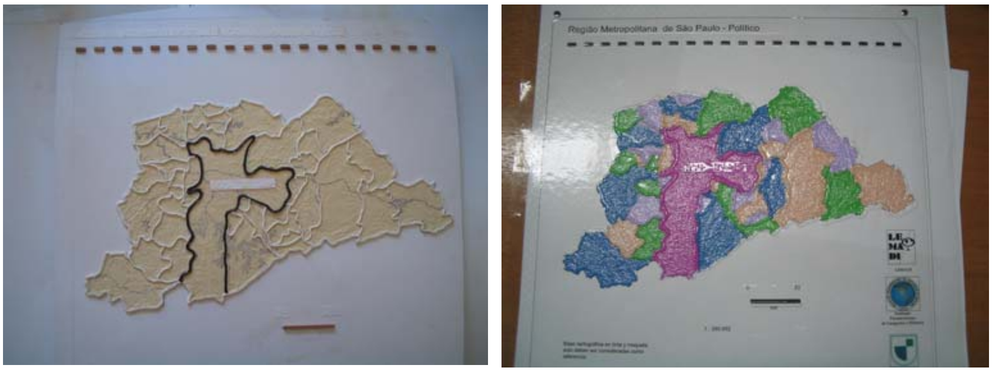


Figure 8. Metropolitan Region of São Paulo (Political): example of material produced during the project (original and copy in thermoform)

Figure 9. Metropolitan Region of São Paulo (Physical): example of material produced during the project (original and copy in thermoform)

Final considerations

The experience acquired in the area of cartography for visually disabled people and a positive evaluation of the tactile resources built until now, also in schools for auditive disabled people, demonstrated that the tactile didactic materials can and must be used by auditive and visually disabled people in the learning of Geography, motivating the learning through senses: touch, sight and hearing.

The materials produced make it possible to work in an integrated manner, with children and young visually disabled people, and also with "no-disabled" students, starting a new area for the cartographic discipline development.

Beyond school, the midia frequently uses different types of graphic representations (maps and mainly graphics) in newspapers, magazines, internet and TV, to illustrate or explaining several subjects. The visually disabled ones receive, thus, this sort of information through an oral representation, not always convenient. The tactile cartography may reduce and also overcome this information restriction.

The use of graphic resources in relief, therefore, provides the overcoming of the informational barriers, contributing to the inclusion of the disabled ones at school, at work and in daily-life. This way, the tactile cartography benefits those who depend on the touch and on the hearing to apprehend images, to use maps and to comprehend graphics. Besides, it can be used in every classroom, in every school, with all students.

Developing materials and methods to help Geography teaching for all, independently of its differences, by respecting each one's necessities, is an important step for the concept of inclusion.

This inclusion can only be put into practice with the partnership between researchers and teachers. In this sense, the projects' experiences provide the organi-zation of courses and workshops for the diffusion of techniques and methodo-logies on the using of didactic adapted materials, by the constant exchange of ex-periences on the theme and the discussion of its process at school.

LEMADI–DG–USP is nowadays an important space in the area of Tactile Cartography, a space to the development of discussions on inclusion, where the whole community can benefit on the materials and on the results reached up to this moment.

Bibliography

Almeida, Regina: A Cartografia Tátil no Ensino de Geografia: Teoria e Prática. In: Almeida, R. D. (Org.) Cartografia Escolar. São Paulo: Ed. Contexto, 2007.

Carmo, W. R.: Cartografia Tátil Escolar: experiências com a construção de materiais didáticos e com a formação continuada de professores. São Paulo, 2010 Dissertação de Mestrado. Departamento de Geografia, FFLCH, Universidade de São Paulo.

Coll, A.: Contribución al proceso de enseñanza aprendizaje en la educación de personas ciegas por medio de la cartografía. Informe final año 2004 Proyecto Diseño y Producción de Cartografía para las personas ciegas de América Latina. Anexo IV publicaciones 2004.

Coll, A e Pino, F.: Impacto de la Cartografia táctil em La enseñanza de La Geografia em America Latina. In: Conferencia da ICA/ACI. 2007. Moscou.

Edman. Polly K.: Tactile Graphics. American Founation for the Blind. New York. 1992.

Sena, Carla C. R. G de: O Estudo do Meio como Instrumento de Ensino de Geografia: desvendando o Pico do Jaraguá para deficientes visuais. São Paulo, 2002. Dissertação de Mestrado. Departamento de Geografia, FFLCH, Universidade de São Paulo.

Sena, Carla C. R. G de: Cartografia tátil no ensino de Geografia: uma proposta metodológica de desenvolvimento e associação de recursos didáticos adaptados a pessoas com deficiência visual. São Paulo, 2008. Tese de Doutorado. Departamento de Geografia, FFLCH–USP.

Sena, Carla C. R. G. Carmo, Waldirene R.: Produção de mapas para portadores de deficiência visual da América Latina. In: X Encontro de Geógrafos da América Latina. São Paulo. Março de 2005.

Sena, Carla C. R. G. Carmo, Waldirene R.: Tactile Map Production For The Visually Impaired User: Experiences in Latin America. In: XXII. International Cartographic Conference. La Coruña. Espanha. Julho de 2005.

Sena, Carla C. R. G. e Carmo, Waldirene R.: Uso de maquetes no ensino de conceitos de Geografia Física para deficientes visuais. In: XXVI Congreso Nacional y XI Internacional de Geografia. Santiago. Chile. Outubro de 2005.

Sena, Carla C. R. G. Carmo, Waldirene R.: Uso de maquetes no ensino de conceitos de Geografia Física para deficientes visuais. In: XI Simpósio Brasileiro de Geografia Física Aplicada. São Paulo. Setembro de 2005.

Vasconcellos, R.: A Cartografia Tátil e o Deficiente Visual: uma avaliação das etapas de produção e uso do mapa. São Paulo, 1993. Tese de Doutorado. Departamento de Geografia. FFLCH–USP. São Paulo.

MAP DRAWING COMPETITION FOR CHILDREN IN INDONESIA

Rizka Windiastuti
BAKOSURTANAL (Indonesia)
rizka@bakosurtanal.go.id

Abstract: The National Coordinating Agency for Surveys and Mapping of Indonesia (BAKOSURTANAL) has been organizing map drawing competitions for children in Indonesia as a way to popularize map to children. These competitions were always handled seriously and such competitions were always participated by more than expected numbers of children. This paper will share how BAKOSURTANAL organized the competitions, from the publicaion until the judgments to get the winners.

Introduction

The National Coordinating Agency for Surveys and Mapping of Indonesia (BAKOSURTANAL) is a government body that is responsible to conduct governmental duties in the field of surveys and mapping according to prevailing regulations. As the coordinating agency for survey and mapping activities in national scope, BAKOSURTANAL has an obligation to disseminate information about services and products of survey and mapping activities, especially the ones performed by BAKOSURTANAL. It is also necessary to raise awareness about maps and the usages to various levels of community, including the children. Some of the methods used to raise public awareness include organizing various exhibitions, workshops, seminars, trainings, map adventure games, and map drawing competitions.

The map drawing competition was initially inspired when the International Cartographic Association (ICA) in cooperation with UNICEF invited BAKOSURTANAL to coordinate a map drawing competition in Indonesia. The best five drawings were then sent to Durban, South Africa, to be enrolled in an international map drawing competition held during ICA Congress in 2003. That was the first time BAKOSURTANAL, in cooperation with ICA and also Indonesian Cartographic Association (AKI), organized a national map drawing competition.

Following the success in 2003 and considering the number of children participated in the competition, BAKOSURTANAL organized the next national map drawing competitions in 2005, 2007, 2009 and 2011, and always sent the best drawings to go into Barbara Petchenik competitions in the year. In addition to the national competitions, BAKOSURTANAL also held local competitions in various areas:

- 2005 in Cibinong (West Java),
- 2006 in Surabaya (East Java) and Jakarta,
- 2007 in Jakarta,
- 2008 in Bandarlampung (Lampung),
- 2010 in Pontianak (West Kalimantan).

Children map drawing competitions, which allow the children to explore their imaginations in drawing, have been used by BAKOSURTANAL to introduce maps to children. By following such competition, children will be driven to open their atlases and learn about the world, such as the richness and beauty of their country or even province, through maps. Hopefully, this competition would (directly or indirectly) contribute to Cartography education in Indonesia, and to increase the children's care and respect to their country and the Mother Earth.

Organizing map drawing competitions

The map drawing competitions held by BAKOSURTANAL always participated by an unexpected number of participants. The national competition in 2003 was followed by 1045 participants from 27 provinces in Indonesia, in 2005 by 1002, in 2007 by 1377, in 2009 by 1179, and in 2011 by 1205 participants. The local compeitions in various regions in Indonesia were also interested by no less than 200 children. Here will be explained how BAKOSURTANAL organized the competitions.

Preparation

The preparation to organize a map drawing competition was started since about the middle of the preceding year, i.e. when BAKOSURTANAL prepared the budget for activities in the subsequent year. The organization of a national map drawing competition was somewhat different from that of a local competition. For the national competitions children drew at home or school then sent the result to BAKOSURTANAL, so the children had plenty of time to draw. For the local competitions the children came to the venue and drew on the site for about 3 hours.

Initial stage in executing a map drawing competition was to form an organizing committee at the beginning of the year when it will be run. The organizing committee of the national competitions comprised about 10 to 15 staff of BAKO-

SURTANAL, where as for the local competitions, especially the ones held outside Jakarta or Cibinong area, we collaborated with other institutions as the local hosts. In 2006 we cooperated with Surabaya State University (UNESA), in 2008 with Yayasan Xaverius Tanjungkarang, and in 2010 with Tanjungpura University, Pontianak. In general, the organizing committee consisted of three teams:

- Secretariat team who was responsible to do administrative tasks, accept the drawings or registrations (for local competitions), collect data about the drawings, and answer any questions regarding the competitions that were asked by the public.
- Publication team who was responsible to let general public know about the ongoing competition through advertisements in mass media (national newspaper, radio etc.) and/or brochures that were distributed to schools and other public areas.
- Selection team who was responsible to communicate with the juries about selection criteria, prepare and assist the juries during the judgment.

In addition to the organizing committee, at this initial stage were also formed boards of juries. For the national competitions, because we expected to have more participants then the local ones, we prepared two kinds of juries, namely: internal juries and national juries. The detailed duties of these juries will be explained later in this paper. The juries were selected considering their knowledge in cartography and art.

The organizing committee would then create a theme and rules for the competition and set up some important dates, including: when were the promotions, the last day to receive drawings/registration, the judgment, the winner announcement, and the delivery of best drawings to ICA (for national competition). The theme and rules for national competitions would stick to those of Barbara Petchenik competitions, including the drawing groups based on the ages of the authors (group A for ages below 9 years old, group B for ages 9–12, and group C for ages 13–15). For local competitions, we classified children into three groups based on their school grades (group A for grade 1–3, group B for grade 4–6, and group C for grade 7–9).

Drawing Collection

After the organizing committee was formed and the information about the competition was open to public, the secretariat team got ready to accept registration or to collect the drawings by preparing a database to store data of the participants. The database was developed using Microsoft Access and for the national competitions it included data about the authors (name, school and home addresses, date of birth, etc.) and the drawings (title, received date, etc.). Every drawing received was stamped and given a unique ID number. For local competitions the database prepared for the registrants was much simpler. Data entry was performed soon after the drawings arrived.

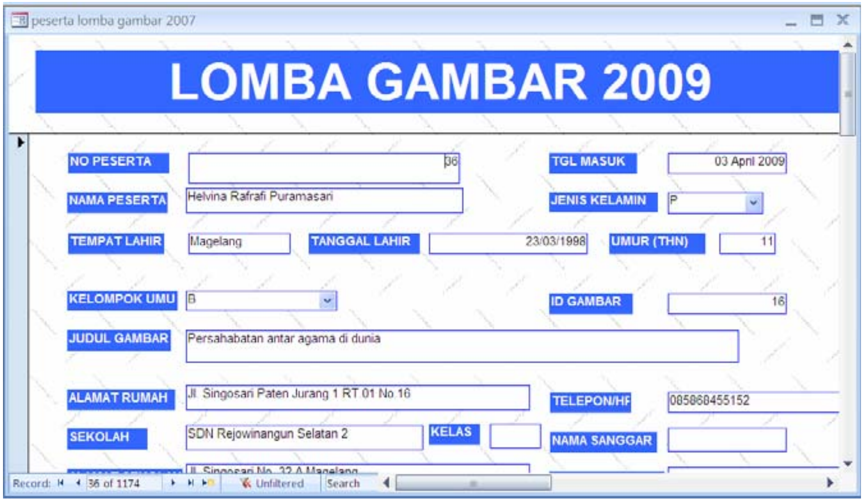


Figure 1. Database form to enter participant's data during national competition in 2009

During the national competitions, where the participants sent drawings to our address, the packages were usually delivered near the end of the deadline. Figure 2 showed the number of drawings received on a specific day during the national competition in 2007. The deadline at the time was post stamped on 30 March 2007. We can see from the graphic that most participants sent the drawings on or slightly before 30 March 2007 such that most drawings arrived on 2 April 2007. From this experience, since the following national competition in 2009 the deadline was no longer the delivery date, but the date the drawings were received by the organizing committee.

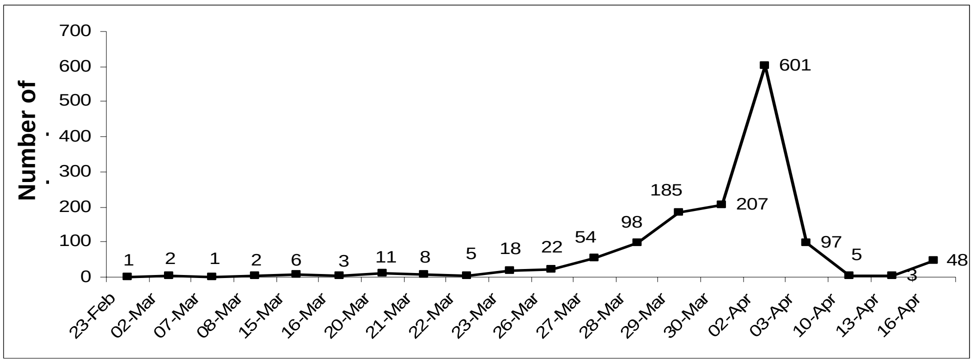


Figure 1. Number of drawings received on a specific day during national competition in 2007

The data entry was a crucial step during execution of map drawing competitions. We used the data entered in previous years to inform participants about succeeding events. For local competitions, the registrant data were used on the competition day when children came to the venue. The children were asked to re-register so they could get an ID badge, T-shirt and snacks. Children who did not register beforehand were allowed to register at the time only when the space was available for them.

Judgement

National Competition

As mentioned previously, for national competitions we had two boards of juries: internal and national. The internal juries comprised of 3-5 staff of BAKOSURTANAL who met the criteria as a jury for map drawing competitions. The national juries comprised of 3 persons; at least one of them came from BAKOSURTANAL with a strong knowledge about cartography, and at least one of them came from an art institute or was a professional artist who had experience in judging children's drawing competitions.

The mechanism of judgment for national competitions was as follow: before being evaluated by the boards of judges, the drawings were selected by the selection team of organizing committee based on their administrative completeness. The drawings that used paper size other than A3, had incomplete author's identity (such as no address or date of birth written either on the back of the drawing or on a separate piece of paper) and were out of the predefined theme, were eliminated. In fact, many drawings did not include maps or only had maps, so these drawings were considered out of theme.

If the number of drawings were more than 250, then the judgment would be done in 3 steps for every group; the first step was performed by the internal juries to eliminate about a third or half of the drawings, the second step was performed by the national juries to select 15 best drawings for each group, the last step was also performed by the national juries to select the best drawings to be enrolled into Barbara Petchenik competition and 3 best drawings from each group.

If the number of drawings were equal to or less than 250, then the judgment would be done directly by the board of national juries to select 10-15 best drawings for each group, then select the best drawings to be enrolled into Barbara Petchenik competition and 3 best drawings from each group.

During the selection process performed by board of internal juries, each of the juries was given an evaluation sheet to evaluate the drawings, as shown in Figure 3 below. The drawings were hung in front of the juries, 20 drawings at a time, and each of the juries decided whether each drawing had the following criteria: composition of world map, scale proportion of the map features (applicable for group B and C), relative position of the map features (applicable for group C only), theme suitability, color composition, and creativity. Each jury checked the criteria that existed in the drawing, and let the organizing committee do the counting.

LEMBAR PENILAIAN TAHAP I
LOMBA GAMBAR PETA UNTUK ANAK
BAKOSURTANAL 2009
KELOMPOK A

Penilai :

No	No. Gambar	Kriteria						
		Komposisi peta dunia	Proporsional skala	Posisi relatif peta	Kesesuaian tema	Komposisi warna	Kreativitas	Jumlah
1								0
2								0
3								0
4								0
5								0

Figure 3. Evaluation sheet for internal juries

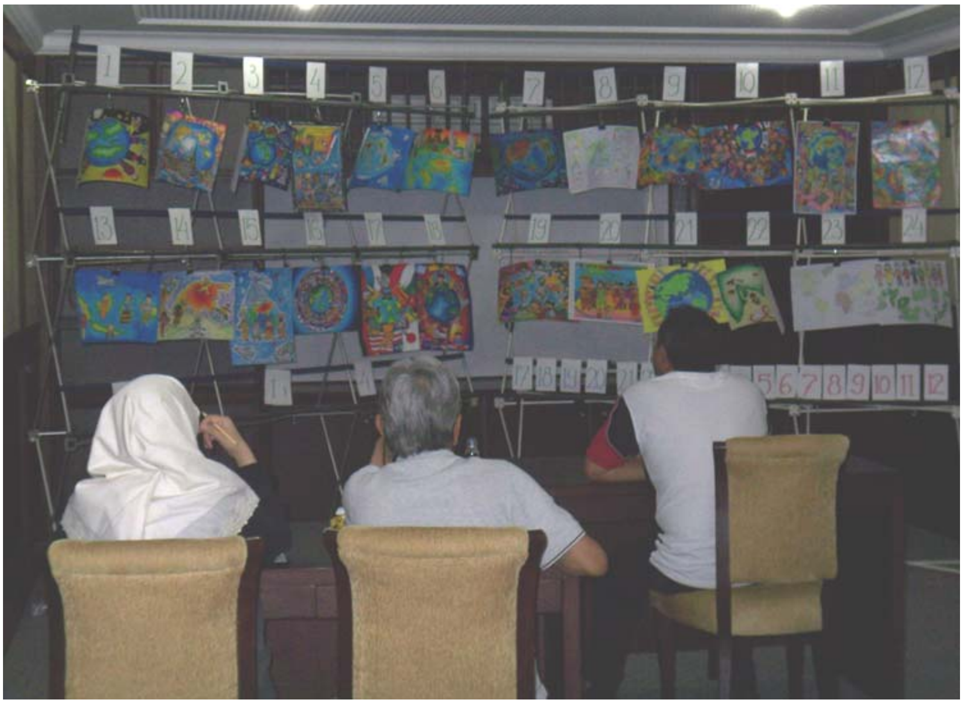


Figure 4. Judgment by board of internal juries

During the selection process by board of national juries, it is important for the juries to be able to see all drawings at once. Therefore, all drawings from each group were put on the floor with the drawing side up. The juries then looked a-round and eliminated the drawings by turning the drawing side down. It was not so hard in the beginning, but as the drawings got fewer, the juries would discuss to determine the best 15 drawings.

Figure 5. Judgment by board of national juries

Figure 6 showed the result of judgment during the 2009 competition. At that time we received 1179 drawings, 13 were sent by children whose ages above 15 years old and 5 had no author's identity, thus 18 drawings were eliminated from the competition.

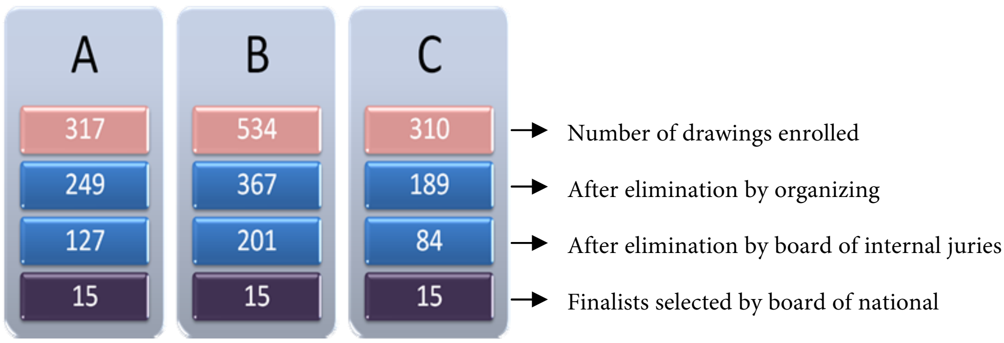


Figure 2. Elimination process during judgment of national competition in 2009

After we found the 45 finalists, the juries would then determine the overall winners who would represent Indonesia in Barbara Petchenik competition. The juries individually nominated 2 drawings for each group, totaling 18 drawings. A drawing that was nominated by most juries automatically became an overall winner. The juries would then discuss to select the drawings nominated by only 1 jury until we obtained 5 overall winners. Each jury would then give a score of 1-100 to the rest of 40 finalists, considering map contents, theme suitability and creativity. The score was necessary in case the winner candidates failed verification process.

Because the drawings enrolled in the national competitions were drawn at home or school, we need to verify that the drawings were really the work of arts of the children. Therefore, we established a verification process when we came to their home or school and asked them to prove that they drew it by themselves. During the verification process, we also checked the children's date of birth from their school report or birth certificate in order to assure that they really belonged to an age group and thus were eligible to follow the competition.

Local Competitions

Local competitions were usually held from 9 a.m. to 12 p.m. in a hall provided by the local hosts. The children, unaccompanied by their family members, sat on the floor according to their ID numbers. After all participants sat in the place assigned to them, organizing committee distributed drawing papers to be used. The judgment process begun soon after the organizing committee collected all the drawings.

Board of juries for local competition usually comprised of 3 persons: at least 1 of them came from BAKOSURTANAL and at least 1 jury taken from a local paint artist who had experience as a jury for children's drawing competitions. Similar to the judgment process of national competitions, here all the juries together determined the best 15 drawings from every group, to get the total of 45 finalists. The winners were determined by the total scores given by all juries.

During the scoring stage, every jury individually evaluated each drawing based on certain criteria. Each component of the criteria was given a weight: suitability with theme of competition (weight = 30), map contents (weight = 20), creativity (weight = 20), color composition (weight = 15), and drawing technique (weight = 15). The juries gave a score of 1-100 to every criteria component for each of the 45 finalists. The organizing committee then assisted the juries to calculate the final scores. Table 1 and 2 below illustrates how the final score of the drawings were obtained.

Table 1. Sample of initial scoring sheet by individual jury

Drawing ID	Theme Suitability	Map Contents	Creativity	Color Composition	Drawing Technique	Total Score by Jury 1
1	95	90	80	80	80	86,5
2	90	95	85	80	80	87
3	95	90	80	80	80	86,5
4	95	95	90	90	90	92,5
…	…	…	…	…	…	…

Table 2. Sample of final scoring sheet

Drawing ID	Participant ID	Score by Jury 1	Score by Jury 2	Score by Jury 3	TOTAL SCORE
9	26	93,65	76,85	93,95	264,45
8	21	94	73,95	95,7	263,65
4	20	92,5	75,85	94,95	263,3
11	2	79,25	75,95	92,1	247,3
…	…	…	…	…	…

Winner Announcement

Winners of local competitions were announced soon after the final scores were obtained, and the presents were given directly to the children. BAKOSURTANAL provided presents in forms of money, BAKOSURTANAL's products, trophy, certificate, and school equipments.

Figure 7. The champion's drawing of group A (grade 1–3) at local competition in 2008, entitled "Natural Resources of Lampung", created by Syifa Putri Atalia Sadil in less than 3 hours

Winners of national competitions were announced at BAKOSURTANAL website, national newspaper, and a letter was sent to each winner. The winners who resided around BAKOSURTANAL office were invited to pick up their presents. For those who lived in other areas, the presents were delivered by mail and the money was transferred to their bank accounts.

Conclusion and recommendation

BAKOSURTANAL has been successfully organized map drawing competitions for children in Indonesia since 2003. The high number of participants showed that the information about these competitions was well distributed. However, most of participants for national competitions were from Java Island. For example, percentage of participants coming from 6 provinces in Java Island was 73.93% in 2007 and 83.88% in 2009. This data suggested that BAKOSURTANAL needs to socialize maps to children outside Java Island, perhaps through local map drawing competitions. BAKOSURTANAL can also establish partnership with regional institutions, such as universities, local government or even painting studios to organize map drawing competitions in the region. Hopefully, BAKOSURTANAL's task to raise awareness about maps and the usages to entire levels of community can be well implemented.

References

Warta BAKOSURTANAL, 2005. Lomba Gambar Se-Jabodetabek dan Tingkat Nasional 22 Mei 2005 [online] Available at:
http://www.bakosurtanal.go.id/bakosurtanal/warta-bakosurtanal-edisi-ii-juni-2/ [Accessed 19 March 2011].

Warta BAKOSURTANAL, 2007. Indonesia Siap Kirim Wakilnya di Kompetisi the Barbara Petchenik Award [online] (Updated 22 April 2007) Available at:
http://www.bakosurtanal.go.id/bakosurtanal/indonesia-siap-kirim-wakilnya-di-kompetisi-the-barbara-petchenik-award [Accessed 19 March 2011].

BAKOSURTANAL's Website, Lomba Gambar Peta Untuk Anak Se-Provinsi Lampung [online] Available at:
http://www.bakosurtanal.go.id/bakosurtanal/lomba-gambar-peta-untuk-anak-se-provinsi-lampung/ [Accessed 19 March 2011].

BAKOSURTANAL's Website, Lomba Gambar Peta Untuk Anak di Pontianak [online] Available at:
http://www.bakosurtanal.go.id/bakosurtanal/lomba-gambar-peta-untuk-anak-di-pontianak/ [Accessed 19 March 2011].

BAKOSURTANAL's Website, Lomba Gambar Peta Untuk Anak di Pontianak [online] Available at:
http://www.bakosurtanal.go.id/bakosurtanal/lomba-gambar-peta-untuk-anak-di-pontianak/ [Accessed 19 March 2011].

CHILDREN'S MENTAL MAPS OF THE WORLD

Shimshon Livni
Kaye College of Education (Israel)
livni_s@netvision.net.il

Abstract: This paper will report on a study into the children's graphic, cartographic and verbal performance in their impressive entries sent to the Barbara Petchenic Competition of the years 2003 and 2007 and were published accordingly by J. Anderson (2005) and by T. Bandarova (2010). Following K. Gurjanovaite (2007) and J. Reyes (2010), the author sees those entries as mental maps and to study them by Reyes' (2010) Judging Model application and add the research tools of K. Lynch (1960) and O. Eide (2010) about the verbal expressions which are completing the graphic data depicted in maps (and mental maps).

Introduction

In the last two decades the International Cartographic Association (ICA) organized two international contests intended to children and youngsters. The central target of the contests was "to promote the creative representation of the world in graphic form" (Reyes, 2010, p. 1) when the participants supported were to draw a map on a general theme, that was changed in every contest. In the last years the procedure of judging the "young cartographers" entries was made systematical on the following Model (Reyes, 2010):

1. The population of the participants was divided into three age-groups: under 9, age 9–12 and above 12
2. The participants'entries had analyzed as "Maps" and studied by cartographic tools such:

   2.a Types of representation of the world

2.b Types of projections used in the maps

3. Those entries analyzed too as “Mental Maps” when they studied their
   - 3.a Pictorial and “unusual" representations
   - 3.b Pictorial connection to the “direct” Environment and “Outer Space”
   - 3.c Type of valued attitude to the Competition’s Theme
   - 3.d Interest to activate the Competition’s Theme.

The author activated in his study the judging tools of the Reyes (2010) Model when he added two further instruments:

- 3.e K. Lynch (1960) elements of inquiring mental maps
- 3.f O. Eide (2010) described verbal expressions.

The Age-groups in par. 1 were the independent variables of the reported study. The Analyzing tools in par. 2 end 3 were the dependent variables of this study.

Aim, assumption and hypotheses

The aim of this study was to evaluate the children’s entries according to their graphic, cartographic and verbal expressions.

It was assumed that the children’s entries should be studied as mental maps by using the relevant research-tools of J. Reyes (2010), K. Lynch (1960) and O. Eide (2010). Hypotheses tested by using quantitative statistical method:

a) significant differences between the entries of the age groups that studied two Years of Competition – will be obvious.
b) significant differences connected with the impact of the Competitions’ general theme on the participants’ performance – will be observed.

Hypotheses studied by using the qualitative assessment method: as is described in the Introduction Chapter of J. Anderson etc. (2005) and T. Bandrova etc. (2010).

Method

Population: 100 entries of the Year 2003 Competition compared to 100 entries of Year 2007 competition. Each year-population divided to three age group respectively. See Figure 1. Procedure:

1. The participants sorted into age groups (as the independent variables of this study), see Figure 1.
2. The research-tools of Reyes (2010), Lynch (1960) and Eide (2010) (as the 14 dependent variables of this study) identified in the participant’s entries, see Figure 1.

3. The relative value in percentages of the 14 depended variables calculated, see Figure 2.
4. The Hypotheses examined quantitatively using Two paired Ttest, see Figure 2.

Findings

Outcome of quantitative evaluation:

a) The differences between the performances of age groups of Years 2003 and 2007 was insignificant.
b) The differences between the performances of age groups of each year separately was insignificant.
c) The differences between the Means of the tested age groups on the dependent variable "the Theme is not mentioned" was insignificant.

Outcome of qualitative evaluation (main dependent variables) see Figure 1.:

a) Size of the age groups: the largest age group in Year 2003 was – "above 12" in Year 2007, "age 9–12".
b) Reference the K. Lynch's landmarks: the age group of "above 12" in Year 2003 excels his greatest interest when describes the World and/or the Theme by activating many landmarks; see Figure 1.
c) Activating the Competition's Theme – most of the entries in age group of "above 12", Year 2007.
d) Interest in the Competition's Theme – nearly 40% (!) of the participants in age groups of "age 9–12" and "above 12" in both years didn't mention this detail in their entries.
e) Verbal Expressions further the Landmark's names, appeared in about 1/3 of the entries, except of the age group "under 9" of 2003.

Conclusion

The Barbara Petchenik Competition invited the Children and the Youngsters in the interested countries to express their mental images about the World respectively to the officially declared "general Theme". The "young cartographers" entries in the Years 2003 and 2007 Competitions studied by using the ICACC Jury's judging Model (Reyes, 2010) as supplemented by the author.

It should be interesting if an additional research would be made, to inquire the next Competition's entries, to refine the reported studying mode and give some new ideas about the World as is percepted by the "young cartographers". Such work could be very helpful for the cartographers, who are functioning in the Cartographic Industry aimed at the new generation of mapmakers and map users.

Figure 1. B. Petchenik Competition, number of items in the entries

Theme: "Save our Environment"	**2003**	**2003**	**2003**			
Theme: "Many Nations – One World"				**2007**	**2007**	**2007**
Age group (independent variables)	**Age < 9**	**Age 9-12**	**Age 12<**	**Age < 9**	**Age 9-12**	**Age 12<**
Dependent variables: Cartographic analysis of the entries as "maps"						
Types of representation of the World						
2D representation – Continents and Oceans						
Hinted	7	8	17	7	10	14
Copied	3	4	1	1	26	7
3D representation						
Hinted Spheres	3	4	5	13	9	9
Copied Spheres	3	12	10	1	6	5
Mapmaker centered represetation		10	12	3	9	3
Number of entries in the Age group	**10**	**40**	**50**	**20**	**47**	**33**
2D Projection of the Earth (Copied Cartographic Projection as:)						
Mercator	2	12	22	4	17	12
Eliptic	1	6	8	1	12	5
Azimuthal, Conic		2	1	2	3	1
Rarely used Projection as Cubic			1		3	5
Number of entries in the Age group	**10**	**40**	**50**	**20**	**47**	**33**
Non-cartographic analysis of the entries as mental maps						
K. Lynch's tools for studying mental maps						
lines		2	2	3	3	4
edges				3		
districts as continents and oceans	7	27	34	16	40	19
continents only	1		5			1
landmarks as						
Statue of Liberty, N. Y.		3	4		1	1
Statue of J. Ch., Rio de Janeiro			2			
Opera, Sidney		1	3			
Kremlin, Moscow			2		1	
Totem, S. Africa						1
Totem, Vancouver			1			
Pyramids, Egypt	1	1	4		1	
Tower, London			3		1	1
Padoga, Great wall, Chine			2		1	1
Torrai Gate, Japan			2			1
Eifel Tower, Paris		1	4		1	
McDonald, KFC					2	
Eskimo Igloo					3	
Sagrada Familia, Barcelona					1	
Akropolis, Athen					1	
Statue of Buddah						1
Khaba Rock, Mecca						1
Number of entries in the Age group	**10**	**40**	**50**	**20**	**47**	**33**

Theme: "Save our Environment"	2003	2003	2003			
Theme: "Many Nations – One World"				**2007**	**2007**	**2007**
Age group (independent variables)	**Age < 9**	**Age 9-12**	**Age 12<**	**Age < 9**	**Age 9-12**	**Age 12<**
Pictorial representation of the Earth						
Human shapes as eye, head, hand, girl, dancing child, heart	1	1	4	1	1	6
Fauna shapes as dove, cat, panda, snail, butterfly, fish, ladybird, cow, dog	1	10	2		5	1
Flora shapes as flower, leaves, tree, walnut-shell		7	3		2	
Articles as pipe, ice cream, flag, umbrella, balloon, basket ball, pieces of maps, medal, card, puzzle, pizza, dancing sirt, a moon-face, a drop of water, dove's nest, knitted plate, shoe, bus, chess, ligths, skirt, lamp, balance, stitched, table cloth, tootem South Africa, anchor	1	6	12	8	9	9
Number of entries in the Age group	**10**	**40**	**50**	**20**	**47**	**33**
Connecting the Earth to some pictorial environment						
Human connection as girl, agriculturist, worker, mother, triffled girl, Noah's ark, caress child, skull, in the heart, children, united nations, drawing youngs, astronauts, publicized people, dancing children, demostrating youngs, irrigation, crowd, Earth in hand, embryo, multinational children, angel, Hope and dispair, transportation, crying child	3	14	13	14	14	20
Annimal connection as cat, dove, bear (toy), tiger, eagle, whale, snail, turtle, birds, rabbit, songbird, giraffes, mouse	3	5	4	4	8	4
Botanical connection as trees, flower, fertile env., olive, leaf, root		7	2	1	5	
Connection to the "Outer-Space" as moon, stars, sun, polluted space, political conflict, rainbow, natural hazards, satellite	3	15	9	5	15	6
Artificial connection as suburb, sattelite, icecream, reef, rural env., national flags, life belt, raptured chain, flask, cliff, umbrella, plastic bags, living room, weapon, toys, carpets, children's drawings, piano, balloon, ligths	3	5	4	3	7	3
Number of entries in the Age group	**10**	**40**	**50**	**20**	**47**	**33**
Ways to represent the competition's Theme						
Positive	6	25	33	15	22	29
Negative		2	4	2	2	2
Number of entries in the Age group	**10**	**40**	**50**	**20**	**47**	**33**

Theme: "Save our Environment"	2003	2003	2003			
Theme: "Many Nations – One World"				**2007**	**2007**	**2007**
Age group (independent variables)	**Age < 9**	**Age 9-12**	**Age 12<**	**Age < 9**	**Age 9-12**	**Age 12<**
Tools used to express idea of the copetition's Theme						
Realistic depiction	2	3	14	2	5	7
Fantastic depiction	5	21	26	11	28	22
Humorousness depiction	2	9	4	2	5	5
Number of entries in the Age group	**10**	**40**	**50**	**20**	**47**	**33**
How the Theme "Save our Environment" should be activated						
UN should save			1			
On-line connections save			1			
trade connections save					1	
Angels save			1			
Children surround the Env.	2	1	3	2		
Env. saved in child's dream			3			
Env. saved in child's heart, belly, hand, bosom	4	5	5	1		
Cats save	1					
Dove(s) save	1	1	1			
Rabbit save					1	
Birds save	1	1				
Children clean, maintain, irrigate the Env.		5	2		2	
Env. saved as Home, peacefull, a common place, surrounded by flowers, as a drop of orange	1	2	3	1	4	
to save as flora, fauna, ozon cover, nuclear free		4				
Env. bloomed as baloon						1
The Environment is threatened by… economy, danger, pollution, loss of endagered speciments, war,		2	9			
smoking, natural dangers, useless bags				1		
How the Theme "Many Nation – One World" should be activated						
The Theme in a balloon, in smily children's face,				5	7	2
dancing continents, Earth ligths up multinationality, colorfull cloth, a dove carry olive leaf						2
The Theme appears – in flags, dancing children, living in harmony, creating a multinational World, colored states, multinational connections, together eating icecream, working, help to avoid poverty, racial discrimination				8	15	14
The Theme "Save our Environment" is not mentioned	3	17	18			

Theme: "Save our Environment"	2003	2003	2003			
Theme: "Many Nations – One Worl"				**2007**	**2007**	**2007**
Age group (independent variables)	**Age < 9**	**Age 9-12**	**Age 12<**	**Age < 9**	**Age 9-12**	**Age 12<**
the Theme "Many Nations – One World" is not mentioned				2	23	13
Number of entries in the Age group	**10**	**40**	**50**	**20**	**47**	**33**
Verbal expressions in the entries	1	12	19	6	17	14
Number of entries in the Age group	**10**	**40**	**50**	**20**	**47**	**33**

Figure 2. B. Petchenik Competition, number of items in percentage and Ttest

Variables	B	C	D	E	F	G
Theme: "Save our Environment"	**2003**	**2003**	**2003**			
Theme: "Many Nation – One World"				**2007**	**2007**	**2007**
Age group (independent variables)	**Age < 9**	**Age 9-12**	**Age 12<**	**Age < 9**	**Age 9-12**	**Age 12<**
Number of entries in Group	**10**	**40**	**50**	**20**	**47**	**33**
Dependent variables: Cartographic analysis of the entries as "maps"						
2D representation of continents and oceans	100	30	36	40	77	63
3D spherical representation	60	40	30	70	26	42
Mapmaker Centered representation	0	25	24	15	19	9
2D Projections	33	50	64	35	75	100
Districts as Continents and Oceans	70	68	68	80	85	57
Landmarks	20	15	54	0	28	21
Connecting the Earth to some pictorial environment	150	116	64	135	104	100
Positive	60	63	66	75	47	88
Realistic	20	7	28	10	11	21
Fantastic	50	53	52	50	61	67
Humorousness	20	27	8	10	11	15
The Environment should be saved	100	48	40	20	9	15
The Environment should be threatened	0	5	18	5	0	0
How the Theme "Many Nations – One World" should be activated	0	0	0	65	47	31
Verbal expressions in the entries	10	30	38	30	36	42
The theme "Save our Environment is not mentioned	33	40	40			
The Theme "Many Nations – One World" is not mentioned				10	49	40

Statistical Analysis: Two paired Ttest						
N (number of dependent variables) = 14 df(2N-2) = 26, p(0.05) = 2.06						
Ttest: B:E; C:F; D:G between the Age groups						
0,8143198						
0,72996876						
0,601866384						
Ttest: B:C; B:D; C:D in the Age groups 2003						
0,580289874						
0,595540736						
0,928288251						
Ttest: E:F; E:G; F:G in the Age groups 2007						
0,983271031						
0,873040878						
0,845469892						
Ttest: 2003:2007 – the dependent var.: “the Theme isn’t mentioned”						
N (number of Age groups each year) = 3						
df(2N-2) = 4, p(0.05) = 2.78						
0,732813749						

References

Anderson, J. M. etc., ed.: 2005, Children Map the World. ESRI Press. Redlands, California.

Badarova, T. etc. ed.: 2010, Children Map the World, Vol. 2. ESRI Press. Redlands, California.

Gurjanovaite, K. etc.: 2007, Cartographic analysis of general geographic elements in children mental maps. Geography. Scientific Journal. Vol. 43 (1).

Reyes, J.: 2010, The perception of the world in maps made by Hungarian children. Eötvös Loránd University, Budapest. In:
http://lazarus.elte.hu/hun/dolgozo/jesus.htm

Lynch, K.: 1960, The Image of the City. MIT Press. Cambridge MA.

Eide, O.: 2010, An inquiry into relationship between verbal and map-based expressions of geographic information. Unpublished PhD Thesis. In:
http://folk.uio.no/oeide/dg/

Maps for the Future:
Children, Education and Internet
Joint ICA Symposium

Children map the World

CARTOGRAPHIC ELEMENTS IN CHILDREN'S DRAWINGS AS A RESPONSE TO THE RED SLUDGE INDUSTRIAL DISASTER

Henrik Hargitai[1], Pál Gábor Vizi[2]
1 Department of Physical Geography, ELTE TTK (Hungary)
hhargitai@gmail.com
2 KFKI RMKI (Hungary)

Abstract: Children respond to traumatatic events in many way. One way is drawing, used as a form of psychoterapy. We have organized a "draing competition" among children affected by a 2010 industrial disaster in Hungary, asking the children to draw pictures entitled "Red Mud and Mars". The resulting collection contains drawing that use cartographic elements as tools of artistic and metaphoric representation.

Introduction

On October 4, 2010, in Hungary's worst ecological disaster, a spill of toxic red sludge from an aluminum plant in western Hungary flooded three nearby localities. After the liquid part flew away, the red mud covered the area in a thick layer. Ten people died in the accident. Children in the town of Devecser escaped the flood as they moved from the playing ground, flooded minutes later, to higher elevation. Children of the village of Kolontár watched the flood wave from the Library – located at the highest floor – of their School building. The shocking experience caused serious psychological trauma in the children.

The drawing competition

The children expressed their feelings related to the tragedy in many ways, including psychosomatic disorders. A way for relief, a method also used in psychotherapy, was to let the children draw images of the tragedy thus process the shock mentally.

There have been several cases in the past when children affected by traumatic events – mainly war situations – were encouraged to draw their stories, mainly in order to be exhibited and to draw attention to the effect of war, conflict and violence on children – but from the perspective of the children (Chelsea Art Museum 2005, Geist 2002).

Encouraging children to draw is considered to be one of the methods of obtaining the children's perspectives on issues that are important and relevant for them which importance is emphasized by much recent research (Einarsdottir et al. 2009).

Several classes participated in these opportunities, organized as "competitions" (for motivation), at the time when the school was transferred from the affected town to a nearby village for medical reasons. One topic for these drawing competitions was "Red Mud and Mars", because the landscape was described by many locals as "Moon-like" or "Mars-like", which was further supported by the sight of chemical protection clothing of the rescue teams.

The drawing sessions (classes) were organized in Somlószőlős, a nearby village, in a temporary classroom, because children have been evacuated for their school time due to high levels of toxic dust in the air. We have made interviews with the children during of the drawing sessions, which were recorded and broadcast on the local radio (KHH 2010).

Our preconception was that children will draw a barren, red landscape with astronaut-like rescue workers.

Results

In contrast to our hypothesis, the common topic in the drawings was that the "little green men" from Mars travel to Earth by flying saucers and help the locals in the recovery works. Martians appeared in most drawings, offering help or bringing donation (nicely wrapped gift package). This suggests that the children anticipated – triggered by the sight of rescue workers – that Martians will also come and help the troubled earthlings. This may be considered as a representation of the children's wish for a heavenly help which also includes the fact that such help is impossible, since Martians do not exist. This shows a very complex idea that the children could only communicate through images: they need more help than it can be given by humans, but it would not come. Or, alternatively, it shows that since the children experienced a huge wave of help (donations) from every corner of Hungary, even Martians (symbolizing the whole universe) join the donations and wish to help. If we use this interpretation, it shows a very positive response as the children acknowledge donors and trust that even Martians will help them.

Several of the images are "taken from Space", thus showing both planets and Martian fleet of space ships approaching the Earth. This view also has a strong cultural context: since H. G. Wells and Orson Welles, Martians visit the Earth as enemies. Despite this strong cultural background, pupils show Martians as good natured beings – may be as a result of the positive experience from a large number of "alien" help, never-seen volunteers arriving to these country localities.
It worth also mentioning that in the drawings both Martians and Humans work together in masks and special clothing – they both need protective clothing, thus the difference between them is eliminated.

In one of the drawing, may be ironically, a human in space suit visits Mars and says "It is just like the Earth".

Also unexpected, many drawings show Mars as a globe and Earth as a globe with continents and oceans displayed in a cartographic way. Several drawings show both planets in several scales from local to global which may be influenced by television news transmission's visual style.

The two planets in most cases are depicted as global or partially visible global images. The Earth appears as it is shown in topographic maps: continents are well visible and are colored green, mountain ranges brown, oceans blue and arid spot marks the location of Devecser as seen on a satellite image. Mars is either red and featureless or craters are shown as flat or somewhat elevated circular features, holes with a rampart or rim, and, in some cases volcanoes of the same size are also shown. Various symbols are used for crater representation. Their nature is clear in all cases.

Conclusions

The pupils affected by the disaster used very complex and often metaphoric representation of a mixture of their feelings, hopes and reality. Cartographic elements, including colors and various relief representation methods, helped them in telling a complex message and have been used as a proper form of art representation of surface features have been arranged in an artistic way. Despite the young age and the relative obscurity of the pupils, they showed that such a competition can help not only as a psychotherapy, but also it brings out true artistic values of the children. Such artistic expressions of children's hand-drawn maps are also highlighted in the Barbara Petchenik Competition, organized by ICA's Commission on Cartography and Children (Reyes Nuñez 2007).

Appendix: A selection of the drawings

Bakos Beatrix and Vinter Bernadett: “Destination: Planet Earth”. The location of the red sludge disaster is marked by the red spot.

Fenyvesi Fanni: “We come, we help”. Both planets have a equal area of various landforms: on the Earth, unrecognizable – stylized – continents with mountains and oceans, plus an anomalous red area (the disaster site), on Mars there is no anomaly: the planet has three major land cover type: positive landforms: volcanoes, negative ones: crates and plains in between.

Göcsei Eszter. Earth has oceans, continents and a broken polar ice cap, while Mars is almost featureless

Habor Konrád: "Destiny: Devecser". A very complex, "motion picture" representation with picture-in-a-picture technique and zoomings in and out. Mars has positive landforms (crater or volcano) cracks and plains.

Joó Virág: “It is just like the Earth” Several planets appear here, with Mars having 3D craters, the Moon having a 2D representation of craters, the other bodies are featureless.

Kálmán Alex. Mars shows the same texture as the red sludge, black fragments on red backgound. Black and red are clearly of different physical nature in the two cases but their representation is the same.

Nagy Viktória: "Hold on, we help". On the Earth, the broken ice caps are clearly visible, while Mars have a red plain background with various sized circular features.

Nagy Viktória. Mars has craters or volcanoes – it is not clear from the drawing, which unconciously calls back the uncertanity on the origin of Lunar craters in the 19th–20th century. In contrast to Mars, Earth is represented as flat: only the known colors, well known from color coded topographic maps refer to relief.

Szilvágyi Bence. Colorful Erth with a similary colored space ship heading to uniformly colored Mars, through the black space in between.

Pápai Szabina. Color of the Earth became Martian: however, they are cleared by the almost similarly (but still, well distinguishably) equipped and dressed Martians and Earthlings together.

Acknowledgement

We are grateful for the help of the Veronika Trombitás, the Teacher of Arts at Gárdonyi Géza Elementary School in Devecser and the children who participated.

References

Einarsdottir J., Dockett S., Perry B.: Making meaning: children's perspectives expressed through drawings. Early Child Development and Care, Volume 179, Issue 2 February 2009, p. 217–232.

Reyes Nuñez, J. J.: Artistic Expressions in maps made by children. 2007. Available at http://lazarus.elte.hu/hun/dolgozo/jesus/artandmaps/poster1.pdf

Chelsea Art Museum: Through My Eyes: Children's Drawings from Conflict Zones. Exhibition July 14–30 2005

Geist A. L. (ed) 2002: They Still Draw Pictures: Children's Art in Wartime from the Spanish Civil War to Kosovo. University of Illinois Press

KHH: Közös Hullámhossz Rádió, Devecser, Aired on Oct. 27. 2010.

THE SPATIAL NOTIONS OF THE CULTURAL UNIVERSE OF CHILDHOOD

Paula Cristiane Strina Juliasz[1], Rosângela Doin de Almeida[2]
Post-graduation Program in Geography Geography and Cartography Teaching Research Laboratory, São Paulo State University (Brazil)
1 paulacsj@rc.unesp.br
2 rda.doin@gmail.com

Abstract: In Brazil, the area of school cartography counts on an event called Colloquium of Cartography for Children and Scholars. In the last edition of the Colloquium in 2009 themes which deserve some research were indicated, among them are the studies about 'cartography and childhood'. We elaborated this project with the objective to contribute with these studies. We are here investigating the elementary relations established by children aged 3 to 4 years old in the time-space-body organization. We will carry out an inductive analysis of the data registered during teaching activities which mobilized the time-space relations. This study has the objective to present the utilization of children literature as a way to understand these relations in the children's cultural universe.

The spatial notions in the cultural universe of childhood

In school activities students and teachers re-elaborate their personal experiences, constructing and reconstructing knowledge, making the view from the inside of the school an essencial element for the studies about teaching. Thus, the studies carried out in the Geography and Cartography Teaching Research Laboratory (LABENCARTOGEO, São Paulo State University, UNESP, campus Rio Claro) take the school culture as reference. It is understood that the knowledge and school practices consist of social constructions, less connected to the knowledge prescribed in the curriculums, therefore founded in the knowledge and practice endowed with cultural values and with the school institution itself, which also fundaments the present study.

Studies developed in LABENCARTOGEO are the result of a trajectory of the Brazilian studies about Cartography teaching at school, initiated after the I Colloquium of Cartography for Children, held in Rio Claro (SP) in 1995. The event was held in 2009 and there some topics which need to be researched and studied were recommended, among them are the topics concerning childhood. Although there are several studies carried out by Brazilian researches about the genesis of the spatial representation in children's drawings, these studies do not reach kindergarten.

In order to meet this demand, we outlined this master's degree research entitled "A study about the cartographic language and the time–space representation by 4–5 year-old children" (this research is funded from The State of São Paulo Research Foundation – FAPESP). This research is mainly justified by the comprehension of time–space–body organization established by children and their representations, aiming to contribute to a childhood-related cartography. For this, we need to comprehend the motor-sensorial development of the child.

Time – space – body organizations

With the comprehension of the fact that time and space are inextricably linked comes a pertinent question: how this relation is present in childhood, once space and time are fragmented and little by little acquire linearity and a sequential sense? One of the clues to answer this question is to consider that it is through the relations which are established in the social groups in which they are inserted that the pre-school children become aware of the different dimensions and relative values concerning time–space.

In this sense, we have an important reference on Vygostky and his successors for the analysis of the registers of teaching situations. Oliveira (1992, p. 33) states that 'Vygotsky's postulations about the biological and social factors in the psychological development point to two complementary ways of investigation: on one side, the knowledge of the brain as a material substrate of the psychological activity, and, on the other side, the culture as an essential part of the constitution of the human being, in a process in which the biological becomes social-historical'.

Considering this, the same author shows that the emergence of the orality allows a new structural organization of the action, attributing to the symbolic activity initiated with the speech an organizational function which produces fundamentally new forms of behavior. Almeida (1994, p. 9) states that 'there is a convergence between the speech and the practical activity (action) in a way that the children control the environment through the use of the speech, before controlling their own behavior. There is a relation among time, space and speech. With the help of the speech, the children reorganize the visual-spatial field, evoking absent objects through the word and creating a temporal field that is perceptual, real and visual as well.

In the same line, Wardswoth (1992) presents the language as a social knowledge of adaptive value, that in the period between ages two to four or five is not characterized by the intention of communicating, and the thought that involves this language (a form of representation of objects and events) is free from the limitations of the direct action of the sensorial-motor thinking. With this, we can notice the relation between thinking and language. It is possible to observe the interaction of the psycho-physiological and social-cultural factors in the domain of the space, as many situations can be favorable for the development of particular competences, such as the ones that mobilize the proprioception, which refers to the sensibility of the movement of a particular part of the body or the whole body, or kinesthesia, differentiating the parts of the body.

Several studies based on the psychology of development and learning have indicated that the progressive acquisitions in the corporeal field amplify the domain of the space and that the posture influences the apprehension of the information about the environment. With this, special references are established in relation to the body itself, allowing the ingression in the founding factor of the special organization: the corporeal scheme.

According to the wallonian perspective the corporeal scheme is the result of the relation that is established between the postural space and the environment space. The corporeal scheme is the cognitive basis on which the exploration of the space which depends both on the motor functions and the perception of the immediate space.

According to Le Boulch (1982) as soon as the children are aware of their oriented body, the temporal space increases and its geometry allows them to spread the axes of the body, serving as coordinates in the acquisition of the euclidian space. When this happens, the articulation between the body and the more abstract and less limitative space is reached.

In this acquisition, it is possible again to notice the importance of the language in the formation of the concepts, making it possible to dissociate the corporeal scheme of the body itself and Project it on the objects. Lurçat (1979) states that we project the orientations from our body (above/below, left/right, front/behind) in the space. As for the language scope, Le Bouch (1982) states that it allows the children to establish their references and relate them in a topological space, a process that can take place approximately at age three.

Le Boulch (1982, p. 124) complements saying that the definition and orientation of the axes of the euclidian abstract space influence the reintroduction of the body which will represent the true reference system.

In addition, the corporeal scheme is amplified through graphical representations. Greig (2004) distinguishes five stages in the construction of the human figure: the tadpole figure synthesis, its verticalization, the organization of the head-body structure, its improvement and the finishing with the drawing of well distinguished male and female figures.

The corporeal experiences in the space influence the internal space organization which are present in the representation of the human figure. These representations are originate in the acquisition of the closed forms that generate the tadpole figure in the representation of a character, which will later create an dissatisfaction in relation to its property to represent the body. Thus, concerning what we can consider a childhood-related cartography, the verticality of the body plays a structuring role. Almeida (2009, p. 6) states: 'we think that this point of construction of the corporeal scheme is the fertile ground in which the notions about other spatial coordinates germinate. The verticality becomes the main axis of the whole human spatial organization (...). Therefore, it is in the childhood that the notion of special coordinates is originated. The drawing of a character is not only a drawing, for it brings in itself the germ of cartography.

Concerning verticality, while addressing the corporeal scheme and spatial organization, Le Boulch (1982) considers the vertical and horizontal references fundamental to constitute a system of coordinates which establish relations of order which will in turn orient the euclidian space, after the topological space.

Other authors have addressed the representation of the space, among them and of great importance is Jean Piaget, author of Space representation in the child, co-written by Barbel Inhelder. It is important to consider that Piaget's studies did not consider the space as a geographic concept, as Almeida (2001, p. 59) states: 'the authors' concerns were related to the mathematical and geometrical space, which although not referring to the terrestrial space the same way as geography, constitutes the basis of Cartography'. Still according to Almeida (1994, p. al. 48) 'the theory that Jean Piaget constructed with the help of a group of researchers remains as a fundamental theoretical support for the studies about the representation of the space, mainly because it addresses the construction of the mathematical space by the children (topological, projective and euclidian relations) on which the geographical space leans'.

The sensorial-motor activities and their relation with the corporeal scheme are fundamental in the construction of the space by the child. Therefore, we developed a number of teaching activities that mobilize the time–space–body organization with the objective to analyze the performance of children aged 3 to 4 in learning situations.

The investigation path

To investigate the relations that children establish in the time–space–body organization we will carry out an analysis of the data obtained from ethnographic registers, based on the methodology of the qualitative research (Bogdan and Biklen, 1994).

In this approach, the presence of the investigator in the place of the studies allows the understanding of the actions of the individuals who are to be studied, their activities and environment, aiming at the approximation between researchers and researched. Thus, according to Erickson (1989) the qualitative method has as basis the intensive and long-term participation in the field, accurate registers about what happens in the field, analytic reflection on these data and written register of the participative observations. Under this perspective, the researcher should try to find ways to understand the meaning of the manifest and latent of the behaviors of the individuals, while trying to maintain an objective view of the phenomenon.

The researcher plays the subjective role of participant and the objective role of observer, reflecting about the experiences of the students and about the narratives produced by these observations and recordings of activities in the classroom. This type of narrative investigation is a variable of the qualitative research, being justified by the fact that we – human beings – are story-tellers organisms that, individually and socially live reportable lives. (Connelly and Clandinin, 1995, p. 11)

After the activities performed by the children, narratives about the facts and students' dialogues are prepared, allowing the emergence of several "selves" through the interventions and students' productions, the reflections on the activities and aspects of the process (Conelly and Clandinin, 1995, p. 44). In this perspective, both the teacher and the students are story-telleers and also characters of their own and other stories. Therefore, the narrative structures the experience that will be studied and will be the way by which it will be analyzed and how it will be presented.

As an example, we will present a teaching activity that was performed with children from kindergarten. It is important to emphasize that the dialogues exposed here use the initial letters of the students' names and TEACHER refers to the researcher who performed the practical activity.

Cartography in the children's universe

To perform this activity, we chose a children's literature book because this kind of book mobilizes the imaginary of the children and is widely used by the teachers. We used the book "A Pirilampéia e os dois meninos de Tatipurum" (The Pirilampéia and the two boys in Tatipurum), by José Rufino dos Santos, a story of two boys who live in Tatipurum (a planet). Each boy lives in one side of the planet so they always argue about who is upside down.

A cicada called Pirilampéia, helps them to find out that in the space there is no upside or downside, no matter the side of the planet you are on. From this story we notice that the spatial relations of neighborhood (upside/downside) could be developed in the classes.

We planned a didactic sequence composed by three activities developed in a class (Pré I A) with kids aged from three to four years old, at "Escola Municipal Sueli Maria Proni Cerri", in the city of Rio Claro, São Paulo. In this study we will present the first stage of this didactic sequence, which has the purpose to get to know and represent the story in a tridimensional material.

The activity was recorded – image and sound – making it possible to transcribe the speech of the participants and also the gestures of the students, elements that sometimes scape from the teacher-researcher's immediate perception. For this transcription, we used the minuting technique, which consists in taking notes of the observation in intervals and when necessary integrally transcribe parts of the participants' dialogues. , These transcriptions helped in the elaboration of the narrative that reports the development of the activity.

To perform the activity, we divided the students in two groups so that we could register the students' dialogues and actions more accurately. ANA, GAB, JES, JHE, MAR, VIN, participated in the activity, and they were chosen using affinity as criteria, because the activity involved pair-word.

We had the students sit around a table and started the story by the observation of the book cover (Figure 1) and reading the title "A Pirilampéia e os dois meninos de Tatipurum" (Pirilampéia and the two boys from Tatipurum). In the beginning, the characters "Tom" and "Dick" are introduced, and to make it easier to distinguish them we talked about the color of their hats, Tom wearing a blue hat and Dick a green one. JES anxiously asked what Tatipurum was. We showed that it was a planet in which the boys lived.

(TEACHER) Tom and Dick lived in planet Tom lived in one side, Dick in the other – each character is shown on different pages of the book.

So we moved on, reading the story using the book's illustrations:

(TEACHER) Tom and Dick did not have much to do. Tatipurum was a boring planet. Tom was always chasing ants. He put them on the palm of his hands and blew the little creatures to space. Dick tried to spit farther and farther. Each time he tried to break his own record. One day, tired of this game, he shouted to Tom: 'Hey, boy! Do you like to stay upside down?'

While reading this excerpt, some children laughed and looked curiously at the illustrations. And, in this moment, the question "who is upside down" appears as the central conflict of the story, which promoted some questioning from students like GAB, who asked after seeing the illustration (Figure 2):

(GAB) I want to see him upside down! Where is it?
(TEACHER) He is saying that he is right side up and that the other is upside down. Let's see who is upside down – I answered – So, the other said: it is you who is upside down. I am right side up.

Figure 1. Book cover

Figure 2. “Who is upside down?’

To prove that he is not upside down, Tom plants a tree called Jameleira and says ‘Jameleira grows upwards, doesn’t it? So, if I am upside down it doesn’t grow. When they saw the illustration (Figure 3) of the planet Tatipurum with this tree the students asked to turn the book so that the illustration of the Jameleira was vertical, as shown in Figure 4.

Figure 3. Illustration commented by the students

Continuing the story, Dick made a balloon and asked Tom: ‘a balloon goes to what direction?’. Tom said that the balloon goes upwards, so Dick stated that if he were upside down the ballon would not go upwards. The balloon went upwards and the two boys began to fight. Then appears a cicada called Pirilampéia, in the planet Tatipurum, She came from the planet Pirilampeu . She wanted to know why the boys were fighting and when she understood what was going on she explained: ‘I, who come from space, can land on Tom’s space. Then, Dick is upside down.’ Then, Pirilampéia flew to Dick’s side and said: ‘Now it is Tom who is upside down”. And I finally said that in the space there is no upside or down-side, asking the students to change sides.

To talk about this change I said “one here” and gesticulated. The student JHE also gesticulated and said “one there”. These gestures show the notions of ‘near’ and ‘far’ related to ‘here’ and ‘there’.

Figure 4. Position asked by students

When we finished telling the story, we asked the students to get in pairs. I informed that we would perform an activity with the materials I had brought (Figure 4). These materials consisted of a green foam ball and the pictures of the following elements: Pirilampéia, Tom, Dick, Jameleira and the balloon. The students were supposed to place them in the correct place on the foam ball.

We distributed the material to each pair which caused some conflicts among the students, as in this stage of development egocentrism is a characteristic of the children. Some students explored the material rolling the foam ball on the floor or throwing it up. After, we gave them character Tom.

(TEACHER)	Who is this?
(JES)	Tatipurum.
(TEACHER)	Tatipurum is the planet that is on your table. This boy wearing a blue hat is Tom.

Then we gave them character Dick. We asked them to place the two characters (Tom and Dick) in the planet "Tatipurum".We observed that some students as JHE had already started to do this, before we asked them to do so. However, we noticed that the pair MAR and JES was not doing what they were supposed to, instead they were disputing the material. JES asked me which figures were MAR's, and it was necessary to talk about the division of the material and the proposal of the pair work.

As the pairs placed the characters, they talked a little about their actions. JES stated that the characters were organized that way because MAR "did it the wrong way":

(TEACHER)	Did it the wrong way? What do you mean?
(JES)	She was supposed to put hers here and not where mine is.
(TEACHER)	And, why do you think that hers is supposed to be put there? – trying to understand if what she was saying had any relation with the organization fo the characters in the story.
(JES)	Because it cannot be put beside mine
(TEACHER)	Why don't you want one beside the other?
(JES)	Because not.

Trying to understand MAR's position in the activity, we asked:

(TEACHER)	MAR, why did you want to put it in this side?
(MAR)	Because I wanted to do so.
(JES)	But I didn't!

We observed that this pair was more concerned about the object itself instead of considering the story and there was evidente dispute between the children despite their affinity. Answering "because I wanted to do so" can be related to the egocentrism t can also indicate that one of the students found out that the characters occupied opposite positions and the other did not see this clearly.

The pair ANA and GAB stated that they had placed the characters one in each side 'because we like it this way'. The students shared the material in the following way: GAB stayed with Dick and ANA with Tom. To show the way they had placed the characters ANA placed Dick in the opposite side. In this case, we noticed that the the character placed by GAB served as reference to ANA. GAB, talking about the position of the characters concluded: 'this here and that there'.

In the third pair, JHE stated that the characters were one in each side in the activity because they were in this position in the book. Then, with the characters placed on Tatipurum, I introduced other elements of the story that would also be placed on the foam ball: Pirilampéia, Jameleira and Ballon. Some questions e-merged:

(JES)	Which of them made the balloon? Let's see in the book? Does anyone know who made it?
(JHE)	The green one.
(TEACHER)	Right. The one with the green hat, Dick, made the balloons. The one with the blue hat, Tom, planted the Jameleira.

I felt the need of a referential which would allow the exploration of the no-tion near/far, using the objects created by the characters and their location on the planet Tatipurum. I observed that JHE and VIN were disputing the material and were not in agreement about the position of the balloon. VIN indicated that he would place it beside Tom, but before he had said that Dick had made the balloon and JHE stated that it should be placed nest to Dick. VIN's suggestion prevailed.

Figure 5. Production by JES and MAR

Figure 6. Production by ANA and GAB

Figure 7. Production by JHE and VIN

To finish the activity, we had the students sat together and started a conversation:

(TEACHER)	The balloon near Dick and Jameleira near Tom, because he palnted it. And Pirilampéia? – observing the material used by ANA and GAB.
(GAB)	To help them.
(TEACHER)	What kind of help?
(GAB)	Prevent them from fighting
(TEACHER)	What did she say to make them stop fighting?
(JHE)	To change.
(TEACHER)	Let's change here, in your activity?

The children accepted the suggestion and so we changed the position of the characters. We observed that JHE changed the position of the characters and other elements as well, placing the balloon close to Dick and Jameleira close to Tom, actions that VIN did not adopt despite his suggestions. This demonstrates the importance in developing individual activities with children from this age group when the objective is to understand individual notions related to topological notions. To help in the comprehension we asked:

(TEACHER)	What did they notice when they changed places?

There was silence and I moved on. They noticed that there was no upside or downside, as Pirilampéia said: "when I am here, Tom is upside down and if I fly here it is Dick who is going to be upside down. But in space there is no upside or downside – I said using the concrete material.

This finalization – using the concrete material to explore the problem was positive, as the students were able to Interact and explore once more the narrative.

Final Considerations

Children's literature is really a bridge to the universe of childhood. We observed that as the story advances a sequence of facts is established which pre-establishes the temporal sequence and that the Reading of stories can promote the construction of linearity in the relation time–space.

In this activity we could observe that the students took the story as reference to locate certain elements, as in the case of the tree and the balloon (JES asked the peers if they knew who had made the balloon before placing it). Some children used a previous action as reference, as ANA, who placed the character after GAB had done it. We can state that some children may have placed their characters according to the illustrations of the book (JHE anticipated the explanation of the activity placing one of the boys in a side of the planet).

After this activity we noticed that it was important to perform more activities to promote the relations of neighborhood and that it would be necessary to carry out an individual activity to verify the performance of each student. So, two other activities were planned. The first consisted in the organization of the elements of the story through pasting (using bidimensional material) and the second a drawing about the story.

The students' productions are "registers" by the children themselves concerning the theme and can be filed in an individual portfolio. In addition to these materials, the dialogues show that this kind of activity promotes a collective discussion about some topics allowing the production of knowledge by the interaction among people.

We emphasize the importance of the techniques used to register the activities, because they enabled us to obtain accurate information about the students' thinking (in the dialogues transcribed in the recording minuting) As a result of this research we hope to obtain a rich collection of registers and narratives to be analyzed in the future, and also clarify some aspects about the relations time–space–body and their representation.

References

Almeida, R. D.: 1994, Uma proposta metodológica para a compreensão de mapas geográficos. 1994. Tese (Doutorado em Educação), Faculdade de Educação, Universidade de São Paulo, São Paulo.

Almeida, R. D.: 2001, Do desenho ao mapa. São Paulo: Contexto.

Almeida, R. D.: 2009, Cartografia e Infância. In: VI Colóquio de Cartografia para Crianças e II Fórum Latino-americano de Cartografia para Escolares. Juiz de Fora, MG. 2009. Avaiable at
<http://www.scribd.com/doc/21198272/Cartografia-einfancia?
secret_password=1y7uc0bv6objyzc80osp> [Accessed 10 February 2010].

Bogdan, R.. and Biklen, S. B.: 1994, Investigação Qualitativa em Educação: uma introdução à teoria e aos métodos. Translated by M. J. Alvarez; S. B. dos Santos and T. M. Baptista. Porto: Porto Editora.

Connelly, F. M. and Clandinin, D. J.: 1995, Relatos de Experiencia e Investigación Narrativa. In: J. Larrosa. Déjame que te cuente: ensayos sobre narrativa e educación. Barcelona: Editorial Alertes, p. 11–59.

Erickson, F.: 1989, Metodos cualitativos de investigacion sobre La enseñanza. In: M. C. Wittrock. La investigación de la enseñanza II. Métodos cualitativos y de observación. Barcelona: Ediciones Paidós.

Greig, P.: 1994, A criança e seu desenho: o nascimento da arte e da escrita. Porto Alegre: Artmed.

Le boulch, J.: 1982, O desenvolvimento psicomotor: do nascimento até 6 anos. Translated by A. G. Brizolara. Porto Alegre: Artes Médicas.

Lurçat, L.: 1979, El niño y el espacio; la función del cuerpo. Translated by Ernestina C. Zenzes. México: Fondo de Cultura Económica.

Oliveira, M. K. De: 1992, Vygotsky e o Processo de Formação de Conceitos. In: Y. La Taille and M. K. de Oliveira and H. Danta, Piaget, Vygostky, Wallon: teorias psicogenéticas em discussão. São Paulo: Summus. p. 23–34.

Piaget, J. and Inhelder, B.: 1993, A representação do espaço na criança. Translated by B. M. de Albuquerque. Porto Alegre: Artes Médicas.

Rufino, J.: 2000, A Pirilampéia e os dois menino de Tatipurum. São Paulo: Editora Ática.

Vygotsky, L. S.: 2008, Pensamento e linguagem. 4th ed., Translated by J. L. Camargo 2008. São Paulo: Martins Fontes.

Wardsworth, B. J.: 1989, Inteligência e afetividade da criança na teoria de Piaget. São Paulo: Livraria Pioneira Editora.

TEACHING CARTOGRAPHY TO CHILDREN THROUGH INTERACTIVE MEDIA

Marli Cigagna Wiefels[1], **Jonas da Costa Sampaio**[2]
Universidade Federal Fluminense (Brazil)
1 cigagna@vm.uff.br
2 jonasjjj@yahoo.com.br

Abstract: Computer technology arrives very quickly to schools where young students from the first grades already utilize it for electronic games, for access to internet or for video games, among friends or in family. The proposal to build an interactive media with the basic information about the city of Niterói (State of Rio de Janeiro) was the first step of an activity intended to help geography teachers in their daily work.

The municipality of Niterói, located in the State of Rio de Janeiro, has 458.465 inhabitants (2001) and is the scenario of all geographic information provided by this media. The location of UFF in this municipality and the edition of the school Atlas of the municipality of Niterói, implemented during a former university project, constituted the main inspiration for the present project. Students and schoolchildren were mobilized for the project and contributed providing information for the media.

All begins with a mental map of the schoolchild going to school, with different graphic situations: the street of the school, the school itself, the classroom. It is in these places that all events of the media happen.

According to the Brazilian National Programme Parameters (Parâmetros Curriculares Nacionais – PCN) one should «know how to use different information sources and technological resources in order to build the elements of knowledge». This is very propitious to the introduction of this media in the first grades of the basic school.

The building of mental maps, the understanding of photographic images, orientation, environment and the graphical recognition of objects are the main themes treated in the media. In the present project, school and graphic cartography provide the young pupils with a material which stimulates them to learn and with recreational activities which strengthen their liking for geography and cartography. At the end of the project, the media will be open to public on the university web site and dissemination seminars will be provided to school teachers of the municipality.

Methodology

The idea

«Classroom in a shoebox». The idea appeared during the preparation of a model of a classroom which was materialized in a shoebox. The model allowed the visualization of the physical elements of a classroom according to a vertical spatial projection.

The elements of a classroom in the first grades of the basic school are very propitious to the project: they constitute significant fixed elements like the student desks, the teacher desk, the blackboard, wall charts, the bookshelf, door and windows. On the teacher desk we find a terrestrial globe, books, pieces of chalk, a cleaner. On the sideboard in the corner, we find a small museum nearby an aquarium. Based on these elements, other icons will be presented and activated in the media.

The activity will be developed based on the classroom. But, before to arrive in the classroom, other scales are presented, as the building of a mental city map, the arrival at school and finally the classroom.

For this purpose, many proposals were suggested and selected. A bibliography specialized in school cartography was consulted and surveys of electronic games were necessary to perform the different stages of the media.

The presentation of the activity begins with a sketch drawn by a child (mental map) symbolizing the way from home to school. In a second moment we see a bus passing in the school street. It stops and a child gets out. He goes until the pedestrian crossing and waits for the green light to cross. He is now just at the entry of the school. During these stages, we see several situations that help in acquiring knowledge. The teacher will be able to treat several aspects of localization, orientation, and space with his pupils. He will also deal with the location of the school in the district, the orientation of space according to the pupil's home and the representation of the near space related to the far space. All different special points nearby the school will be observed and lived in the media.

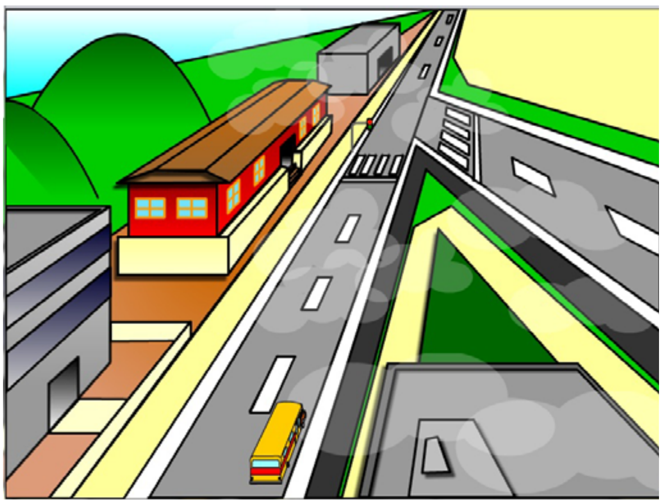


Figure 1. The bus run to go to school

Organization and list of the themes

The themes selected for the media are: the Earth references, the rotation and translation of Earth, the orientation with the compass, the cartographic and historical representations of Niterói, the landscape, the coastal fauna and environment.

The presentation of these themes proceed from the fixed elements in the classroom, as for instance the terrestrial globe on the teacher desk, which activate many windows informing about geographic concepts and suggesting games to pupils with demonstrative icons.

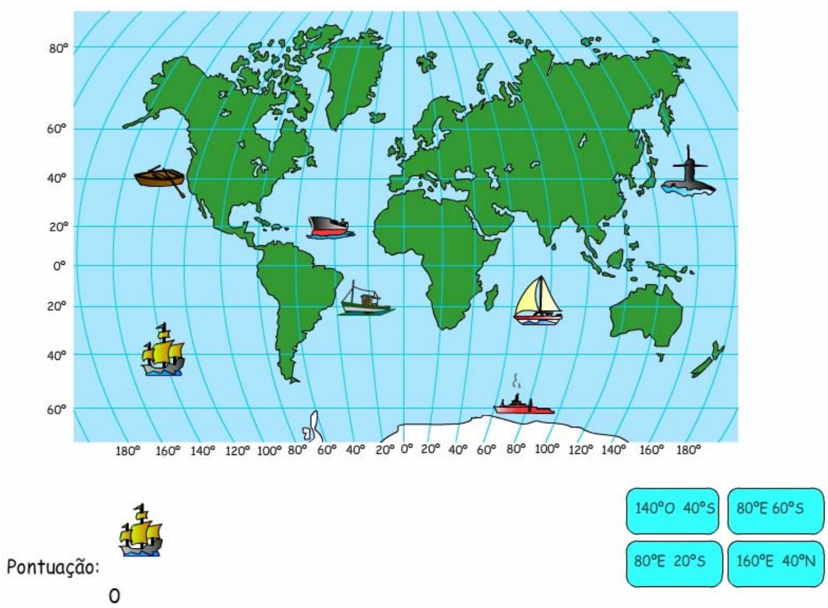


Figure 2. Localization game: where are the ships?

Human resources

Building up the team is the most important stage as well as the most difficult, mainly when it is about preparing activities for children. The project is performed as an University extension activity, entitled "Production and dissemination of didactic material for the teaching and practice of geography". In the team, we have a scholarship student from the computer science course and three scholarship students from the secondary school programme «Young Talents for Science»

"The Young Talents project is a scientific pre-initiation programme implemented since 1999. This project is realized in partnership with research institutions and with public and private universities of the State of Rio de Janeiro. Through this mean, students of the public secondary and professional schools are inserted in scientific pre-initiation". (CECIERJ Foundation)

The "young talents" Felipe Correa Mesquita, Kenya de Oliveira Silva Souza and Maicon Peclat are students of different secondary schools of a Niterói neighbouring municipality and participate for the second consecutive year in the researches for this project. They collaborated with the authors in graphical work and in the design of the media, as well as in bibliographic research.

Resources and institutional support

The project is implemented at the UFF's Institute of Geosciences, in its cartographic laboratory, with the direct support of the Department of Geo-environmental analysis and of the UFF's Board of Extension, where the project is registered.

The project is very ambitious and the financial resources are limited to the scholarships awarded to the students. It has a great educational value as it makes secondary students work together with university students. As a matter of fact the project has begun through an exchange of ideas between the members of the team. The data inserted in the project were provided by the students of the project team during their researches and of course also by the authors.

Creating and realizing activities

This includes the design of the boards as well as the illustrations included in the work, the supporting pictures, the researches about the contents, the conception, the graphic programming, the animation, and the final arrangement.

Evaluation

The evaluation of results will be done in schools where the media will be tested. The results will be presented in the academic agenda of the UFF during the Science and Technology week of the University. The results will also (and mainly) be presented to the teachers of the public schools network during a special seminar.

Development of the media

The planning and execution of the project are based on the content of the media with a special language adapted to the children of the first years of basic schools. A special attention is given to the content and to the way this content can interact in the education and in the learning motivation of geography and cartography. The progress attained in this training leads the children to be more reflexive and clever in the content games and in taking notes. The selection of themes is strongly associated to the "fix points" located in the classroom space.

The objective of the media is to allow a constant dialogue with the «playing» child who will be able to play alone at home or in the school computer room with the presence of a teacher who can intervene and orient him in the utilization of this pedagogic tool.

By clicking or by passing the cursor on the image, many elements are activated and a window opens in order to inform about the next steps of the proposed activity. At this moment information and concepts are proposed followed by games. The time taken to perform the games is measured and helps the player to evaluate himself.

The creation of themes

Themes are grouped according to significant elements in the classroom (board, teacher table, pupils desks…) that we call "fix points". This group of objects allow the building of the contents.

The different points of view of the classroom image were graphically designed based on pictures taken in a model classroom located in the premises of the UFF's Institute of Geosciences. These pictures were registered in different angles. This allows the vision of space and environment according to different perspectives.

The Earth rotates (rotation and translation movements – seasons of the year)

These themes are developed based on the board «birthdays this month» located near to the door. The media, in its basic conception stimulates the ordinary daily life of a classroom in the first years of basic school.

In order to highlight the theme "The Earth rotates" we begin with a Globe rotating from west to east, simulating the alternation day/night. Information about this movement is presented since the beginning of activity. Passing the cursor on the birthday board presents the months of the year as well as information about the seasons. This part of the media is more informative in order to satisfy curiosity. It presents the interest of the media dynamism and allows a supporting interaction of the teacher. .

On the same wall of the classroom we find a bookshelf with books and maps. These elements are enabled to execute the media activities. The game box for instance can be enabled and the activity hereunder will appear on the screen.

Continuing going around the classroom, the pupil will be stimulated top observe the terrestrial Globe on the teacher's desk and, by passing the cursor on it, to activate it. New windows will then open with the presentation of different representation concepts of the Earth, by means of terrestrial globes and maps. The reference lines of Earth are indicated as well as the presentation of meridians, parallels, latitudes and longitudes.

After the presentation of cartographic concepts and the illustration of the main reference lines of the terrestrial globe, the pupil will be invited to participate in a game of identification of geographic coordinates on a map where small ships appear. The pupil has to indicate their coordinates (figure 2).

All games count points and have a limited time to be realized. This is already commonly what happens with electronic games. The timing in the different steps allows competition among pupils and encourages their rapidity and smartness. That is why the project team thought about introducing a chronometer.

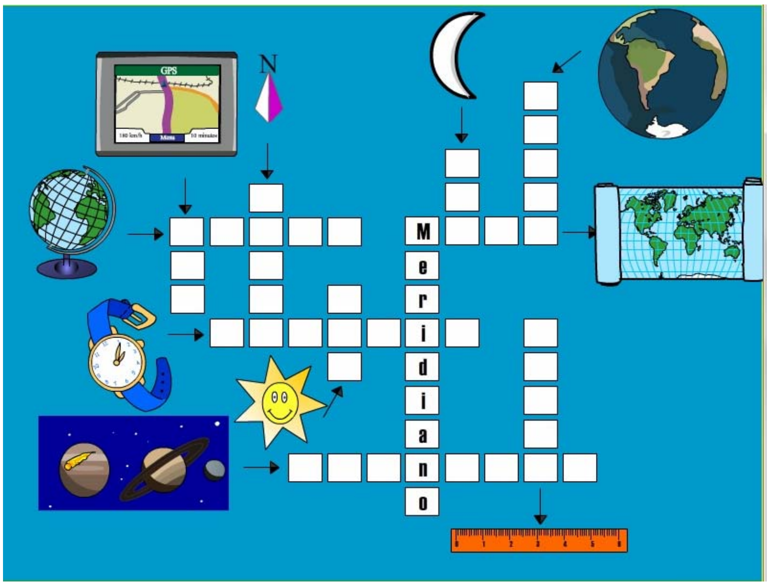


Figure 3. Game: crossword puzzle

The pupil will always be invited to develop his knowledge and to participate to the several activities proposed by the media during his virtual tour through the classroom. In this school environment, designed for learning geography, we use an attractive visual and graphic language, in order to provide a more friendly and interesting training, and to offer challenges to advance in the reading of maps and in practical cartography.

Other important fixed points in the media are the classroom windows. It is through these windows that the landscape can be observed. The landscape can be the community, the other side of the school building, the urban landscape or even a beach. Regarding this theme, we try to stimulate the sketching of the landscape presented by pictures of Niterói, cut in 9 equal rectangles, making it possible to build a puzzle as a linked activity.

Another fix point is the waste bin in the corner of the room, nearby the teacher desk. Pupils are invited to read short texts about garbage, their decomposing time and the care to be brought to environment. Afterwards they are invited to a selective collection of garbage, with bins of different colours (green, yellow, blue and red) according to the type of garbage to throw.

In the classroom we also have a small museum with relics of a thematic long walk along seaside, and an aquarium with a fish. The question put to the pupil: is the fish is its natural environment? At this moment an activity is introduced with information about the fauna (fishes, crustaceans, molluscs and marine mammals) of the Guanabara bay. The proposed game afterward is very like a "naval battle", using alphanumerical coordinates to localize each element of the game. At each good shot, the player receives a picture of the animal (fish, crustacean, mollusc). In this game the animals are only presented with pictures.

The daily classroom goes this way and the cards and posters stuck on the board are elements of activities for these media players. The pupils will have the opportunity to make their own board posters according to the suggested themes.

Conclusions and perspectives

"Games constitute a resource still seldom used in classrooms. They are however very valuable because they arouse expectation, anxiety and enthusiasm to the pupils. A game is ludic by itself and presents challenges well accepted at all ages, in the classroom as well as outside it. For students, it is something amazing, as the game sounds like a challenge to their cleverness, bringing them to know more about the rules and to think about winning strategies." (Passini, 2007)

The didactic resource represented by this media and described in the present document is the result of a research and of a dream. We have brought together an heterogeneous group of students to build an educational and interactive media, where concepts and actions are mixed in order to allow the pupil training through interesting activities and games.

The new communication technologies are essential instruments in a classroom where teachers and pupils are integrated and make instruction and education a dynamic and friendly training. Who does not like to have a game in a classroom? However, we must also have in mind that not all teachers already live in a digital era and that not every school has its own computer room. Our proposal is therefore to have this media available as an important auxiliary tool in a classroom for the teaching of the proposed themes.

Once we have completed this first model, it will be evaluated by the teachers of the public schools network, as well as by those of the private schools, in order to improve it even more.

References

Nogueira, Ruth E. (Org.): Motivações Hodiernas para o Ensinar Geografia – Representações do espaço para visuais invisuais. Florianópolis: [s.n.] 2009.

Passini, Elsa Yassuko, Passini Romão, Malyz, Sandra (org.): Prática do ensino de geografia e estágio supervisionado. São Paulo: Contexto, 2007.

Pontuschka, Nídia N. Paganelli, Tomoko I. Cacete, Núria H. (org.): Para ensinar e aprender Geografia. São Paulo: Cortez, 2007.

Internet: Parâmetros Curriculares Nacional (PCN):
portal.mec.gov.br/seb/arquivos/pdf/livro01.pdf
portal.mec.gov.br/seb/arquivos/pdf/geografia.pdf

CARTOGRAPHY IN TEXTBOOKS PUBLISHED BETWEEN 1824 AND 2002 IN BRAZIL

Levon Boligian[1], Rosângela Doin de Almeida[2]
1 Universidade do Vale do Ivaí (Brazil)
boligian@hotmail.com
2 Universidade Estadual Paulista (UNESP), Campus of Rio Claro (Brazil)
rda.doin@gmail.com

Abstract: The main focus of enquiry on this research is the historical evolution of Cartography contents from 1824 until 2002 and its role in the establishment of an educational geographic culture in Brazilian schools. It has identified curricular alternations, permanence and transformations of these contents during the investigated period, taking as source materials the official syllabus programmes, but especially the compendia and Geography textbooks addressed to students in the first year of secondary school. Through this socio-historical view of the curriculum, it was possible to evidence important epistemological differences between the scientific geographical knowledge and the educational geographical knowledge.

1. Purposes for this study

This research investigated the hole that Geography textbooks, published since the beginning of the 19th century, and the curricular contents contained therein have in the socio-historical process of construction and reconstruction of an educational geographical knowledge considering the Brazilian educational system.

To achieve this aim, the evolution of Cartography contents presented by authors of textbooks and by the Brazilian official programmes to students in the first year of secondary school were analysed and, through a spreadsheet of subjects, notions and cartographic concepts, it was possible to notice the alternations, the ruptures and the curricular transformations occurred between 1824 and 2002.

2. Analysis of the socio-historical evolution in school cartography contents

A research conducted by Callai (1999) with a sector of students and teachers of secondary education in Brazilian state schools, in the middle of the nineties, revealed that, for the majority of people interviewed, Geography seems to be extremely fragmented and naturalistic. In this sense, names of places, their localisation and mainly their natural characteristics are studied, once "Physical Geography" is a field in this subject considered to be the most "scientific", because is more observable and objective than "Human Geography". Besides, according to the above mentioned research, for the interviewees, the ideas of "map" and "cartography" are inseparable from "Geography". For them, these concepts are practically synonyms. Martinelli (2000, p. 3) also highlights this aspect in his thesis, writing that:

"When we talk about 'maps', immediately we associate them with 'Geography'. It is a cultural aspect. Maps, therefore, would represent Geography, what is geographic. They would be Geography themselves. [...] In this sense, we can verify that a map is a symbolic representation of Geography. [...]"

We understand that this representation in the imagination of people is a socio-historical construction whose origin is at schools, in the Cartography contents worked by Geography teachers. It is a knowledge dictated by the curricular programmes and especially by the textbooks published and used in Brazil in the last two centuries. During this period, the cartographic contents have been worked, roughly, in the volumes regarding the first years of secondary education. And these contents are our main focus of analysis on this study.

3. The selection of documents and method of work

Information and data collection for this research in documentary sources were carried out based on the Library of Textbooks (BLD) collection, located at the Faculty of Education of Universidade de São Paulo. We complemented the survey of textbooks, asking the most important Brazilian publishers for an authorization to look up their private collections, in a way to have access to the major works published in Brazil during the specified period. We had permission to consult the private collections from the following publishers: Saraiva, FTD, Scipione, Ática and Abril Educação.

Besides consulting the publishers' collections, we had access to available documents at the Documentation Department and Memory of Colégio Pedro II (NUDOM), in Rio de Janeiro, where we consulted the minutes of the Teachers Council, Geography compendia and theses regarding the school since its establishment. Colégio Pedro II was the first institution of secondary education created in Brazil, in 1837, in the same traditional mould of French collèges and licèes. Until the end of the fifties, the teaching staff of Colégio Pedro II were entrusted by the State with the formulation of the syllabus for every subject taught in secondary schools in the whole country. Consequently, the access to the above mentioned documents was essential for the development of this work.

In relation to the criteria for selecting the textbooks used as source of information for the research, we used as major parameters: the works of authors mentioned in the researches of Issler (1973), Colesanti (1984), Vechia & Lorenz (1998), Gasparello (2002, 2006) and Vechia (2007), which, according to those specialists, stood out in the Brazilian educational circle until the third quarter of the 20th century; and, with relation to the most recent textbooks, published from the seventies on, we opted for the ones that, according to information provided by the person in charge of the collection in the visited publishers, stood out in terms of adoption, both in private and governmental purchases in the last four decades.

In the event of textbooks of a same author that were republished during a long period of time – works called "editorial success" – we selected editions for the first year of secondary education, with intervals of some years between them, intending to verify developments carried out by the author in the way that the contents of Cartography were worked. Actually, in several cases, there was not a possibility to perform a sequential analysis of the editions due to shortages of some of them in the consulted collections, even in the own collections of the publishers. This fact referred us to a matter already mentioned by Bittencourt (1993) related to a characteristic of textbooks. As they are products that are quickly consumed, almost in a disposable way, in accordance with the changes in the curricular and market context, these publications create a paradox. Even if the titles have a great circulation, that is since the beginning of the 20th century, they are badly preserved by the society in general, including the very publishers which produce and commercialise them in the whole country, because, in accordance with we could observe, few of them invest in the organisation and conservation of their own collection of works already published.

Regarding the consulted curricular programmes, our main sources were the following documents: the book "Programa de ensino da escola secundária brasileira: 1850–1951", under the authorship of Professors Ariclê Vechia e Karl Michael Lorenz, from Universidade Federal do Paraná, in which the old official programmes from Colégio Pedro II were consulted, all of them drawn up and published during the period of Empire in Brazil; the dissertation "O ensino de Geografia através do livro didático no período de 1890 a 1971", under the authorship of Professor Marlene Teresinha de Muno Colesanti, published under orientation of Professor Lívia de Oliveira, in 1984, in which we looked up for the programmes of curricular reforms occurred during the First Republic and the New Republic in Brazil; the documents "Guias Curriculares Propostos para as Matérias do Núcleo Comum do Ensino de 1o Grau", drawn up by the Centre of Human Resources and Educational Researches "Professor Laerte Ramos de Carvalho" (CERHUPE), published in 1975, and the "Proposta Curricular para o Ensino de Geografia /1o Grau", drawn up by the Coordination Office of Studies and Pedagogic Principles, first edition published in 1988, both institutions part of the Education Department of São Paulo State, where we consulted the curricular programmes of Social Science and Geography, for the second half of the seventies and for the eighties and nineties, respectively. As in this period, the Federal Government, through the Law of Directives and Bases of Education, No. 5692/71, decentralised the establishment of curricular proposals, we tried to get information about cartographic contents from these documents because we believe that São Paulo has become a national reference; and lastly, the document "Geografia", for the 5th to the 8th grade, or the 3rd and 4th cycles of Primary Education from the "Parâmetros Curriculares Nacionais" (PCNs), established and published by the Ministry of Education, in 1998.

Based on the criteria of selection already mentioned, for this study we consulted 13 (thirteen) official curricular programmes and 37 (thirty-seven) teaching materials, among compendia and textbooks.

After selecting the materials, the next step comprised of recording the data and information extracted that would be the basis for our analysis. After trying some resources, like making photocopies of books, we concluded that the best way to store the pages of the books, in order to subsequently analyse them, would be by means of digital photography. Therefore, we photographed the pages of the official programmes and the minutes of the Teachers Council of Colégio Pedro II, as well as the compendia and textbooks that had some concepts (especially the ones of public use or model exercise) linked to Cartography. Altogether, we accumulated around 5730 images in JPG format.

The criteria to choose the Cartographic contents present in the curricula and textbooks were based on the analysis of the Simielli (1993, 1996, 2008), Almeida, Sanchez & Picarelli (1997), Almeida (2003) and Le Sann (2005) studies, which helped us to compile a set of notions, concepts and cartographic subjects. As far as we understand, these contents were historically established as Cartography contents to be taught in Geography classes in Brazil. The tables below bring the contents extracted from the above-mentioned studies.

Table 1. Cartographic contents proposed by Maria Elena Simielli, 1993

Cartographic contents proposed by Maria Elena Simielli, 1993	
Shapes	Proportion
Symbols	Measurements
Legend	Scale
Oblique view	Grids/tables
Vertical view	Coordinates
Representation in the plane	Maps (interpretation)
Generalisation	Aerial photographs
Laterality	Scale model
Direction / Orientation	Localisation
Simielli, M. E., 1993. Coleção Primeiros Mapas. Teacher's book. São Paulo: Ática. Simielli, M. E., 1996. Cartografia e ensino: proposta de contraponto de uma obra didática. Thesis of "Livre-docência". Faculty of Philosophy, Arts and Human Science, Department of Geography, Universidade de São Paulo.	

Table 2. Cartographic contents proposed by Rosângela Doin de Almeida, Miguel Sanchez and Adriano Picarelli, 1997

Cartographic contents proposed by Rosângela Doin de Almeida, Miguel Sanchez and Adriano Picarelli, 1997	
Book 2	
Cartographic subjects	**Knowledge relating to spatial representation**
Scale	Conservation of measurement Conservation of distance Proportional areas
Cartographic Projections	Projection of sphere in the plane Notions of circumference Concept of angle Notions of parallelism and perpendicularity Parallels and meridians
Topography	Orthogonal projection Planning of geometric solids Notion of plane and curves Perpendicularity between straight lines and planes Landforms Contour line
Projection in the Plane	Conservation of a point of view Orthogonal projection from a vertical point of view Symbolisation
Book 3	
Cartographic subjects	**Knowledge relating to spatial representation**
Localisation **Orientation** **Coordinates**	Location references on the globe: west-east and north-south directions Location and geographical orientations: parallels and meridians Angle measurement
Scale	Notion of proportion Metric system Conservation of distance and measurement Calculation of distance
Topographical Representation	Contour line Topographical outline Orthogonal projection from a vertical point of view Classification and connection between classes Relation between numerical and spatial proportions Visual proportion and variable visual size Visual order and variable visual value

Book 4	
Cartographic subjects	**Knowledge relating to spatial representation**
Localisation **Orientation** **Coordinates**	Geographical references on the globe Orientation in the world map Geographical coordinates Division of angles
Topographical Representation	Ratio and proportion Perpendicularity between straight lines and planes Contour line
Scale	Ratio and proportion Cartographic projections
History of Cartography	Cartographic projections
Thematic Representations	Ratio and proportion Classification and connection between classes Relation between numerical and spatial proportions Visual proportion and variable visual size Visual order
Application of Cartographic Knowledge	Interpretation of aerial photographs Topographical map Land relief outline
Almeida, R. D. Sanchez, M. C. Picarelli, A., 1997. Atividades Cartográficas. Teacher's book, vol. 2, 3 and 4. São Paulo: Atual.	

Table 3. Cartographic contents proposed by Janine Le Sann - 2005

Cartographic contents proposed by Janine Le Sann - 2005 General plane	
Main axes	**Cartographic notions**
Representation	Shape of objects Free drawing Photographs
Comparison	Scale Relation-dimension
Proportion	Standard measurement Perceptual measurement
Le Sann, J. G., 2005. A caminho da Geografia: uma proposta metodológica. Belo Horizonte: Editora Dimensão.	

Based on the contents indicated in these studies, we drew up a cluster of notions, concepts and subjects, divided in some large thematic groups in order to consider a universe of School Cartography contents developed in the Brazilian secondary education. Below we present the groups created with their respective contents.

Table 4. Cartographic contents (concepts, notions and subjects)

<table>
<tr><th colspan="4">Cartographic contents (concepts, notions and subjects)</th></tr>
<tr><td rowspan="6">Shapes</td><td>Geometric shapes</td><td rowspan="12">Cartographic representations (two-dimensional)</td><td>Interpretation of maps</td></tr>
<tr><td>Shape of objects</td><td>Plan</td></tr>
<tr><td>Symbols</td><td>Map</td></tr>
<tr><td>Legend</td><td>World Map</td></tr>
<tr><td>Points of view</td><td>Sorts of projections</td></tr>
<tr><td>Mind Map</td><td>Topographic map</td></tr>
<tr><td rowspan="3">Localisation and Orientation</td><td>Localisation</td><td>Outline</td></tr>
<tr><td>Laterality</td><td>Sketch</td></tr>
<tr><td>Direction / Orientation</td><td>Thematic maps</td></tr>
<tr><td rowspan="4">Scale</td><td>Proportion</td><td>Choropleth map</td></tr>
<tr><td>Measurement</td><td>Anamorphosis</td></tr>
<tr><td>Cartographic scale</td><td>Graphs and diagrams</td></tr>
<tr><td>Geographical scale</td><td rowspan="3">Cartographic representations (three-dimensional)</td><td>Scale model</td></tr>
<tr><td rowspan="6">Coordinates and imaginary lines</td><td>Coordinates (elementary notions)</td><td>Block diagram</td></tr>
<tr><td>Shape of the Earth / Movement of celestial bodies</td><td>The Globe</td></tr>
<tr><td>Hemispheres</td><td rowspan="5">Technology and Cartography</td><td>Aerial photographs</td></tr>
<tr><td>Imaginary lines / parallels and meridians</td><td>Satellite images</td></tr>
<tr><td>Latitude and Longitude</td><td>GIS</td></tr>
<tr><td>Time Zones</td><td>Cartographic techniques</td></tr>
<tr><td colspan="2">Elaborated by Boligian, 2009</td><td>History of Cartography</td></tr>
</table>

Based on the table above, we started reading the official programmes and the pages of the selected textbooks, trying to identify the presence of the chosen cartographic contents.

4. Results of the documentary analysis

The analysis of the selected official curricular programmes and teaching materials allowed a "visualisation" of a historical evolution of cartographic contents in the last two centuries in Brazilian schools.

We perceived that since 1824 the contents are becoming increasingly diversified over time, with new notions, concepts and subjects being added to the syllabus prescribed, both in the official curricular programmes and in the teaching materials (compendia and textbooks) of Geography. It is well known how compendia and textbooks, in general, deal with more contents of Cartography than the curricula themselves, which bring a more simplified programme, except for the PCNs (1998).

In a more specific interpretation, we can observe the existence of a sort of "hard core" of contents, which starts to be established in the 19th century. This "hard core" consists of the following groups of contents:

- "Localisation and Orientation", particularly the content that refers to "Direction/Orientation";
- "Scale", particularly the content that refers to "Cartographic scale";
- "Coordinates and imaginary lines", particularly the contents "Shape of the Earth/Movement of celestial bodies", "Hemispheres", "Imaginary lines/parallels and meridians", "Latitude and Longitude" and "Time Zones";
- "Cartographic representations (two-dimensional representations)", particularly the content that refers to "Map";
- And "Cartographic representations (three-dimensional representations)", particularly the content that refers to "The Globe".

As it is possible to notice, the mentioned contents establish a continuity, a "school tradition" that dictates certain cartographic notions that "must" be worked in the first year of secondary education for almost two centuries, lasting for practically all the curricular reforms and the programmes of textbooks produced during the 20th century and also permeating the 21st century.

Another important aspect that we perceived with the analysis refers to the work done with the notions of "Symbols" and "Legend". Even though some textbooks dealt with them during the thirties and forties, these contents reappear as prescriptions in all consulted textbooks that were published from 1972 to 2002. At this moment, there is a need to carry out some parallelisms between the domain of school knowledge and the domain of production of academic knowledge. We understand that working with these subjects has become more powerful due to the discussion in the academic sphere about the systematisation of thematic cartography which is specially reinforced by the studies of Semiology of Graphics developed by Professor J. Bertin, from the end of the sixties to the beginning of the seventies (Martinelli, 2000, 2007). This parallelism points to an educational transposition from this academic knowledge to a knowledge to be taught, prepared especially by authors of textbooks. On the other hand, the development of learning activities directed to the interpretation of maps, which is recommended by the last three curricular programmes analysed, is not a procedure that is transposed to textbooks.

However, as a general rule, we can notice a process, from the seventies on, that makes Cartography subjects become more complex and the contents prescribed by the curricular programmes and textbooks, during the nineties, more comprehensive. We can see again the process of debates within the academic domain reflecting on the work of professors and authors of official curricula and teaching materials. This is because, right during this period, more accurate researches on how to teach Cartography were conducted in Brazil. At first they occurred by means of studies of few researchers, like the case of pioneering researches developed by Professor Lívia de Oliveira, from Universidade Estadual Paulista (UNESP), in Rio Claro, during the seventies (Almeida, 2007).

However, from 1995 on, for the first time in Brazil, it was established a forum for debates concerning Cartography and its implications in teaching Geography, called "Colloquies of Cartography for Children", which are held approximately every two or three years. The colloquies became, therefore, a way to exchange information and to spread researches through their annals. The academic production in this field of research has also been spread and featured prominently in periodicals and newspapers, becoming the core for discussions in important events, like in the National Meeting of Geography Teaching (ENEG) and the Meeting of Geography Teaching Practice (ENPEG). Thus, it is possible to notice in the last decades, a process of transposition of this academic production to a knowledge to be taught through the curricular programmes and teaching materials.

5. Conclusion

According to what we observed, a great part of the group of geographical concepts and, more specifically, of the geographical concepts prescribed in the national teaching materials, doesn't have its origins in a systematic academic knowledge. We verified that its origins are supported by a sort of classical and erudite knowledge, based on the spirit of humanities, which formed the foundation for the secondary education in our country, before the establishment of the first universities.

Also, much of this classical geographical knowledge and, as a result, Cartography is part of it, is still present at schools by means of what we call "hard core of cartographic contents": a set of notions, concepts and subjects such as "Direction and Orientation", "Shape of the Earth and Movement of celestial bodies", "Imaginary lines: parallels and meridians", "Geographic coordinates/Latitude and Longitude", "Map" and "Globe", that have lasted in the Brazilian curriculum of Geography addressed to secondary education for the last two centuries, approximately. These explicit concepts, as well as the teaching method historically established by teachers-authors of textbooks, whom most of them also contributed to the production of the official programmes, at least until the forties, demonstrate a distinguished cultural production in which we verified that school Geography appears not only as a vulgarisation or an adaptation of scientific Geographic knowledge, but as a characteristic and original knowledge from the educational institution for the educational institution. Thus, two different groups of knowledge were set up: the one intended for teaching and another for the academy.

References

Almeida, R. D. Sanchez, M. C. Picarelli, A.: 1997, Atividades Cartográficas. Teacher's book, vol. 2, 3 e 4. São Paulo: Atual.

Almeida, R. D.: 2003, Cartografia na escola. [online] Available at: <http://www.tvebrasil.com.br/salto/boletins2003/ce/index.htm> [Accessed 3 May 2005].

Almeida, R. D.: 2007, Apresentação. In: R. D. Almeida (organiser), ed. 2007. Cartografia escolar. São Paulo: Contexto.

Bittencourt, C. M. F.: 1993, Livro didático e conhecimento histórico: uma história do saber escolar. Doctorate. FFLCH – Universidade de São Paulo.

Brazilian Department of Elementary Education (1998). Parâmetros curriculares nacionais: Geografia. Brasília: MEC/SEF.

Callai, H. C.: 1999, A Geografia no Ensino Médio. Terra Livre. 14 (July 1999), p. 60–99.

Colesanti, M. T. M.: 1984, O ensino de Geografia através do livro didático no período de 1890 a 1971. Master's Degree. Institute of Geosciences and Exact Science – Universidade Estadual Paulista, Campus of Rio Claro.

Gasparello, A. M.: 2002, Historiografia didática e pesquisa no ensino de história. In: X Encontro Regional de História – ANPUH-RJ. "História e Biografias". Universidade do Estado do Rio de Janeiro, Brazil.

Gasparello, A. M.: 2006, Traduções, apostilas e livros didáticos: ofícios e saberes na construção das disciplinas escolares. In: Usos do Passado – XII Encontro Regional de História ANPUH–RJ. Universidade do Estado do Rio de Janeiro, Brazil.

Issler, B.: 1973, A Geografia e os Estudos Sociais. Doctorate. Faculty of Philosophy, Science and Arts – Presidente Prudente – São Paulo.

Le Sann, J. G.: 2005, A caminho da Geografia: uma proposta metodológica. Belo Horizonte: Editora Dimensão.

Martinelli, M.: 2007, A sistematização da cartografia temática. In: R. D. Almeida (organiser), ed. 2007. Cartografia escolar. São Paulo: Contexto, p. 193–220.

Martinelli, M.: 2000, As representações gráficas da Geografia: os mapas temáticos. Thesis of "Livre-docência". Faculty of Philosophy, Arts and Human Science. Universidade de São Paulo.

Simielli, M. E.: 2008, Cartografia no ensino fundamental e médio. In: A. F. Carlos, ed. 2008. A geografia na sala de aula. São Paulo: Contexto, p. 92–108.

Simielli, M. E.: 1996, Cartografia e ensino: proposta de contraponto de uma obra didática. Thesis of "Livre-docência". Faculty of Philosophy, Arts and Human Science – Department of Geography, Universidade de São Paulo.

Simielli, M. E.: 1993, Coleção Primeiros Mapas. Teacher's book. São Paulo: Ática.

Vechia, A.: 2007, Os livros didáticos de história do Brasil na escola secundária brasileira: a produção dos saberes pedagógicos no século XIX. In: CD-ROM Simpósio Internacional Livro didático: Educação e História. São Paulo, Brazil 5–8 November 2007.

Vechia, A. Lorenz, K. M.: 1998, Programa de ensino da escola secundária brasileira: 1850–1951. Curitiba: Authors' publisher.

THE TRANSITION FROM THE ANALYTIC TO SYNTHESIS REASONING IN THE MAPS OF GEOGRAPHIC SCHOOL ATLASES FOR CHILDREN

Marcello Martinelli
Departamento de Geografia, Pós-graduação, Programa Geografia Humana
Faculdade de Filosofia, Letras e Ciências Humanas, Universidade de São Paulo
São Paulo, SP (Brazil)
m_martinelli@superig.com.br

Abstract: At the end of 19th century, geographic school atlases gained credit among didactic materials. The "Atlas do Império do Brazil" of Almeida was the first Brazilian school Atlas. Currently there are many geographic school atlases on a variety of formats. Elaborating a school atlas is not a simple task. The first step for its coordination is the integrated interlacement of two fundamental orientations: the teaching of the map, based on the construction of the space notion by the student and its representation; the teaching through the map, founded on the knowledge of the world from the nearby, the place, to the distant, the worldwide space. Regarding the thematic maps, the representation of the reality can be carried out within analytic or synthesis reasoning. Analytic maps represent places, ways or areas characterized by attributes or variables. Synthesis maps identify groupings of places, ways or areas characterized by groupings of attributes or variables.

Opening

In the teaching and learning environment of Geography since its institution as a school subject, first in Germany and after in France, on the second half of the 19th century, geographic school atlases gained credit among didactic materials, increasingly adapting themselves to this function in the classroom.

They have appeared as selections and simplifications of the great general reference atlases, which evolved from simple collections to a systematic organization with specific and intellectual purpose.

The "Atlas général Vidal-Lablache: histoire et géographie" of 1824 was a classic that inspired several derivations in France as well as in other countries of the continent.

In 1868, the first Brazilian school atlas was published, called "Atlas do Império do Brazil" of Cândido Mendes de Almeida. It was adopted by the Colégio Imperial Pedro II, in Rio de Janeiro.

As a result of the whole evolution and epistemological transformation of atlases cartography, a great number of assorted geographic school atlases is currently available in print and electronic formats.

Elaborating a geographical school atlas

This elaboration is not a simple task. It will have to start with the lucubration about the construction of the space notion and its representation by the student. As chief sources, among others, there are the psychogenetic studies of Jean Piaget and his team and of other researches, like the ones from Vygotsky and Wallon. (Piaget and Inhelder, 1972; Wallon, 1995; Vygotsky, 1998).

In Brazil, we count on the contributions of Doctor Professor Lívia de Oliveira, who established the master lines for a correct orientation of these works, having instituted a proper school with high qualified disciples (Oliveira, 1978, 2006; Almeida and Passini, 1989; Almeida, 2001).

A school atlas will not be only a collection of maps, ready and finished, but a systematic organization of representations developed with a specific intellectual purpose. With this intent, the articulation of two fundamental methodological bases has to be taken into account: the methodological basis of the map and the methodological basis of the acquisition of knowledge in geography trough the map.

Therefore, maps would not be seen as mere illustrative figures of didactic texts, but as representations that reveal questions that will be tackled and discussed within the geographic speeches, opening space to critical and conscious reflections.

The atlas enterprise considers the integrated interlacement of two basic orientations as a first step for its coordination:

- The teaching of the map, propagated on the theorist-methodological postures about the construction of the space notion and its respective representation by the scholar, involving initial cartography practices,

- The teaching through the map, accomplished on geography, promoting the knowledge of the world from the spatial inclusion and continuity, starting by the nearby, experienced and well known – the place – to the distant unknown – the worldwide space.

The atlas content is organized in consonance with the context of the geography methodological bases.

The spatial outline definition, ranging from the local place to the worldwide space, would come linked to the question of the thematic and scale structure.

Afterwards, the atlas Thematic Cartography is based upon the map elaboration as a construction within the parameters that consider the graphic representation as a language, integrating a monosemic semiotic system (having only one meaning) (Bertin, 1973, 1977).

Within this context, the atlas thematic maps can be constructed by selecting the most appropriate method to the characteristics and forms of manifestation (on dots, on lines, on areas) of the phenomena of the reality took into account on each theme, following a qualitative, ordered or quantitative approach.

The representations can also undertake either a static or dynamic appreciation of the reality. Yet, the phenomena that compose the reality to be represented on a map could be glimmered within analytic or synthesis reasoning. Thus, on the one hand, there is an attention to the constitutive elements, the places, paths and areas characterized by attributes or variables but on the other hand, there are integrated spatial units, which mean groupings of places, paths and areas being characterized by groupings of attributes or variables.

The analytic reasoning

The analytic reasoning in maps is directed to the scrutiny of the geographic space, mobilizing procedures of classification, combination and search for explanations about facts or phenomena seen indistinctly on the reality. The mental operations undertaken, regarding analytic maps, will allow the student to formulate conjectures about what would elucidate the phenomena geography. However, before a more rigorous critic, authors affirm that they would not be able to suggest the causalities or give the explanations by themselves, but to indicate new researches (Rimbert, 1968; Claval and Wieber, 1969).

Analytic maps are the most widespread on school atlases. They can display the representations on a qualitative, ordered or quantitative approach, considering manifestations on dots, lines, and areas, according to the static or dynamical point of view.

Qualitative maps express the existence, the location and the extension of the events on a certain situation on the time, that are distinguished by their nature, species, allowing them to be classified by criteria established by the sciences that study them.

Ordinate maps show, on a certain date, categories that are enlisted on a sole sequence, defining hierarchies, or focalize, on a single map, aspects that were being consolidated over the time.

Quantitative maps evidence the relationship of proportionality between quantities that characterize places, paths or areas for a certain moment. Look at the following example: the map shows in analytic form the ternary structures of Brazil land use of the establishment total areas in 2006 (Figure 1).

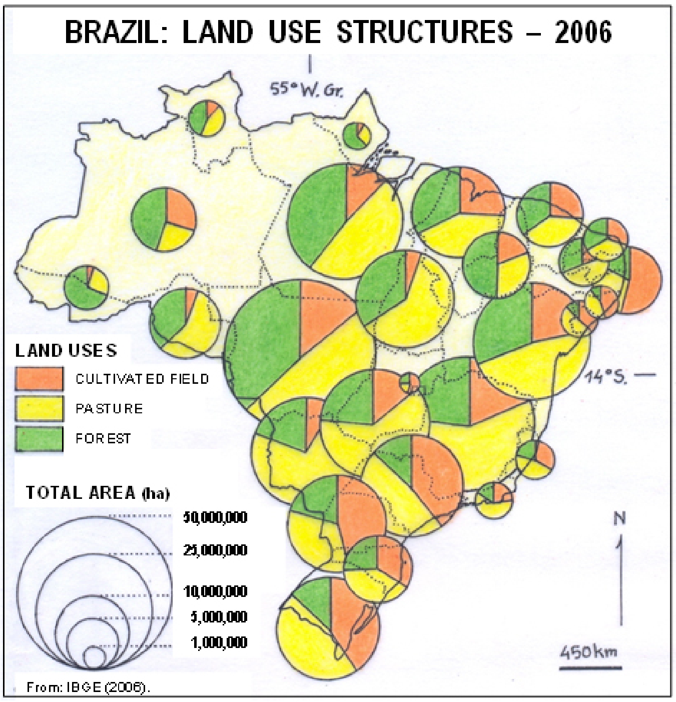


Figure 1. The distribution of ternary structures in the country

From a dynamical point of view, maps can show qualitative, ordered and quantitative variations on the time or qualitative, ordered and quantitative directed movements on the space.

The synthesis reasoning

Synthesis maps would have, as their first function, pointing out the correlations, evidencing connections between distinct phenomena (Claval and Wieber, 1969: p. 103).

Synthesis is a necessity, but it has to be treated in a way that makes new configurations to emerge, completely different from those resulted of a simple sum of the elementary configurations. Just in this manner, an overview of the reality would be achieved.

These maps become a privileged instrument of the geographer, who is interested in regional studies.

Despite this entire methodological base, established with the evolution of the cartographic science, it is noticeable that still exist a lot of confusion about what synthesis cartography is. And this is transferred to school atlases.

Many people still conceive it, by means of maps stated – synthesis maps – but, not like logical systems, but like superposition or juxtaposition of analyses. Then, very confused maps appear, on which a lot of symbols are accumulated, denying the very idea of synthesis.

On synthesis, we cannot have the elements on superposition or juxtaposition anymore, but their fusion in "types". This means that, regarding maps, it is possible to identify groupings of places, paths or areas – as elementary spatial units of observation – characterized by groupings of attributes or variables (Rimbert, 1968; Bertin, 1973, 1977; Martinelli, 1998, 2003, 2005, 2008; Martinelli and Ferreira, 1995).

To explain what synthesis reasoning is, it was borrowed an experimental piece of work done by Gimeno (1980, p. 174). Its aim was to discover which groupings could be formed in a set of 42 elementary data: seven objects related to six attributes. The following diagram shows the transition of the analytic moment; where, in a matrix, each object relates to one or more attributes; to the synthesis moment, achieved with reiterated permutations between columns and rows of the matrix, revealing three groups of objects characterized by three groups of attributes. This is the revealed information (Figure 2).

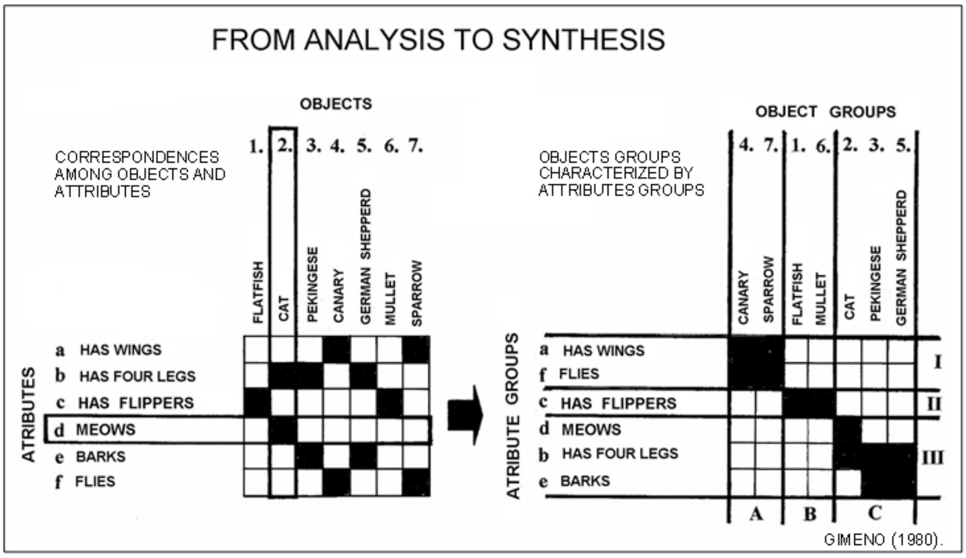


Figure 2. The transition from analytic to the synthesis reasoning

Synthesis cartography can be done by an assorted gamma of methods that were being developed together with an accurate search, involving qualitative, ordinate or quantitative data, on a static or dynamical appreciation, by employing entities like dots, lines, areas.

Thus, according to the objectives and established fields of study, basically three main groups can be pondered: traditional superposition and manual combination of many analytic thematic maps, graphic methods and statistic-mathematic methods.

The Triangular graph method will be considered here due to its intrinsic simplicity. It is employed on a particular case in synthesis cartography, the one which searches for the representation of the "types" of specific ternary structures on space, that is, for variables formed by three collinear components. In this way, such graphic would participate as an algorithm for the treatment of the data and for the legend organization.

The different combinations of the three components I, II and III of the studied variable are synthesized through dots inside the triangle. Since the variable refers to areas, each dot of the graphic represents the structure of each one (Béguin and Pumain, 1994).

Based on the visual analysis of the resultant point pattern, the areas are grouped according to categories defined by the position they assume in the triangle. Sometimes the groupings are not that easy to be discerned. A more accurate control is required. The categories, defined as such, will be later transferred to the map, which will represent the synthesis of the ternary structures grouped into significant classes. The triangular graph will be its legend, giving total transparency to the reasoning undertaken on the map construction

The following representation shows the synthesis of the Brazil information displayed in the figure 1 as "types" of land use structures (Figure 3).

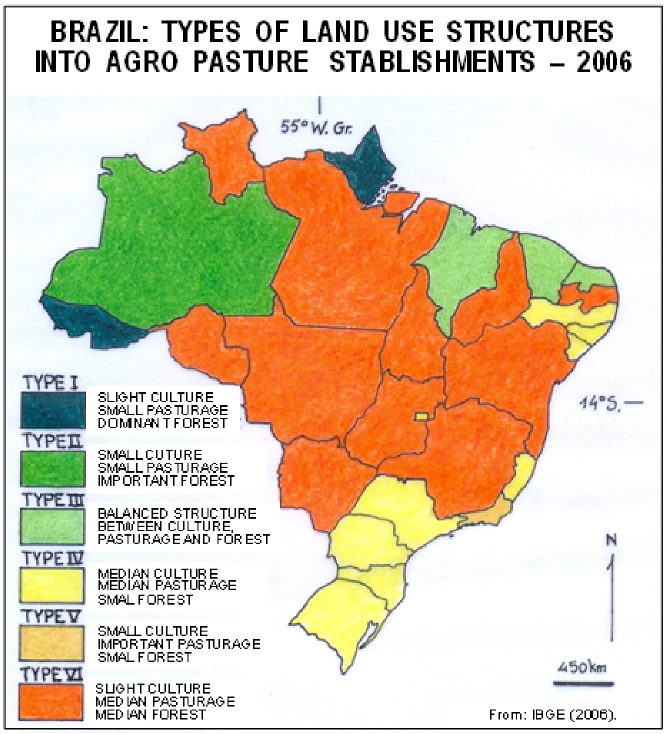


Figure 3. The map represents the synthesis of the ternary structures grouped into significant classes described in the legend

Generally, synthesis cartography worked by graphic methods, is explored along with static situations. However, it is also possible to elaborate it in dynamical approaches like in the case of the establishment of demographic evolution "types" for a certain period of time with various census data.

To get to this synthesis it is mobilized a graphic treatment of the data, which consists in elaborating an evolution graph in semi-logarithmic graph-paper for each observation unit. After ready, these diagrams will be visually classified, approximating those that are more similar, trying to form groups with similar evolutionary characteristics. Each group will consist of a "type" that will be qualified on the legend by a symbol and its respective epithet, expressed in a concise manner.

Each rubric of the legend, thus specified, will receive either an indicative colour or texture to be plotted on the map that will express the synthesis.

A remark on this topic is extremely important for school atlases. It is insufficient to use analytical and synthesis maps only to show the existence of these two kinds of reasoning. A consistent presentation of the synthesis map is only valid when the analytical maps, employed to accomplish the synthesis representation, are available to the students.

Final remarks

These methodological directions are considered imperative to sustain all and any undertaking directed to the geographic school atlases idealization, when dealing with analytic and synthesis maps. They will confirm to them, in consistently form, their pedagogic role in geography, preparing the citizen for the practice of social transformation.

References

Almeida, Rosângela D.: 2001, Do desenho ao mapa: iniciação cartográfica na escola. São Paulo, Contexto.

Almeida, R. D. and Passini, E. Y.: 1989, O espaço geográfico: ensino e representação. São Paulo, Contexto.

Almeida, Rosângela D. et al.: 1977, Atividades cartográficas. (4 vol.). São Paulo: Atual.

Antunes, A. R. et al.: 1993, Estudos sociais: teoria e prática. Rio de Janeiro: ACCESS.

Beguin, M. and Pumain, D.: 1994, La représentation des données géographiques: statistique et cartographie. Paris: Armand Colin.

Bertin, Jacques: 1977, La graphique et le traitement, graphique de l'information. Paris: Flammarion.

Bertin, Jacques: 1973, Sémiologie graphique: les diagrammes, les réseaux, les cartes. Paris: Mouton, Gauthier, Villars.

Claval, P. and Wieber J-C.: 1969, La cartographie thématique comme méthode de recherche. Paris: Les Belles Lettres.

Gimeno, Roberto: 1980, Apprendre à l'école par la graphique. Paris: Retz.

Martinelli, Marcello: 2005, A student geographic atlas for the natural and social spaces learning. In: International Cartographic Conference, A Coruña, Spain. Poster. A Coruña: CD – Global Congresos.

Martinelli, Marcello: 2003, Atlas geográfico: natureza e espaço da sociedade. São Paulo: Editora do Brasil.

Martinelli, Marcello: 1998, Mapas e gráficos: construa-os você mesmo. São Paulo: Moderna.

Martinelli, Marcello: 2008, Os mapas da geografia e cartografia temática. São Paulo: Contexto.

Martinelli, M. and Ferreira, G. M. L.: 1995, L'atlas géographique illustré: un premier atlas pour les enfants. In: Proceedings. Poster Session. 17th. International Cartographic Conference Proceedings, Barcelona: ICA/ACI.

Oliveira, Lívia: 2006, Os mapas na geografia. Geografia, 31(2): 219–239.

Oliveira, Lívia: 1978, Estudo metodológico e cognitivo do mapa. São Paulo: USP–IG.

Piaget, J. and Inhelder, B.: 1972, La représentation de l'espace chez l'enfant. Paris: PUF.

Rimbert, Sylvie: 1968, Leçons de cartographie thématique. Paris: Sedes.

Vygotsky, L. S.: 1999, A formação social da mente. São Paulo: Martins Fontes.

Wallon, H.: 1995, A evolução psicológica da criança. Lisboa: Edições 70.

CARTOGRAPHY AT ELEMENTARY SCHOOL LEVEL: CONTINUING EDUCATION OF TEACHERS AND EXPERIENCES IN THE CLASSROOM

Maria Isabel Castreghini de Freitas
Universidade Estadual Paulista, UNESP (Brazil)
ifreitas@rc.unesp.br

Abstract: The main aim of this article is to present a methodology for the continued education of teachers at CECEMCA/UNESP, (Center of Continuing Education for Mathematics, Science and Environment/ São Paulo State University) in the area of Cartography, based on the formation of study groups arranged by tutors. I also aim to share some information about some of the Cartography activities related to the preparation of sketches, led by a professor who attended the Continuing Education Course. In the activity related to the sketch of the way to school, we selected 3 pieces of work that illustrate the diversity of possibilities of representation on the part of the students, in accordance with their previous experiences and their level of cognitive maturity. The results of this study highlighted the fact that teachers, in general, find it difficult to prepare records, which limits their effectiveness, hindering the transformation of the practical work in the classroom.

Introduction

Today, Cartography is a mandatory and widely taught discipline in Geography degree courses and aims to provide graduates and undergraduates with knowledge that will allow them to read and interpret cartographic, systemic and thematic documents in either analogical or digital form. Whilst observing the work of professionals at elementary school level, we noticed that there was an enormous discrepancy between the material that was presented in their classes and a large amount of material from the textbooks, which, as a rule, contain cartographic material related to Geography. We have observed, through experience of Cartography courses taught throughout Brazil, that a significant number of Elementary School teachers are reluctant to give their students cartographic activities and exercises. They claim that this is due to limited education in this area, which should be taken into consideration given that the majority of these teachers come from Pedagogy courses, which don't have a tradition of offering subjects that deal with these topics. Even for the Geography graduate, working in the Cartography area it is no easy task, since, and despite the significant number of hours dedicated to Teaching Practice, courses such as School Cartography for example, are rarely present among the compulsory disciplines that make up the core curriculums of tertiary courses in our country. We consider that the graduate's education should take into account the specialties of school education, which, according to Santos and Kulaif (2006), should be one of the instruments that allow a human being to become a conscientious and free individual. For the authors, well-taught School Geography teaches a student to become conscious of his/her spatial reality and for this to occur the intervention of the teacher is necessary, in terms of integrating local spatial logic together with global spatial logic in his/her classes. In the attempt to give credit to such a thought, Cartography, and other related disciplines, are fundamental in educating the graduate. The authors stress that "cartography being a visual medium (language) is a powerful tool in creating a school geography that is more dynamic at elementary and secondary school level" (Santos and Kulaif, 2006 p. 412).

Objectives

This article's main objective is to present a methodology of continuing education for teachers from CECEMCA/UNESP[1] , in the area of Cartography, based on the formation of study groups conducted by tutors. It also aims to share some of activities in Cartography related to the preparation of sketches, conducted by a teacher who attended Continuing Education Course for Primary School Teachers. This study aims to illustrate the possibilities of representation the students came up with in the early years of elementary school, as results of the experiments in the classroom that were organized and applied by teachers that participated in the study groups. These participants can contribute as specialists in the area and Primary School teachers, with the view of increasing studies and reflections of the theme.

Continuing education course for teachers and the practice of recording

In the book Teacher Knowledge and Professional Education, by Maurice Tardif (Tardif, 2010) the author asserts that it is not possible to disassociate teacher knowledge from aspects involved in their daily work routine, from the teacher's personal life and professional background:

"In reality, in the area of employment and professions, I don't believe that we can speak of knowledge without relating it to the key factors and the work context: knowledge is always the knowledge of someone that works on something with the purpose of achieving some goal (objective). Furthermore, knowledge is not something that floats in space: a teacher's knowledge is his/her knowledge and it is related to his/her person and to his/her identity, to his/her life experiences and professional background, to his/her relationship with the students in the classroom and to other individuals in the school, etc. Therefore, it is necessary to study it by relating it to these essential elements of a teacher's job." (Tardif, 2010, p. 11)

According to the author, teacher knowledge is social knowledge because it consists of shared knowledge among a group of agents, their peers, with a similar level of education initially, that operate in the same organization and are subject to similar work situations, such as the programs, the subjects and the rules of the teaching institution.

Taking into consideration the views of the author and our own experience, we can consider the way for us to have success in teaching practices, which include, besides the initial stages, the continued education of teachers exercising their profession, is to take a closer look at the subjects taught and the teaching practices used:

"What is needed is not just the dispensation of disciplinary logic from teacher training programs, but at least open a larger space for professional education logic [initial and continuing], which recognizes the students [and the teachers in continuing education] as subjects who have knowledge and not simply as virgin spirits to which we simply provide disciplinary knowledge and procedural information without doing a thorough job related to cognitive, social and emotional beliefs and expectations, through which future teachers [and teachers in continuing education] receive and process this knowledge and information. This professional logic should be based on the analysis of practices, tasks and knowledge of professional teachers, and it should be a process of reflective focus, taking into account the actual teaching conditions and the strategies used to eliminate these factors in operation." (Tardif, 2010, p. 242)

The structure of the proposal for the continuing education courses conducted on the premises of CECEMCA/UNESP came closer to the one presented by Tardif (2010). The interaction with the knowledge of the teachers in training, through practices, exchanging experiences and experience in the study groups that were formed, aims at continuing education that interacts with teaching practices, considering the cognitive aspects, reality of life and work outside the social context.

The teacher in the classroom, as a rule, works alone. "In this setting, he/she never gets an immediate response. The silent understanding that accompanies this makes it difficult to know how it was, how well his/her discourse is being received..." (Fontana, 2003, p. 168).

The exchanges and interaction in the classroom are critical and need to be encouraged, as they are during continuing education. The results of these exchanges should be recorded in the form of texts or narratives that detail not only the events involving the teachers and their professional performance, but also the questions, struggles and reflections about the teaching practice.

The act of recording makes high demands on the teacher, because it differs from the daily routine in the classroom by allowing our interaction with the act of teaching, recording our feelings arising from it, recording what remained in our memory, that which stimulates and incomodates in the quest for transformation and transcendence:

"In the written report, we document our work of interpretation, through its gestures and words, the evidence of the relationship they share with education, whether it be to evaluate it or us, or to scrutinize our teaching practices." (Fontana, 2003, p. 169).

"[...] None of us was prepared and ready to do it and nor was it necessary, as they made (and make) us believe. When we were sharing experiences, it became evident that the record as well as all the activities that make up the list of things that our teachers have to do, go beyond the demands in the course of our professional training, producing complex and arduous activities, which include difficulties that need be learned and developed in their principles and fundamentals (they are those that guide the procedures)". (Fontana, 2003, p. 173)

In detailing some aspects of the record, the author stresses that there are many ways that you can get these records, "asking questions, asking our peers for help, sharing this knowledge with our colleagues, provided that students, together with a teacher, dispense with routine practices whose meaning we had forgotten" (Fontana, 2003, p. 173).

Given the statements exposed here, the record is a fundamental tool for the teacher, giving concreteness to the ideas, fears, reflections, certainties and uncertainties arising from the practice in the classroom. It should be seen as an ally of the teacher who seeks self-knowledge and understanding of his/her profession, striving for continuous improvement of his/her performance in the education of children and youth.

Training for Primary School Teachers is not restricted to their initial training and continuing education courses. As stated by the researcher Maria Lucia Giovani (Giovani, 1998), in a study on the formation (education) of teachers and on the role of the university in this process:

"It is recognized that the training of teachers and education specialists cannot be achieved through accumulating information, attending courses and acquiring techniques, rather by learning and real-life practice, individual and collective, critical reflection on practices and work contexts, providing opportunities for reconstructing professional and personal identity. It also recognizes the importance of "knowledge through experience" and providing opportunities to exchange experiences or "knowledge sharing" as a starting point for a new professionalism of staff in service. It is, above all a starting point, to initiate and sustain the effort of active appropriation of theoretical knowledge that supports and guides the competency to be put into practice." (Giovani, 1998, p. 3)

Thus, learning on the job, "knowledge through experience", whether it be individual or collective, should be viewed as opportunities for the stimulation and the appropriation of theoretical knowledge and instruments that enable the transformation of teacher practices in the classroom.

Also Freire (2005) in his lengthy debate of "thinking right" emphasizes the importance of thinking and doing together, sharing, communication between teacher and student, a "communicative act" whose understanding is "co-participated":

"Right thinking is not – one isolating themselves, one hiding himself away in a secluded place, rather it is a communicative act. There is no right thinking without understanding and this understanding, from a correct thinking point of view, is not something transferred but co-participated. [...] The task facing the individual who thinks right, is not transferring, depositing, offering, donating to another, to become a victim of his own thinking, the intelligibility of things, facts, concepts. The task of the educator who consistently thinks right, is employing, as a human being, the irrecusable practice of understanding reality via objective logic, challenging the student with whom he/she communicates and producing understanding of what is being communicated. There is no intelligibility that is not communication and intercommunication, and that is not based on dialogicality. Right thinking is dialogical and therefore not controversial." (Freire, 2005, p. 37–38).

The authors presented here agree about knowledge through practice, gaining knowledge through means of challenge and communication, whose experiences can and should be shared through records of teaching practices. According to Freitas and Yokoro (2009), in the article Cartography in Continuing Education of Teachers: Myths, Fears and Living Experiences, which presents some of the results obtained in training activities of teachers from CECEMCA/UNESP, the teacher's training will only be of an effective, definitive and permanent character when they are aware that they are first and foremost responsible for their education and retainers of the knowledge and experiences arising from their teaching practices, which must be shared and improved for the consolidation of knowledge in their students.

Experiences with school cartography

Cartography is presented in Geography as a discipline whose theoretical and technical foundations allow for the exploitation and enhancement of the capabilities of primary school students, such as their observation skills, acquisition of knowledge, power of explanation, comparison and representation of space and its transformation, by means of elementary topological relations, reading and interpretation and preparation of sketches and maps to represent characteristics of their living space, personal space, as well as different landscapes and geographical space.

The pioneering work of Livia de Oliveira, which lays the foundation for School Cartography in Brazil was based on the theoretical framework of Piaget and was the reference point for a significant amount of the work that researchers produced afterwards.

In her thesis for full professorship, defended in 1978, Oliveira presents the Methodological and Cognitive Framework for Maps, Oliveira (1978), a contribution to laying the methodological foundations of map study in Geography.

"In this study we set out to approach the map from a cognitive and methodological point of view. It was designed, therefore, in order to contribute to the foundations of a map methodology." (Oliveira, 1978, p. 11)

The author adheres to Piaget's studies on the child's intellectual development over space, "which states that topological spatial relations are the first to be established by the child, both on a perceptive and representative level, and it is in the framework of topological relations that the projective and Euclidean relations will be developed" (Oliveira, 2008, p. 17).

From the perspective of education, it is considered that "a qualitative analysis of the map is justified from a cognitive point of view", requiring the teacher to have "flexible teaching guidelines that are easy to manage and of low cost" (Oliveira, 2008, p.18).

We agree with Oliveira's assertions (2008) when considering that "the value of the map is determined by what the teacher intends to do with it" meaning that it is up to the teacher, who possesses knowledge of this instrument, to use and apply this "model of reality" to situations that arise during their lessons (Oliveira, 2008, p. 24).

According to Almeida (2003): "Piaget, with the support of a team of researchers conducted several studies that enabled him to create one of the more complete genetic theories on the cognitive development of humans. Even though today, in the light of other theories, Piaget's proposal suffers certain restrictions, his studies remain fundamental in terms of their representation of space." (Almeida, 2003, p. 59)

In a study of Geography for a child's learning, Callai (2005) points out the importance of cartography for the education of children at Elementary School:

"One way to read space is through maps, which are the cartographic representation of a given space. Scholars of cartography teaching/learning consider that, for an individual to be able to read space critically, it is necessary for him/her to know how to interpret the actual/concrete space and as well to be capable of interpreting of his/her representation, the map. It is, of course, commonly understood that the individual who knows how to make a map will be in a much better position of being able to read a map. Drawing routes, paths, plans of the classroom, of their home, of their schoolyard may well be the beginning of the student's work for ways of representing space. These are tasks that children generally perform in their early years at school, but it is worth remembering that the interesting thing is that they base them on concrete and real data/facts and not on things that are imagined. That is to say, that they are trying to represent that which actually exists." (Callai, 2005, p. 244)

The author emphasizes here that which was pointed out by Oliveira (2008); the need to construct models that are close to the reality of the child, their concrete spatial domain, representing through sketches, plans and models their everyday living environment.

In this study, with reference to the cited authors, we consider it necessary that cartographic activities be experienced and incorporated into the everyday practices of teachers of the early years at Elementary School. They should be prepared for this when doing their undergraduate courses, and courses undertaken once in the profession, called continuing education courses. Thus, the disciplines related to topics such as School Cartography and Teaching Methodology for Cartography, in undergraduate courses, should be valued more, whether they be Geography or Pedagogy to ensure that children and youth are adequately instructed in the subject.

Methodological guidelines

In order to develop our work, we undertook a literature review, consulting documents related to the initial and continuing training of Primary School teachers in the areas of Education and Cartography.

The basic data for the research were drawn from our experience in creating and coordinating the CECEMCA/UNESP continuing education courses on the theme Cartography and the Environment, especially the reports prepared for UNESP and MEC in 2007/2009, as well as the reports of the educators, tutors and professors involved in the process. We still had access to final reports of the participating teachers, who developed practical activities with their students in the classroom, some of which were selected to give concreteness to the ideas expressed here.

To develop the research we referred to the qualitative methodology, which is explained in Bogdan and Biklen (1994):

"We use the term qualitative investigation as a generic term that includes numerous research strategies that share certain characteristics. The data collected are called qualitative, which means rich in descriptive details regarding people, places and conversations, and complex in terms of statistical analysis. The issues to be investigated are not established through operationalizing variables; rather, they are formulated with the objective to investigate the phenomena in all their complexity and natural context. Although the individuals who carry out qualitative research might select specific issues as they collect the data, the approach to the research is not designed to answer previous questions or test hypotheses. They favor, in essence, the understanding of behaviors based on the point of view of the subjects of the investigation." (Bogdan and Biklen, 1994, p. 16).

Thus, stories, photos, drawings and descriptions of tasks performed by the teacher and his/her students, are presented in the attempt to comprehend how effective the education of the teachers in Cartography and the Environment was and understand the results of the practices developed throughout the course.

The Center for Continuing Education in Mathematic, Scientific and Environmental Education (CECEMCA–UNESP) is a UNESP Extension Program run by the Dean's Office, which began its operation following approval of the project submitted by UNESP to the Ministry of Education (MEC), which culminated in the creation of CECEMCA/UNESP, in March 2004. From this date on, CECEMCA went on to set up the National Network for Continuing Education of Teachers of the Secretariat of Elementary Education (SEB) of MEC.

All the teaching material prepared by the CECEMCA team, makes up the SEB/MEC[2] network file. In this experiment of educating teachers about Cartography and the Environment, through the continuing education courses at CECEMCA–UNESP, we referred to the book Cartography and the Environment, by Freitas (2005).

There was a condition in these courses that all registered teachers had to be part of a study group, in which there was a mediator appointed by the Secretary of Education, called the tutor, who had prior training in a specific course. We placed the responsibility on the teaching leaders, the Education Secretary and his team, to choose the local tutor, who was relieved from some of the learning activities to act as coordinator of the Study Group, which allowed 10 and 30 teachers of his city and region to pursue their continuing education course.

The training courses for tutors ranged from 40 to 120 hours, while the teacher/professor training courses, mediated by tutors, were from 40 to 180 hours, depending on the demands of the systems of teaching partners. One standout feature of the training courses for the tutors and teachers was the semi face-to-face format, with part of the work carried out in long distance mode. In the case of the tutor-training course, we adopted a The Long Distance Education Environment TelEduc[3], to facilitate communication between the educators at CE-CEMCA and the teachers-tutors.

In their continuing education courses, the tutors were prepared to coordinate study groups for teachers, and were also responsible for the descriptive activities in the Cartography book, organization of practical activities, debates and discussions, monitoring the group, with the central themes: Cartographic Representation of the Environment, Thematic Cartography in Environmental Studies, Remote Sensing in Environmental Studies and Environmental Awareness and Educational Excursions.

The local tutors were instructed to draw up an agenda for each meeting to be held which was then sent to the center, through the Virtual Environment TelEduc before each meeting. Secondly, the tutors would post up personal details regarding the meetings, such as the activities undertaken and records of the participating teachers, on a board.

Figure 1. Tutors Training Course in Piracicaba, SP conducted at UNESP
Source: UNESP (2008)

The records made at the end of each learning activity, face-to-face or in distance learning mode, assisted part of the discussions in the study groups and made it possible for local tutors under the supervision of the trainer and coordinator of the course, to modify the activities at each meeting, according to the needs and concerns reported.

Reports of teachers and educators

This experience of integrated education can open new possibilities for the teacher's performance in the classroom. In the stories that follow appear the mechanisms that the teachers adopted to carry out their work, reflecting on the teaching material available and the necessity to adapt it to the needs of their students with respect to age and their life context. Given the ready acceptance of the course by teachers, it was interesting to note the initial comments of some teachers about the versatility of the material in the disciplines, because the study groups were comprised of teachers of different subjects and year levels.

"I noticed the enthusiasm of teachers at the start their study of cartography, the associations made between theory and practice made them reflect and understand the great need to develop activities for cartography, not only in geography but in all areas of knowledge. The teachers thanked us for the opportunity to participate in the course offered, because in their reports they were happy to say that: "It was very valuable because up to this point my greatest resource was the textbook". Those words made me think and see that the course offered, will be as it was for me, a great new interdisciplinary development applied in context. Another participant concluded: "Knowing how to read, interpret, analyze and find one's place in the earthly representation, makes the student a real being, capable of guiding him-/herself and defining his/her place (space)." (Instructor Antonio, Naviraí, MS, 2007)

The difficulty of access to communication equipment via the Internet slowed down the training courses and resulted in many tutors delivering their reports late. The difficulty of reporting their experiences during the study group meetings, in either the face-to-face or long distance mode meetings, was shared with the instructors from CECEMCA online.

Another differentiating aspect of the training courses concerns the preparation of the reports by the tutors, and we would like to include some remarks by an educator from CECEMCA:

"Sometimes they were actually reports, they mentioned that they had done a certain activity in the classroom and [that], sometimes the class had difficulty understanding [the content] ... These results came to us in two ways: reports from the face-to-face meetings (once a month) and through Teleduc (every week). Thus, most of them were delivered in person because of the difficulty they had registering and sending them via Teleduc which was a little vague. When we went to the face-to-face meetings it was emphasized even more, with more detail and so [we realized that] not only the students were having difficulties, but sometimes the instructors when they were trying to teach the students, realized that there was something they had not understood." (Rafael, 2010, personal information)

The activities developed in the study groups on Thematic Cartography and the Environment, led to the proposal to conduct studies and experiments involving the group of teachers and their practices in the classroom. To illustrate these activities we selected one of the practices involving the preparation of a Sketch of the Route from Home to School, which made up part of an account by one of the teachers participating in the Continuing Education Course at CECEMCA/UNESP.

Map sketches of the route from home to school

One activity present in the practices conducted by teachers in training was the preparation by the students themselves of sketches and drawings of a space closeby, usually a classroom, but also of other environments such as home, the home street, the route from home to school, among others.

In Piaget's theoretical systematizations, knowing means organizing, structuring and explaining reality based on our own experiences. Knowledge is always the product of the subject's action on the object. Therefore, the operation is the essence of knowledge: the interiorized action modifies the object of knowledge, imposing order on space and time.

"[...] Upon analyzing its principles it is possible to infer that the Piagetian thread of argument, that is, the basic orientation of his work, expresses itself in the idea that knowledge does not originate in perception, but in action." (Palangana, 2001, p. 71–72)

From the activities related to sketches of the route from home to school carried out with students of the 4th year, we selected three pieces of work that illustrate the diversity of possibilities of representation by the students, according to their previous experiences and their stage of cognitive maturity to represent a mind map showing the Home-School Route on a sheet of paper.

Figures 2, 3 and 4 correspond to the representations of the route from home to school, prepared by students of a teacher called Agatha (Piracicaba, SP), who describes the activity undertaken, in his report to the study group:

"In order that they would have a notion of a sketch, I asked them to draw the route that they take from their home to the school, including the important places along the route so that I could get there. This activity has had great results, with many details." (Teacher Agatha, Piracicaba, SP, 2007)

In Figure 2, we see a drawing by a student called Gio, with a bird's eye view of the street, and images of the house fronts facing upwards in order to represent clearly the objects along the route, where the most important thing is not the accuracy of the route itself, rather the depiction of the references which show where it is, such as the pub, the vegetable garden and the market, distinguished from the common houses by the labels on their fronts and a sign (in the case of the vegetable garden). In the case of Figure 3, the student Leo, also opted for a bird's eye view, showing the route to be a long trajectory, with detailed representation of the reference points showing the path to be followed, from his home, such as the pub, park, bakery, traffic light, butcher's shop, supermarket and health clinic, respectively.

Figure 2. Sketch of the route from home to school by Gio – Grade 4

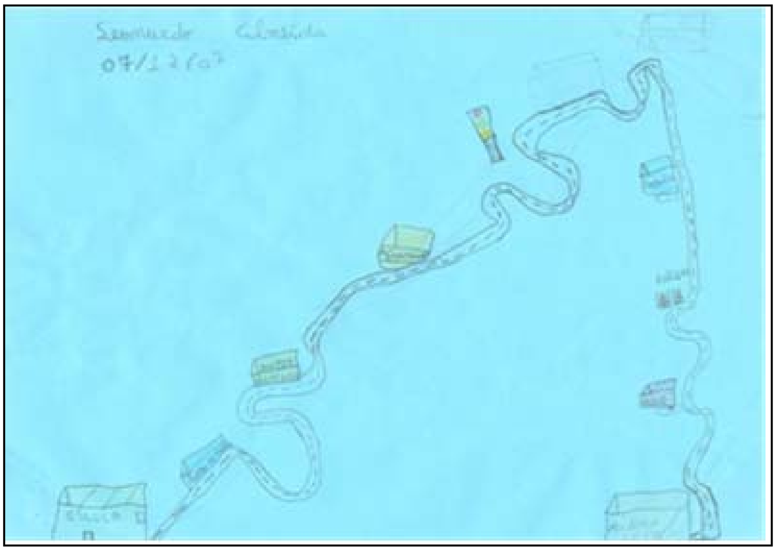


Figure 3. Sketch of the route from home to school by Leo – Grade 4

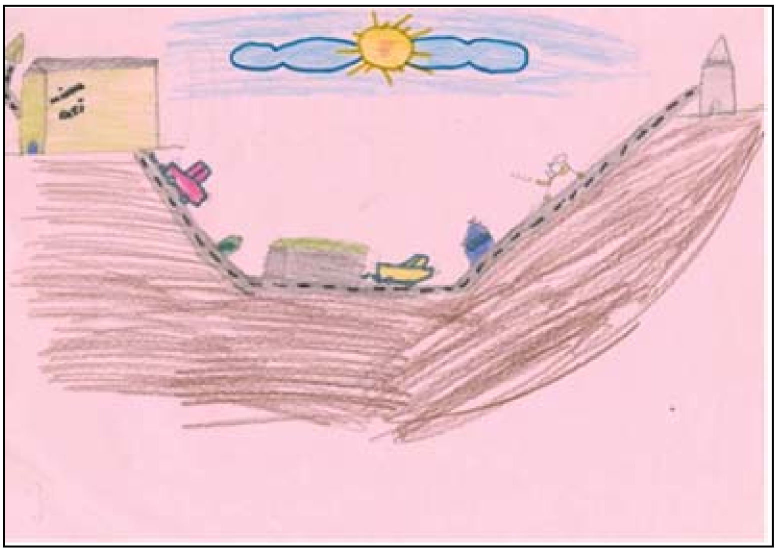


Figure 4. Sketch of the route from home to school by João – Grade 4

In the case of student João (Figure 4) the representation was a profile of the route, causing us to infer that the topographic references to height, or differences of level, stood out on the route and in the student's understanding about the environment he lives in, and for this reason they were included in the drawing by means of representation in profile.

Upon analyzing the work developed by Telmo (1986 cited in Almeida, 2003) of a study that addressed the representation of space by children, in this case the route from home to school, the author concludes:

"The results of this study showed that, although children have different points of view, they are far from knowing how to coordinate them within a single system of perspectives. They also showed that one of the keys for the representation of three-dimensional space is the ability to manipulate the inclined lines to draw an object. The appearance of this ability appears to be linked to the discovery that an inclined plane represents implicit information rather than concrete information." (Telmo, 1986 cited in Almeida, 2003, p.30)

Figures 2, 3 and 4 illustrate the difficulty the students have with coordination as cited in Almeida (2003), in which representations are depicted from different points of view in the same representation.

In figure 2 the object "street" was represented as an aerial view, while the homes and businesses were facing up. In our view, the effect of this depiction of the buildings adopted by student, sought to explain to the reader the differences between the objects that are on the route, i.e., the homes, the businesses and the vegetable garden, the latter represented by a clear sign. The student intuitively sought to explain in this representation, implicit information vertically that might not be visible in a representation from above. This fact confirms their difficulty in coordinating the representation of all the objects in a single perspective, which is due to them not having sufficient conceptual elements to present the representation vertically when preparing the sketch.

For Figure 3, we observed that the student possessed a greater mastery of spatial representation in conventional sketches or maps. The student conveys to the reader through the drawing, the long trajectory he takes to get to school. He selects some common day-to-day objects, for example, businesses and services (pub, bakery, butcher's shop, supermarket and health clinic) and uses symbols to make certain objects stand out on the route, such as a traffic light and an amusement park (represented by drawing two swings for children). His effort, in practicing cartographic generalization, simplifying the route, while informing the reader about the complexity of the path (represented by a series of curves) and its main objects for reference to assist movement and orientation in the space, makes his representation similar to the representation used in standard cartographic products such as house plans and maps.

Figure 4 shows a topographic factor as the determinant for representation of House – School, whose trajectory traverses a valley that separates the two main objects of interest. The representation of the road from a bird's eye view (the division of the two lanes indicated using a dashed line as the symbol) and representation of the vehicles in profile (cars and motorcycle), indicating horizontal or lateral vision, as well as the representation of the houses in perspective, demonstrate the confusion pointed out by authors Telmo (1986) and Almeida (2003). The student's drawing is the only one that includes an allegorical drawing of the sun, sky and clouds, embellishing the representation and functioning as a backdrop for the image.

Analyzing the projects that were presented, allows us to consider how, in the same class with students of a similar age (between 9 and 10), representations of the route from home to school can be presented in so many ways. The teacher should be aware of these situations, which are routine in the classroom, and value the way that each child tackles the task to prepare a map-sketch, individually. The way of understanding and exploring our living space varies from person to person, according to their previous experiences. Referring back to Tardif (2010, p. 11) mentioned at the beginning of this article, the knowledge of individuals, whether they be teachers or students, is directly linked to their identity and life experience.

Examples of map-sketches presented by children from Grade 4, show that the same proposed activity can be tackled and done differently, depending on how the students interpret the teacher's request, according to their cognitive development, their experiences and relationships with each other and with the environment in which they live. This diversity is repeated in many of the activities proposed in the training course at CECEMCA and reflect the diversity of people and the creative ability of each to face up to the daily challenges in the classroom, whether they are teachers or students.

We highlight here a brief report by Aghata (classroom teacher), to which figures 2 to 4 presented here were annexed. Upon selecting the drawings presented and considering them "great results", led us to believe that the diversity of approaches taken by the students of the class to the proposal to prepare the sketch was understood. It is not possible, however, to gauge the teacher's level of comprehension of the results achieved by their students in performing the activity, based on the record made.

This kind of situation occurred several times in the continuing education courses offered by CECEMCA, indicating the teacher's difficulty to conduct an analysis of the effectiveness of their own work in the classroom. Being aware of the value of the material prepared by the students in question, allowed the teacher to select them to present to the study group, although it was not possible for her to interpret and analyze the results achieved from the practice in her record, leaving a gap between what was achieved and understood and documented in the course and the practice in the classroom.

Conclusion

The working environment of the continuing education courses at CECEMCA, through the establishment of study groups, allowed those who accepted the challenge of this experience, to grow as professionals. The compiling of records, by the tutor and the teacher, although adopted in all teacher-training courses offered by CECEMCA, presented difficulties among those involved. Teachers, in general, have a greater mastery of speech than of writing, when it comes to giving expression to their reflections of the teaching profession and their experiences in the classroom. This leads us to believe that this kind of difficulty in preparing records limits teacher performance by putting obstacles in their way, that they individually and collectively, need to overcome to transform their practices in the classroom. This is based on the experiences of the activities undertaken in the continuing education courses conducted by CECEMCA/UNESP.

Children from the 1st stage of Elementary Education develop the activities in different manners, depending on how they interpret the teacher's request and according to their cognitive development and their previous experiences. The representations provided by the teachers were mostly displayed vertically with a flat or upturned view of the objects (e.g.: houses and buildings), or the pictorial profile (horizontal view of the street with allegorical elements such as sun, clouds, among others), as illustrated in the examples presented here. Drawings that depict the images from an exclusively vertical point of view are rare. The confusion with regard to the presentation of different objects is crucial in representation by this age group, which is consistent with the literature devoted to the theme of this age group.

The experiment reported here and the resulting reflections, although being the results of experiences of Brazilian Primary School Teachers during the continuing education course, according to theme, have repercussions in the different countries that include a system of references for Cartographic Initiation for children and youth in their School Cartography courses, and have therefore, a universal character.

Notes

1 http://cecemca.rc.unesp.br/cecemca/index.htm

2 http://portal.mec.gov.br/seb/arquivos/pdf/Rede/catalg_rede_06.pdf

3 TelEduc Environment: Virtual Learning Environment (VLE) created by Centro de Computação (Center of Computation) of UNICAMP (University of Campinas) in 1997, with various tools for virtual interaction such as a menu of

activities and tasks, posting of reading material, slides, films, chat room, e-mail, agenda, place for posting tasks, among others, that permit the creation and administration of long distance courses, partially face-to-face and also used as support in the face-to-face classes.

References

Almeida, R. D.: Do Desenho ao Mapa: Iniciação cartográfica na escola. 2ª ed. São Paulo: Editora Contexto, 2003. p. 115.

Bogdan, R.; Biklen, S.: Investigação Qualitativa em Educação: Uma introdução à teoria e aos métodos. Porto: Porto Editora LDA, 1994. p. 335.

Callai, H. C.: Aprendendo a Ler o Mundo: A Geografia nos Anos Iniciais do Ensino Fundamental. Cadernos Cedes, Campinas, vol. 25, n. 66, p. 227–247, maio–ago. 2005 Disponível em http://www.cedes.unicamp.br. (consulta realizada em 10 de dezembro de 2010).

Fontana, R. A. C.: Como nos tornamos Professoras? 2ª ed. Belo Horizonte: Autêntica Editora, 2003. p. 204.

Freire, P.: Pedagogia da Autonomia: Saberes necessários à prática educativa. 31ª ed. São Paulo: Editora Paz e Terra S/A, 2005. p. 148.

Freitas, M. I. C.: Cartografia e Meio Ambiente. 1. ed. Bauru: Edição do CECEMCA–UNESP/MEC, 2005. v. 1. p. 156.

Freitas, M. I. C.; Yokoro, C. M.: A Cartografia na Formação Continuada de Professores: Mitos, Medos e Experiências Vividas. In: 12 Encontro de Geógrafos da América Latina, 2009, Montevidéu, Uruguai. Anais do 12 Encontro de Geógrafos da América Latina. Montevidéu, Uruguai: Universidad de la Repúb-lica, 2009. v. 1. p. 1–12. Disponivel em:
http://egal2009.easyplanners.info/buscar.php Acesso em: 3 Dez. 2010.

Giovani, L. M.: Do professor informante ao professor parceiro: Reflexões sobre o papel da universidade para o desenvolvimento profissional de professores e as mudanças na escola. Cadernos CEDES, Campinas, v. 19, n. 44, 1998. Disponível em: <http://www.scielo.br/scielo. Acesso em: 03 Dez. 2010. p. 11.

Oliveira, L.: Estudo Metodológico e Cognitivo do Mapa. In: Almeida, R. D. (Org.) Cartografia Escolar. 1. ed. 1ª reimpressão. São Paulo: Editora Contexto. 2008. p. 15–42.

Oliveira, L.: Estudo Metodológico e Cognitivo do Mapa. São Paulo: Novalunar Gráfica e Editora Ltda, 1978. Tese de Livre Docência. p. 128.

Palangana, I. P.: Desenvolvimento e Aprendizagem em Piaget e Vygotsky: A relevância do social. 3ª ed. São Paulo: Summus Editorial, 2001. p. 168.

Santos, C. E Kulaif, Y.: O Ensino de Geocartografia nos Cursos de Formação de Professores de Geografia no Brasil: apontamentos e reflexões. In: Simpósio Ibérico do Ensino de Geologia, I; XIV. Simposio sobre Enseñanza de la Geologia;

Curso De Actualização De Professores De Geociências, XXVI, 2006, Aveiro. Actas Simpósio Ibérico do Ensino de Geologia. Aveiro: Universidade de Aveiro, 2006, p. 126–161.

Tardif, M. Saberes: Docentes e Formação Profissional. Tradução: Francisco Pereira. 10 ed. Petrópolis: Editora Vozes Ltda. 2010. p. 325.

RESEARCH ON CARTOGRAPHY FOR SCHOOL CHILDREN

Rosângela Doin de Almeida
Universidade Estadual Paulista Julio de Mesquita Filho, UNESP (Brazil)
rda.doin@gmail.com or rdoin@rc.unesp.br

Abstract: The aim of this article is to present research about cartography for school children carried out in the Research Laboratory for the teaching of Geography and Cartography (LABENCARTOGEO) of the Postgraduate Program in Geography of the Geoscience and Exact Sciences Institute of the State University of São Paulo (Rio Claro Campus, São Paulo, Brazil). This laboratory was created/founded in 2005 with the objective of carrying out research with teachers and schools, based on the Qualitative Research of Education approach. Since 1996, we have conducted theoretical studies using this methodology. However, in this article we are going to include information from previous studies so that the reader can follow our line of approach. We are going to present you with some background information regarding studies of teaching maps to children in Brazil, with the purpose of embedding the themes that we investigated in our research framework. At the end we will recommend future directions for the research to be conducted by researchers from LABENCARTOGEO.

Introduction

When LABENCARTOGEO was founded, two pieces of research were carried out on the base of Jean Piaget's learning theory and his recommendations for the teaching of maps, which will be mentioned at a later stage. We developed three extensive studies from 1998 to 2008 as to how to produce local school atlases and the professional development for teachers. More recently, we have been working with multimedia cartography and the Internet and also with time and space references in kindergarten and pre-school education. We intend to present the methodology used and the results of all this research.

Research based on the jean piaget's approach

The impact of Jean Piaget's theory in Brazilian education was very strong throughout the 70s and 80s. Regarding the teaching of maps, Lívia de Oliveira's (1978) thesis influenced studies in this area and served as a reference for various research papers afterwards. This paper was the first to present a detailed study of Piaget's ideas regarding a child's representation of space. In accordance with this line of studies, we published a book, which has been used by teachers for teaching maps (Almeida and Passini, 1989). We based our thesis (Almeida, 1994) on Piaget's ideas, which lead to other publications about cartographic concepts for primary school children (Almeida, 2002; 2007).

In order to continue this approach, we supervised Miranda's research (2001) on the construction of a contour line concept by students of 11 and 12 years of age through observations in the field and of a model done to scale. The results showed us that the students are capable of identifying contour lines on large-scale maps (1 : 1000) and indicating which way the water should drain. However, they had some difficulties in drawing contour lines on hydrographical maps and landmarks they are familiar with.

Another study which followed the same approach was carried out by Valéria Cazetta (2002) and dealt with the concept of land use based on aerial photographs. She used aerial photographs of the city's neighborhoods with students of 12 and 13 years of age (scale 1 : 5000) to produce layers with a pre-defined key. In order to identify the urban areas (built-up areas, unihabited areas, squares and areas occupied by large buildings). The research showed that the students had no difficulties constructing the layers, however not all of them were able to identify different types of neighborhoods based on the designated land use. We concluded that additional knowledge is necessary for this concept to be learned, for example, learning the historical background of the city.

We consider the Piagetian approach suitable for investigating the acquisition of concepts related to spatial relations (topological, projective and euclidian) and to the logical structure of thought, however there are other factors, which interfere with the learning process such as symbolic exchanges (through speech, gestures, written forms, visual images etc.) and the factors in the institutional and social context. Thus we attempted other theories for producing school atlases with the collaboration of the teachers. We changed the way we approached the projects on the basis of the premise that time interferes in the production of knowledge. It is necessary to allocate more time to the discussions so that there is interlocution between the researchers and teachers (Bakhtin, 1981). It is in the interlocution that new knowledge arises and this is a methodological condition for the nature of the research that we do. Another fundamental point is language, as knowledge and language go hand in hand in terms of understanding the issues related to the representation of space.

Other approaches for research

A new approach enabled us to attain the objectives that we had defined related to the curriculum, school culture and the teacher's qualifications. We mainly based our research of the curriculum and school culture on Ivor Goodson's (2001) ideas. He considered the curriculum to be a result of the power plays between the dominant groups within higher educational institutions and the social lobby groups that have a direct influence on schools and the community. This enabled us to observe how effectively this cartographic knowledge is implemented in the school's curriculum. We are aware that in the educational process that the teacers are the most important agents, therefore we observed the teacher's practices in the classroom. To this end we used L. Stenhouse's, John Elliott's and Kenneth M. Zeichner's publications presented by Corinta Geraldi (org., 1998). Other authors that were important in shaping our research methodology were D. Jean Clandinin and F. Michael Connelly (1995; 2000).

This theoretical approach confirmed various studies related to the production of local school atlases at Master and Doctorate levels, as is shown in the table below:

Date	Level	Title	Short abstract
2002	M	The production of the municipal atlas of Santa Maria (RS)	The greatest difficulty faced by teachers attempting to produce a local Atlas was their lack of knowledge of cartographic visualization that is adequate for primary school students. This resulted in maps that were confusing, inaccurate and overly detailed for the students (Viero, 2002).
2004	M	A history of Ipeúna, SP	As this city didn't possess historical records, the researcher put together a historical acount for the School Atlas based on the methodology of research using oral history and statements of former residents (Machado, 2004).
2005	D	Educational practices, mapping processes and aerial photographs: Passages and constitution of knowledge.	The researcher presents cartography as passage between human experiences in space and a search for the production of sense (Cazetta, 2005).
2006	M	Challenges that arose in the teaching–learning process of place in the early primary years: Possibilities to achieve citizenship.	The researcher observes and analyses a series of classes of one group of students whose families had moved (migrated) a number of times. Use of the school atlas during classes had a certain impact on the comprehension of local space and its representation, once the neighborhood where the school was located a long way from the city. This made it difficult for the students to comprehend the city and its cartographic representation (Santos, 2006) .
2006	D	The official curriculum and the curriculum practiced by teachers of a particular net-work.	The researcher discussed the teacher's practices who participated in this networking group. The focus of the research was the material dimensions and symbols of the idea of “place” (Gonçalves, 2006).
2006	D	The connection between orality and visuality: reading the world through maps.	The researcher discusses the connection between orality and visuality on the thematic maps in the Atlas of Rio Claro. She uses Deleuze's theory of mediation and the presuppositions of Mikhail Bahktin and Lev Vygotsky as references (Aguiar, 2006).

Date	Level	Title	Short abstract
2007	D	Establishing fundamental Theories for the Internet Atlas Executed and applied in the Brazilian Primary Education System. (held at RMIT University, Melbourne, Au, under the supervision of W. Cartwright)	This research uses the school atlas of Rio Claro (Sao Paulo State, Brazil) as a case study. The original files used for the production of the paper atlas were evaluated and then procedures for converting them to an SVG product were developed. To achieve this goal different graphical packages were evaluated and an interactive prototype was built in using JavaScript. The interface was developed using simple colors and basic shapes, so that the final template can be imple-mented by people with a basic knowledge of graphic design, and little prior knowledge of SVG. The online atlas prototype was imple-mented and tested in real class situations in Bra-zil (Ramos, 2007).
2008	M	Here, there and everywhere: ways and experiences of teachers in teaching of place.	Upon looking at ethnographic records of the classes of three teachers the researcher realized that knowledge and mainly the involvement of the teacher with the place where that teach interferes to a great extent in their classes. The use of a local atlas doesn't change the teacher's way of teaching, rather the notion that the teacher has of the place (Camargo, 2008).
2008	M	Teacher's practices in terms of place and school cartography in the context of collaborative research.	This study discusses how the teachers that participated in this group of collaborative research brought about an exchange and production of knowledge in terms of teaching about place through the means of a local atlas. It was concluded that the change in their practices could not be obtained without interacting with the research group. The teachers learn to use the maps and photos of the atlas as a way to teach geographical concepts, which they didn't do adequately before the study (Locali, 2008).

Based on this body of research we reached the following conclusions about teaching with a local atlas and the fallout of a collaborative group:

- The teachers’ knowledge and practices about place are not composed of a clearly defined and continuous space. Their knowledge is composed of fragments of space and time, mediated by physical and symbolic elements with which they come into contact, so are fragmented too.
- Immigrants and the media give rise to “place” a cultural diversity, leading to a historical discontinuity between the concepts of social groups who attend the school. This causes serious difficulties when teachers are focused only on the teaching of geography and historical development of the region without taking into account the cultural references of the students.
- The local Atlases should be less standardized and more open to the inclusion of cartographic representations with content related to the culture of the students and the teaching practices of teachers.

Another important topic for the study of School Cartography is related to the origins of the content of cartography in the school curriculum. Based on the ideas of Ivor Goodson (2001), a study was conducted of the didactic Geography books published from 1824 to 1940. In this study, concluded in 2010, we discovered that a set of notions, concepts and topics, such as “Direction and Orientation”, “Shape of the Earth and the “Movements of the Stars”, “Imaginary lines: Parallels and Meridians”, “Geographic coordinates/Latitude and Longitude”, “Map”and “Globe” are items that have remained in the curriculum throughout the last two centuries (Boligian, 2010). Besides this, they are taught in nearly the same way even today. Even though teachers today use advanced resources, the teaching method remains quite descriptive.

Currently, we are carrying out investigations of the topic Multimedia Cartography, Internet and Knowledge. In 2010, research about Cartography in the Cyber Culture Age: mapping other types of Geography in Cyberspace (Canto, 2010) was completed. Mapping projects were analyzed using new programs that are available on the Web. These resources permit the users to obtain maps in the following ways:

- The users took advantage of the open, interactive and global quality of this new space of communication to construct collaborative representations or map out personal stories.
- As these systems allow one to surf the Earth virtually, users create spatial relations that are only possible on the Internet with the real places they know.
- Users create spatial relations with places that they got to know in in the virtual media. Thus, the new term of space-time made the map an instrument capable of presenting new realities.

One of the sites analyzed was the Urban Post (http://post.wokitoki.org) created by Daniel Perosio in Rosário, Argentina. This site is the result of a combination of Google Maps with other tools for the production of collaborative mapping. The objective of the project was to show to the inhabitants and visitors areas hidden by the city's planning. By means of notes- posts- added to satellite images and maps, the people would describe their experiences in the city and afterwards posters with these messages were put up in the areas of the city that marked that site.

Another two studies were carried out in 2010 about cartography and the Internet. One of them dealt with the concept of interactivity in multimedia cartography projects. The term multimedia was incorporated into cartography and is used for a combination between cartographic representations with other forms of media such as texts, figures, videos, sound and animations (Peterson, M., Cartwright, W., Gartner, G. (Org.), 1999). The word “interactivity” was created to emphasize a qualitative change in relation to the user with computer interfaces, when devices that allow for the input and output of data were incorporated in computational systems. These allow for interaction between man and machine. With the purpose of analyzing multimedia cartography projects, the researcher (Gomes, 2010) created the following classification of level of interactivity:

Category	Levels of Inter-activity	General Characteristics
Interactivity of Animation	Level 01	It is not permitted to interfere in the sequence of the presentation (stop, interfere, return), nor the interaction through means of any modification of any variable that alters the simulation. The interactivity is restricted to the option of repeating the presentation.
	Level 02	It is permitted to interfere in the presentation (stop, continue, return, repeat) through means of manipulation of variables that may alter the simulation, enabling the visualization of other situations foreseen by the creator of the project.
Interactivity of selection	Level 01	This interactivity is limited to the option of choice before stopping, continuing or going back, following an order of *linear* movement according to the content, within a certain hierarchical framework.
	Level 02	Allows the *linearity* of movement to be broken by the project, making it possible for the *user* to choose the content which he/she wishes to access in a *non-linear* way.
Interactivity of recreation	Level 01	This allows for the comparison of items, through means of simulation, using preexisting information, in accordance with an individual characteristic and the necessity of the *user*.
	Level 02	This allows for updating information, modifying the content and recomposing the message as needed, making co-authoring possible.

Other research that was completed last year looked at the concept of interactivity in cartographic multimedia projects and the use of Google Maps as a didactic resource for mapping local space for children from 11 to 12 years of age (Fonseca, 2010). Both studies look at interactivity, which is the fundamental concept for studies regarding mapping in multimedia projects that involve time, space and culture.

We have recently begun a study looking at pre-school children's representation of space. The objective is to put together a collection of files recording teaching situations with children of 3 and 4 years of age. This collection enables us to analyze how children in this age-group deal with situations that mobilize relations between time-space-body.

Conclusion

At the start of the article we mentioned that we are carrying out our research based on the idea of school culture. In a nutshell, knowledge and school practices are considered to be social construction and not as knowledge originating from a prescribed curriculum. This knowledge is loaded with cultural values coming from the education institution itself. The power relationships exercised in the school context modify the traditional hierarchy between student-knowledge-teacher. In the context of school culture knowledge becomes a social construction and the method of teaching is affected by the influences originating outside the school. Even though learning is a personal construction, there are many concepts that are common because they are formed by the interaction of personal experiences in the same cultural context. The school is seen as a scenario where the students develop their personal experiences, allowing them to reconstruct and construct them together with new knowledge. Different language types (oral, written, graphic, imagery...) allow for this construction, and the construction of social-spatial knowledge is achieved through cartographic language.

References

Aguiar, L. M. B.: 2006, A cumplicidade entre a oralidade e a visualidade: lendo o mundo através dos mapas. Tese de doutorado. Instituto de Geociências e Ciências Exatas da Universidade Estadual Paulista, campus de Rio Claro, São Paulo, Brasil.

Almeida, R. Doin: 2002, Do desenho ao mapa. Iniciação cartográfica na escola. São Paulo, Contexto.

Almeida, R. Doin (org.): 2007, Cartografia Escolar. São Paulo, Editora Contexto.

Almeida, R. Doin: 2005, Cartographic language and production of knowledge: teaching local geography with a municipal school atlas. In: ICA Proceedings of XXII International Cartographic Con-ference. Mapping approaches into a changing world. La Coruña, Spain. 2005. La Coruna: ICA.

Almeida, R. D.: 2003, Atlas Municipais Elaborados por Professores: A experiência conjunta de Limeira, Rio Claro e Ipeúna. In: Formação de Professores e Atlas Municipais Escolares. Cadernos do Cedes/agosto, p. 149–168. São Paulo: Cortez. 2003.

Almeida, R. Doin.: 1994, Uma proposta metodológica para a compreensão de mapas geográficos. Tese de Doutorado. Universidade de São Paulo. Faculdade de Educação. São Paulo (Brazil).

Almeida, R. D., Passini, E. Y.: 1989, O espaço geográfico: ensino e representação. São Paulo: Editora Contexto.

Bakhtin, Mikhail: 1981. Marxismo e filosofia da linguagem. São Paulo, Editora Hucitec.

Boligian, L.: 2010, Materiais escolares, imperativos didáticos e currículo de Geografia: contribuições para a história da Cartografia Escolar no Brasil. Tese de doutorado. Instituto de Geociências e Ciências Exatas da Universidade Estadual Paulista, campus de Rio Claro, São Paulo, Brasil.

CADERNO CEDES, 2003, Formação de professores e Atlas municipais escolares. vol. 23, n. 60. São Paulo: Cortez, Campinas: CEDES, ago. 2003.

Camargo, P. E. B.: 2008, Aqui, Ali e Acolá: Caminhos e Experiências do Lugar em Práticas Docentes. Dissertação de Mestrado. Universidade Estadual Paulista. Instituto de Geociências e Ciências Exatas.

Canto, T. S.: 2010, A cartografia na era da cibercultura: mapeando outras geografias no ciberespaço. Dissertação de mestrado. Instituto de Geociências e Ciências Exatas da Universidade Estadual Paulista, campus de Rio Claro, São Paulo, Brasil.

Cazetta, V.: 2002, A aprendizagem escolar do conceito de uso do território por meio de croquis e fotografias aéreas verticais. Dissertação de Mestrado. Universidade Estadual Paulista. Instituto de Geociências e Ciências Exatas.

Cazetta, V.: 2005, Práticas educativas, processos de mapeamento e fotografias aéreas verticais: Passagens e constituição de saberes. Tese de doutorado. Instituto de Geociências e Ciências Exatas da Universidade Estadual Paulista, campus de Rio Claro, São Paulo, Brasil.

Clandinin, D. J., Connelly, F. M.: 1995, Relatos de Experiencia e Investigación Narrativa. In: J. Larrosa,et. al. Déjame que te Cuente: ensayos sobre narrativa y educación. Barcelona: Editorial Alertes, 1995, p. 11–59.

Clandinin, D. J., Connelly, F. M.: 2000. Narrative Inquiry. Experience and story in qualitative research. San Francisco: Jossey-Bass Publishers.

Elliott, J.: 1998, Recolocando a pesquisa-ação em seu lugar original e próprio. In: Geraldi, C. M. G.; Fiorentini, D.; Pereira, E. M. A. (orgs). Cartografias do trabalho docente: professor(a)-pesquisador(a). Campinas: Mercado de Letras/ALB, p. 137–152.

Fonseca, R. A.: 2010, Uso do Google Mapas como recurso didático para mapeamento do espaço local por crianças do Ensino Fundamental da cidade de Ouro Fino (MG). Tese de doutorado. Instituto de Geociências e Ciências Exatas da Universidade Estadual Paulista, campus de Rio Claro, São Paulo, Brasil.

Geraldi, C. M. G. (org.): 1998. Cartografias do trabalho docente. Campinas (SP): Mercado de Letras.

Gomes, S.: 2010, Cartografia Multimidia: interatividade em projetos cartográficos. Tese de doutorado. Instituto de Geociências e Ciências Exatas da Universidade Estadual Paulista, campus de Rio Claro, São Paulo, Brasil.

Goodson, I.: 2001, O currículo em mudança. Estudos na formação social do currículo. Portugal: Porto Editora.

Gonçalves, A. R.: 2006, Os espaços-tempos cotidianos na Geografia Escolar: do currículo oficial e do currículo praticado. Tese de doutorado. Instituto de Geociências e Ciências Exatas da Universidade Estadual Paulista, campus de Rio Claro, São Paulo, Brasil.

Locali, R.: 2008, Práticas Docentes Sobre Ensino do Lugar e Cartografia Escolar no Contexto de uma Pesquisa Colaborativa: Processos de uma Cosntrução. Dissertação de Mestrado. Universidade Estadual Paulista. Instituto de Geociências e Ciências Exatas.

Machado, H. M. F. G.: 2004, Uma história para Ipeúna (SP). Dissertação de mestrado. Instituto de Geociências e Ciências Exatas da Universidade Estadual Paulista, campus de Rio Claro, São Paulo, Brasil.

Miranda, S. L.: 2001, A noção de curva de nível no modelo tridimensional. Dissertação de mestrado. Instituto de Geociências e Ciências Exatas da Universidade Estadual Paulista, campus de Rio Claro, São Paulo, Brasil.

Oliveira, L.: 1978. Estudo metodológico e cognitivo do mapa. São Paulo, Instituto de Geografia/Universidade de São Paulo. (Série Teses e Monografias, 32).

Piaget, J. & Inhelder, B.: 1993, A representação do espaço na criança. Trad. Bernardina Machado de Albuquerque. Porto Alegre, Artes Médicas.

Peterson, M., Cartwright, W., Gartner, G. (Org.): 1999.,Multimedia Cartography. 2. ed. Berlin: Springer Verlag.

Ramos, C. S.: 2007, Establishing Fundamental Theories for Internet Atlas Realisation with Application in the Brazilian Primary Education System. PhD Thesis. Geomatics and Cartography . Royal Melbourne Institute of Technology, RMIT UNIVERSITY, Austrália.

Santos, G. A.: 2006, Desafios no processo ensino-aprendizagem do lugar nas séries iniciais do Ensino Fundamental: possibilidades para a formaçao para a cidadania. Dissertação de mestrado. Instituto de Geociências e Ciências Exatas da Universidade Estadual Paulista, campus de Rio Claro– São Paulo – Brasil.

Viero, L. M. D.: 2002, A elaboração de um atlas escolar municipal como uma contribuição para o ensino de Geografia- Santa Maria (RS). Dissertação de mestrado. Instituto de Geociências e Ciências Exatas da Universidade Estadual Paulista, campus de Rio Claro, São Paulo, Brasil.

Wiegand, P.: Educational Cartography; mapping a theoretical framework. In: Anais XXII International Cartographic Conference: Mapping Approaches into a Changing World. La Coruña (Spain): Royal Melbourne Institute of Technology, 2005. p. 151.

Zeichner, K. M.: 1998, Para além da divisão entre professor-pesquisador e professor acadêmico. In: Geraldi, C. M. G.; Fiorentini, D.; Pereira, E. M. A. (orgs). Cartografias do trabalho docente: professor(a)-pesquisador(a). Campinas: Mercado de Letras/ALB. p. 207–236.

Vygotsky, L. S.: 1988, A formação social da mente. Trad. José Cipolla Neto, Luis Silveira Menna Barreto e Solange Castro Afeche. São Paulo, Martins Fontes.

Vygotsky, L. S., Luria, A R., Leontiev, A. N.: 1988, Linguagem, desenvolvimento e aprendizagem. São Paulo: Editora Ícone.

Maps for the Future:
Children, Education and Internet
Joint ICA Symposium

Diversity in Cartography

INTERPRETATION OF SURFACE FEATURES OF MARS AS A FUNCTION OF THE LANGUAGE OF PLACENAMES

Henrik Hargitai
Department of Physical Geography, ELTE TTK (Hungary)
hhargitai@gmail.com

Abstract: Does the language of place names affect the interpretation of a planetary map? Is there any consistent change in the reading of a planetary map if the language of descriptor terms is changed from the official Latin to the mother language of the map reader? A survey made at a middle school in Hugary addressed these questions. The method was to collect preconceptions on the landscape of Mars, then to show the pupils maps in Latin and Hungarian, and again ask the same questions. The results show that there are considerable differences in the two groups.

Introduction

What is the surface of Mars like? Two independent survey was made asking this question. The first asked this question from 3 to 66 year old persons, including university students. The results of this survey were reported by Hargitai (2008). “Wasteland” was a common answer in all age groups. Even university students responded that they previously imagined Mars as a global plain. This is in good agreement with the 19th century picture of Mars in which Mars was seen as a global plain (with some vegetation possible), a global network of canals seen by some of the observers). Topographic features were never seen prior to spacecraft observations from near orbit, because from the Earth it is not possible to see shadows on Mars: Mars, seen from the direction of the Sun, is always in or near full phase. (The case is the same for the Moon: during full Moon phase, topographic features can’t be seen). The lack of visible topographic features were a result of distortion of the observational data set (and partly due to the atmosphere), but were interpreted as a lack of real topographic features. This could have led to the common misconception of canals, which, according to the theory, are used for irrigating the dry but otherwise fertile plains (Lowell 1908). This way theory of a flat Mars helped paving the way to the theory of the canal system of Mars. It is also easiest to imagine a global plain, since it requires no imagination of more complicated geographic features.

Between the age of 12 and 18 the color red was often mentioned, but this observational fact, known by anyone who have ever seen Mars in the night sky, was interpreted differently: a 12 year old explained the color as “lava”, some 15–22 years old natural science students said it is because of its Fe content, while one student of humanities attributed the color to the atmosphere of Mars. This coincides with the history of discovery of Titan, which orange color was first interpreted incorrectly as the color of its surface by G. Kuiper (Kuiper 1944).

A 15 year old “terraformed” Mars: he placed “mountain chains, valleys and volcanic mountains” to Mars. Apart from university students in Earth Sciences, only one respondent mentioned craters and the polar caps. The other answers were volcanoes, river valleys, dust and sand.

Methods

In 2011, this survey was made in four middle school classes in Hungary[1] (two classes studiyng geography in English, two in Hungarian, 16–17 years old pupils). They were given a questionnaire. They first had to give a short description of Mars, then they got two sets of maps of Mars. Half of them got a map using a nomenclature in the official form, in Latin, the others got the standardized, Hungarian language variant (Hargitai et al. 2010, Hargitai and Kereszturi 2002). Then they again had to describe Mars, but now using these maps (Figure 1a, 1b). The maps were cutouts of the topographic map of Mars (Hargitai 2008).

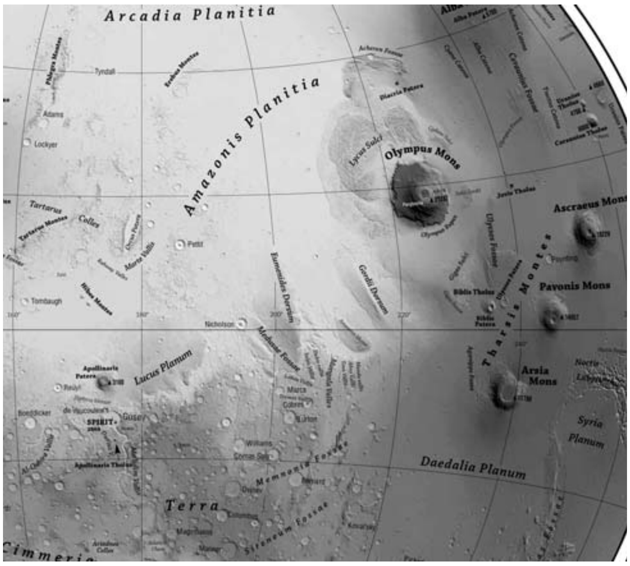


Figure 1a. Detail of the map of Mars, with official IAU (Latin) nomenclature

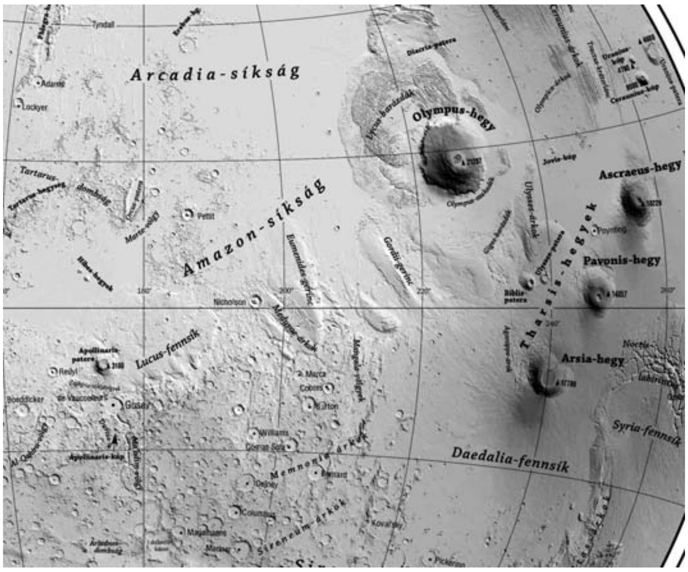


Figure 1b. The same detail of the map of Mars as in Figure 1a, but with Hungarian nomenclature

Results

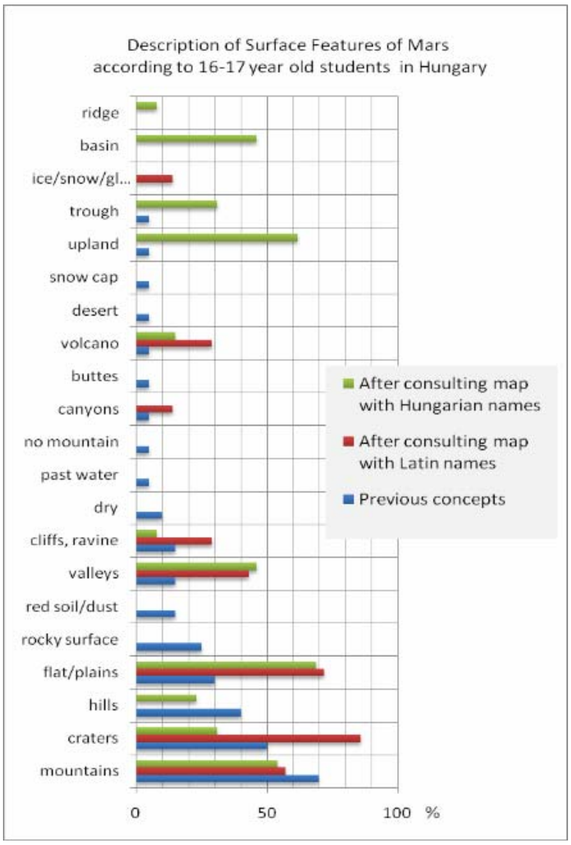


Figure 2. Results of the survey

Previous concepts

Most students in this survey mentioned mountains, craters and hills the most, plains only ranked 4th place. This is in contrast with a previous study in which plains was the most common answer. Many students gave more details: rocky surface, res soil, dust, buttes, snow caps, or mentioned other aspects of its surface: dry and past water. (Figure 2)

Concepts after consulting the maps

Students reading the map in Latin, used the Latin names for surface description, often without any comment. Names with Rupes, Sulci, Planitia could not be interpreted by any of the respondents, but they mentioned ("copied") the names. Valles Marineris was interpreted as ravine or long valley. Plana was understood as plains, Mons and Paterae were described as high mountains, Tharsis Montes as mountain range. Craters were the most frequently mentioned as typical Martian landscape features.

Many of those who got the Hungarian version, described Mars using – simply listing - the descriptor terms used in the geographical names appearing on the map. This made the description easier, but required no deeper thinking. As for the landforms, in this group most respondents mentioned uplands, plains, mountains, basins – as it could have been read directly from the descriptor terms.

Discussion

Before. Of the landscape types described before consulting the maps, some concepts have disappeared completely from the later description: deserts, buttes, soil and dust, rocky surface are not mentioned any more. Buttes are too small to appear on a map, surface characterization is not the task of a topographic map. Arid and dry nature of the surface can't be read from a topographic map. These very important concepts which described the nature of Martian landscape correctly, have been exterminated and overridden by the stronger effect of the nomenclature of the map. However, it is very important that these factors remain in the horizon of the student's knowledge on Mars: maps – especially computer generated maps which are not suitable for showing features smaller than what is visible at a particular scale – should have solution of communicating the surface texture and the existence of smaller landforms in some way.

Latin names. The group who worked with the Latin names could not use the descriptor term parts of place names as handles so they had to figure out the geographical nature of the features. They had to use the map's visual tools: shapes and shaded relief representation of landforms. So they have to invent English (or Hungarian) words instead of the Latin ones, in which they performed well. In some way, even better than those who got the Hungarian version, transparent in meaning: descriptor terms strictly reflect the shape of features (morphology), while looking at the shape of them, their origin/genesis (or geological nature) may become also clear for the students. So, students could correctly name “volcanoes” instead of just “mountains”. A striking difference between the two groups is the frequency of occurrence of mentioning craters: almost twice as many students noticed craters in the Latin group than in the Hungarian one: craters had no descriptive term, so they did notice them as landforms, while for the students who got a map full of understandable names, but without any names having a term “crater”, they may have seemed to be not very important or they just overlooked craters because they concentrated on features named and named with descriptor terms.

Hungarian names. The group who used Hungarian names (i.e. what they understood), used basically only the names that appeared as descriptor terms, but some recognized the importance of craters and some also noticed volcanoes. Many listed “uplands”, and “basins” which is a more detailed description than just “plains” as “translated” from the visual aids of the map. Troughs were also listed by many respondents – an equivalent of Fossae which have not at all been recognized from their visual representation by the group which got only the Latin names.

Summary

The language of Nomenclature does change the perception of the surface features of a planetary body for a general map reader. It changes preconceptions, eliminating some – even important and true – concepts, and makes others even stronger. If the meaning of a descriptor term is opaque (used in a language not known by the map reader), they had to interpret the features themselves; this gives more importance to the visual representation of features. If the meaning of a descriptor term is known, it makes it easier to interpret features, but since it is an easy task, the map reader does not have to rely on visual representation and will less notice features not named. Transparent names help interpreting features which nature is hard to decipher from its visual representation.

Both methods have their advantages and disadvantages, which should be taken into account when the visual representation methods and auxiliary data/texts appearing on the map are planned and realized.

Notes

1. Kürt Alapítványi Gimnázium, Budapest, 10a, 10b, 11a, 11b classes

References

Hargitai H (ed.): Topographic map of Mars, Lambert projection. Kozmikus Anyagokat Vizsgáló Űrkutató Csoport. 2008 Available online at http://planetologia.elte.hu/1cikkeke.phtml?cim=planterkepeke.html

Hargitai H, Kozma J, Kereszturi Á, Bérczi Sz, Dutkó A, Illés E, Karátson D, Sik A: Javaslat a planetológiai nevezéktan magyar rendszerére. [Suggestions for a Hungarian language system of planetary nomenclature, in Hungarian] Meteor csillagászati évkönyv [Meteor Astronomical Yearbook] p. 280–302 2010.

Hargitai H.: Csillagászati ismeretek és téveszmék óvodáskortól időskorig, [Astronomical facts and fallacies from pre-schoolers to elderly people, in Hungarian] Új Pedagógiai Szemle 58. 6–7. 2008., 122–148. p.

Hargitai H.and Kereszturi Á.: Javaslat magyar bolygótudományi szaknyelvi norma létrehozására [Suggestions for a Hungarian language standardized planetary nomenclature and terminology, in Hungarian] Geodézia és Kartográfia LIV, 2002/9, p. 26–32.

Kuiper, G. P.: Titan: a Satellite with an Atmosphere. Astrophysical Journal, vol. 100, p. 378–383, 1944.

Lowell, P.: Mars as the abode of life New York: Macmillan 1908.

MODELLING OF THE PLANT DIVERSITY IN BIOSPHERE RESERVE "SREBARNA" AND RELATED ECOSYSTEM SERVICES

Georgi Zhelezov
National Institute of Geophysics, Geodesy and Geography (Bulgaria)
zhelezov@abv.bg

Abstract: Wetlands are one of the most dynamic and sensitive nature systems. The different wetlands provide a number of goods, support permanent human activities and determinate some of important ecosystem services. The lake Srebarna is the biggest natural wetland system along the Bulgarian sector of river Danube. The transformation of the wetland system is connected with the level of ecosystem services. The investigation of the changes in the basic elements of the wetlands (waters, sediments, vegetation and animal diversity) are related with parameters of the ecosystem services in the wetland and surrounding territories.

Introduction

It is well established that human well-being is dependent upon ecosystem services provided by nature (Costanza et al., 1997, MA, 2005, TEEB, 2008). The ecosystem services cover the broad range of connections between the environment and human well-being, including , supporting servive (e.g. nutrient cycling, soil formation), provisional service (e.g. food, fresh water), regulating services (e.g. climate regulation, flood attenuation), and cultural service (e.g. recreational, spiritual, aestehetic) (MA, 2005). The wetlands nature systems as one of basic nature system provide the number of important servivces. The part of some basic ecosystsem services are connected with spatial dimentions of the plant formations in the reserve. Regulation of the productivity and spatial conditions of the plant formation is foundamental in the sustainable development of the wetland system.

Models and modelling

Spatial models observe as abstraction of the reality. They consist only this part of realty, which is important for the interpret object. The model as abstraction shows the aspects of the real world, which can be manipulate and analyzed in the past, determinate present and give the opportunities for future (Smyth, 1998).

Robinson et al. (1984) draws the basic conceptions in the building of spatial models (cartographic models) as everyone conception determinate focus, center of any type of knowledge:

1. Geometrical focus: connected with the accuracy of the spatial model.
2. Technical focus: determinate the size, characteristics and the process of producing of the models.
3. Presentation focus: this focus is based on the characteristics of the model, which are product on the spatial data, using technologies, visualization conditions, level of graphic art. The second group of signs is contents, characteristics of the symbols, planning of spatial model and generalization.
4. Art focus: connected with specification of spatial model. It is founded as result of colors, lines, orientation, graphics, selection, balance, spatial peculiarities, classifications and personal ideas and decision of the author of the spatial model.
5. Communication focus: connected with interaction between author and consumer of the spatial model. It consist two aspects: producing of spatial model and using of spatial model.
    - Producing of spatial model includes collection, classification, selection, generalization and symbolization of the data.
    - Using of spatial model includes the whole specter of opportunities for using of the spatial model: reading, analysis and interpretation of model.

Spatial model must conclude and shows the real world in determinate form and size. Some of the scientists in modelling theory present the real world as a Cosmos with data. In spatial aspect we can model different system from local to regional and global system. They include different parts of human knowledge: natural and social, theoretical and practical, virtual and real. The most important is opportunity for connection of two or three of these parts (Ziegler et al. 2000). The structure of the models determinates simple and complex models:

1. Simple models: they are presented from net with points and lines or geometrical figures as prism, cylinder, cone, cube and combination of these figures. They determinate as basic frame model, which presented directly

in GIS. The simple models are used in GIS analysis and operation processes.

2. Complex models: they are presented net with points and lines or geometric figures and their combinations with more complex data and details. The image structure can be used in process of modelling, realized from modelling means. There is no analytic process in complex models. They used only for visualization.

Kirkley et al. (1987) investigated models and the role of the models in physical geography. The models presented the effect of the actual or hypothetic net of processes and forecasts with one or more consequences. The simulated situation can be simple and to includes only changes in equation or mechanical presentation of the frame. In other direction the simulation situation can be show the analog of the real world. More of the models determinates any net or forecast.

The other type of modes is stochastic model: they contain least accidental elements in any process and present a big number of consequences.
Spatial models can not show the whole real world, but they give analogies based on lines and conditions. These differences are very big in the level of manifestation and give a different ways for simulations.

The physical determination can not guarantee that the model is effective. The general image shows the small part of real lines. This determinate the basic lows in the model based on characteristics of the real world.

The last spatial model is category based on mathematical foundation, which describes the model. If there is no this type of base the model is ungrounded.

Computer models of the nature objects can present the real world on abstract mathematical level. They give the right decision in process of interpretation of the information from the computer models, forecasts and scientific theories. If there is no spatial model we work only with data and suppositions. If the data are correct we construct the computer model with right parameters and the supposition is proved.

The computer models must have the definitely logic and organization. They are type of quantitative model, used in the process of looking of the forecasts. The forecast must compare with real measurements, which are independent from the data using in the model. This model can be compare with real world. We can simulate any situations from the natural and social real world based on models. Hägerstrand (1967) determinates this type of manipulations as social geographical simulations. The aim is not only the forecast, but using the forecast to control the real processes. The simulation helps in the process of good management and taking of right management decisions.

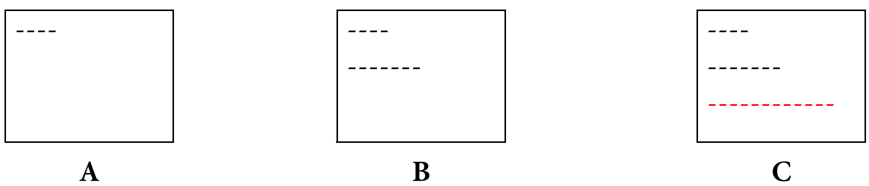


Figure 1. Simulation model (based on Hägerstrand, 1983)

State A show the begging of any process. If we have develop of this process with force and direction show in model state B, we can wait develop of this process to state C (Hägerstrand, 1983).

Based on the abstract character of the models map is also abstract system. The map can be read only with reading of their key: system of signs, colors, lines, projection, orientation and scale. The map can be use for analysis, forecasts and collection of the information. We can make a number of models based on the map. These models give the contents of the map. In this case the map translated on the language of the other system, which gives the process of technical analysis, build the analogical model. The map like the theory shows the image of the empiric processes. There are several levels of information transformations. The basic information is geographic environment. The next level is discovery of the geographic information, mapping and producing of the map images. Robinson et al. (1984) describe three levels of transformation:

1. level: centralization of the general object, collection of the information, compilation of the data and remote sensing,
2. level: selection, classification, generalization and symbolization,
3. level: reading, analysis and interpretation of the map.

Cartographic models every time are connected with geographical knowledge's and comparisons, because it is based on spatial information. Cartographic model is compulsory, when the model has determinate spatial spreading. The base of the spatial models is data bases. The data can be primary and secondary.

Primary source of data is geographic phenomena. The data are result of investigations. Secondary sources are:

- Remote sensing: data from aerial photography, satellite images etc.,
- Cartographic: data from maps and data as result of analysis of abstractions,
- Administrative: statistical data.

Models and especially spatial models have several aiming groups:

1. Analysis and monitoring of investigated phenomena
2. Testing of the hypotheses and theories
3. Building and analysis of spatial-temporal systems
4. Presentation and management of data bases
5. Editing, transformation, determination of the parameters and interpretation of the data
6. Creating of GIS
7. Presentation of the forecasts
8. Simulation of the process and activities in computer environment
9. Presentation of the management decisions

Research problem

The basic research problem of present investigation is connceted with determination and spatial modelling of the plant formation in Biosphere reserve "Srebarna", Northeasteren Bulgaria. The investigation of the basic plant formation is connected with changes and elements of ecosystem services in wetland system. Dynamic and transformations of the plant formation reflect to ecological situation in the lake and related ecosystem services. The determination of different plant zones in the reserve is integrated with the environment conditions and some elements of the ecosystem servives in the wetland. The level of eutrophication and ecosystem services are key point in the process of sustainbale development and management of the protected area.

Study area

The lake Srebarna is one of the biggest wetlands along the Bulgarian sector of river Danube (Table 1). It is situated in northeastern Bulgaria, near the village of the same name, 18 km west of Silistra and 2 km south of the Danube. The reserve embraces 6 km^2 of protected area and a buffer zone of 5.4 km^2, included the lake, the territory between the lake and the river Danube and the Danubian island Devnia. Diversity of the reserve and surrounding territories is determined in Corine Biotope Project in 13 habitat types. The importance of the wetland system is determine from diversity of the rare and protected bird species as Dalmatian Pelican (Pelicanus crispus), Mute Swan (Cygnus olor), six heron species (Ardea alba, Ardea cinerea, Ardea purpurea, Ardeola raloides, Egretta garzetta etc), cormorants (Phalacrocorax carbo and Halietor pygmaeus) etc.

Table 1. Limnological characteristics (Management plan, 2001)

Indicator	Value
Elevation (m)	10,0–13,2
Water catchments (km^2)	402
Length of shore line (km)	18,5
Reserve area (ha)	902,1
Open water body (ha)	120
Capacity (km^3) – low water levels	2,81
Capacity (km^3) – high water levels	14,35
Maximal depth (m)	3,3
Years flow (m^3)	12,48
Time of stay (months)	2,67

Nowadays the lake has high level of nature protection. It is a breeding place for waterfowl birds (1942), Nature reserve (1948), wetland of international importance protected as Ramsar site (1971), Biosphere reserve protected by UNES-

CO (1975), Monument of World Culture and Nature Heritage (1985), CORINE site (1992), Ornithological place of international importance (1997) and part of the Natura 2000 network (2007). At present "Srebarna" biosphere reserve comprises an area of 902 ha. The Ramsar convention (1971) classifies the lake in category "O" – permanent fresh water lake or open water body. Zhelezov (2010) defined the lake of Srebarna as a lake – marsh type wetland.

Several influential anthropogenic measures have been undertaken on the territory of the reserve in the last sixty years:

- the building of the artificial dike along the Danube bank of Ajdemirska lowland, which interrupted the natural connection and interaction between the lake and the river in 1948;
- the opening of the dike in western part of the Ajdemirska lowland at the 13-metre-elevation of the river bank and the building of the second protection dike in 1978;
- the building of the artificial canal between the lake and the river Danube in 1994.

Diversity of biogeographical provinces is determined from three provinces based on Udvardy (1975):

- Middle European forest formations;
- Pontiac steps formations;
- Mountain territories.

Ecosystem diversity in the reserve "Srebarna" is determined from different wetland types based on the Ramsar convention (1971):

M Permanente rivers: river Danube between right bank and island Devnia;

O Permanente fresh water lake: open water body;

R Seasonal marshes and water bodies: area between left bank of river Danube and river dike from Silistra to village Vetren;

X_f Fresh water bodies with domination of forest formations; seasonal flooded forests: whole territory of island Devnia and part of the river bank between Silistra and village Vetren and right bank of river Danube;

X_k Underground karst and cave hydrological systems: natural spring "Kanarichkata" in the south part of the reserve.

Methods

The methodology includes two levels of research:

- Fieldwork
    - Spatial dimensions of the plant formations;
    - Observation and description the status of the plant formations.
- Laboratory work
    - Determination of basic plant formations;

- Spatial modelling;
- Determination of areas with high level of ecosystem services.

Figure 2. Plantzones in Biosphere Reserve Srebarna

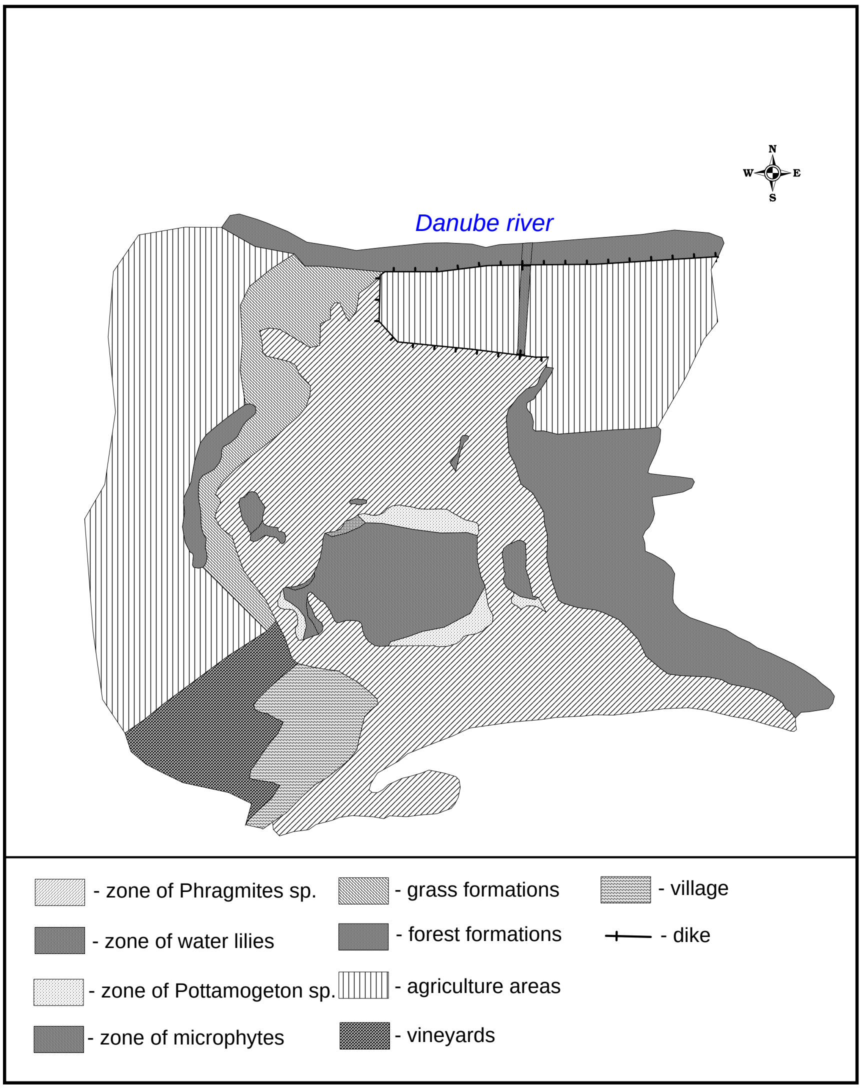


Fig. 2 Plant zones in Biosphere reserve Srebarna

Plant zones in Biosphere Reserve "Srebarna"

The differentiation of the different plant zones in Biosphere Reserve "Srebarba" is based on the system of Shilkrot (1970). We can determine six plant zones in water surface and two zones in depth:

1. Low water zone: temporary flow zone, generally around karst springs;
2. Zone of Phragmites and Typha: zone of permanent water flow;
3. Zone of water lilies: zone of shallow waters;
4. Zone of broadleaved Potamogeton species as Potamogeton crispus, Potamogeton lucens, Potamogeton natans and Potamogeton perfoliatus: zone in depth 4–5 m, calibrate for Bulgaria – 1–1,5 m;
5. Zone of makrophytes: open water bodies;
6. Zone of microphytes: open water bodies.

In depth:

1. Zone of flow plants;
2. Zone of underwater plants.

The determination of the different levels in eutrophication is a result from the analysis of the plant populations (Figure 2):

1. Zone of reed eutrophication zone with permanent hygrophyte populations;
2. Zone of water lilies: zone in process of eutrophication on the first level.
3. Zone of broadleaved Potamogeton species as Potamogeton crispus, Potamogeton lucens, Potamogeton natans and Potamogeton perfoliatus: zone in process of eutrophication on the second level.
   The three zones are connected with shallow water in the wetlands of lake type (until 1 m). They are characterized by stagnated waters and closely cover with water plants. There are no open water bodies, except around the karst springs.
4. Zone of microphites – zone without processes of eutrophication.

This scheme is used for separation of the lake Sreburna in zones with different intensity of the ecosystem services (Fig. 3). They are also indicating the development and intensity of eutrophication processes in the wetland system. The spatial projection of the plants is combined with the results of the sedimentation. The most intensive eutrophication processes are developed in the west littoral zone. It is a zone of water lilies and Potamogetons species. The expansion of the hygrophyte formations is not so strong in the east side. This is a result from the karst activity and the influence of the water flow in the artificial channel between river Danube and lake Sreburna.

The interaction between different plant species and plant zones determinate some of the aspects of ecosystem services in the lake. These zones are connected with small (interior) water bodies. The most representative areas are situated in western, eastern and northern part of the wetland on the contact zone between lake waters and reed formations (dominated from Phragmites species). They provide rich water and food conditions and convenient places for nesting of bird species. The diversity of habitats determinates the high level of ecosystem services and biodiversity.

Figure 3. Zones with high level of ecosystem services

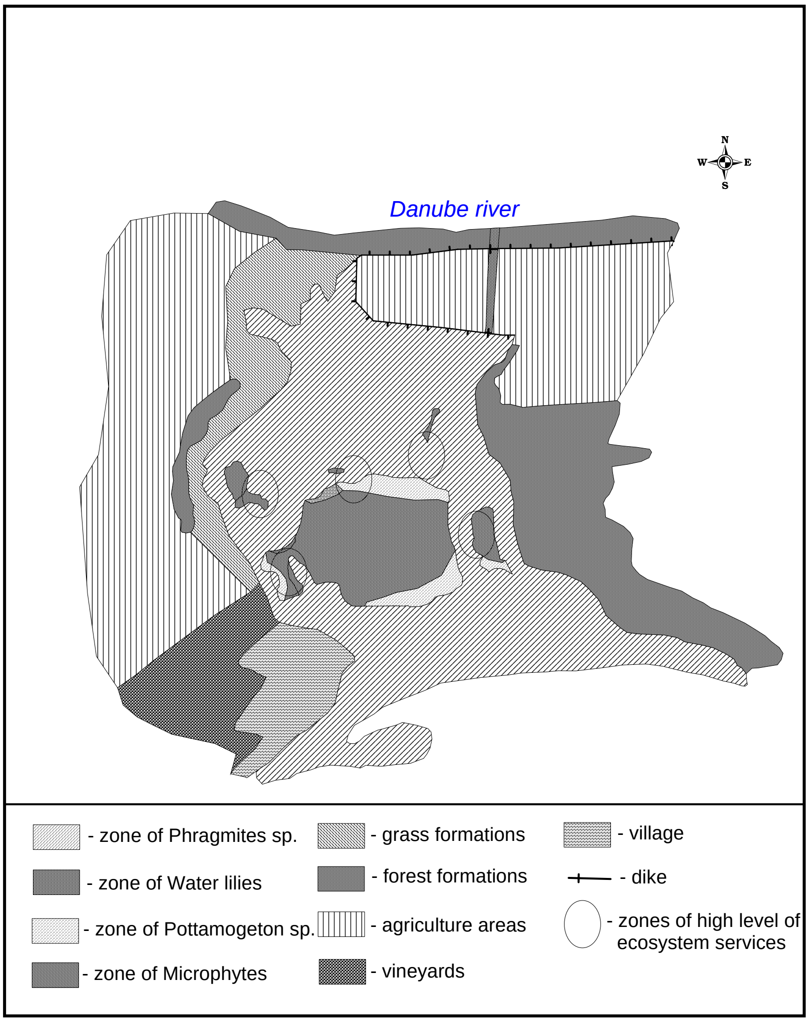


Fig. 3 Zones with high level of ecosystem services

Conclusions

The research modeling the spatial parameters of the basic plant diversity in Biosphere reserve “Srebarna”. The wetland is divided on four plant zones: 1. Zone of reed, dominated from Phragmites species; 2. Zone of water lilies; 3. Zone of broadleaved Potamogeton species as Potamogeton crispus, Potamogeton lucens, Potamogeton natans and Potamogeton perfoliatus; 4. Zone of microphites.

The second important part of the research is connected with determination and spatial modeling of the zone with high level of ecosystem services. They are based on the determination the plant zones. The services of these zones have key importance in the ecological functions of the wetland system. The processes are connected with control of water inflow and transfer of the waters between lake and river Danube. They also provide the best nesting conditions fot the waterfowl bird’s species. Development of the monitoring system for water fluctuation, vegetation dynamic and productivity are the most important elements in present development of the protected system and management strategy of the Biosphere Reserve “Srebarna”.

References

Costanza et al.: 1997, The value of the world's ecosystem services and natural capital. Nature 387, 253–260.

MA (Millenium Ecosysem Assessment), 2005, Ecosystems and Human Well-being: Biodiversity Sysntesis. World Resource Institute, Washington, DC.

Management plan of Biosphere Reserve “Srebarna”, 2001, MOEW. Sofia.

Ramsar convention, 1971.

M. D. F. Udvardy: 1975, A classification of the biogeographical provinces of the world. IUCN Occasional Paper no. 18. Morges, Switzerland: IUCN.

M. D. F. Udvardy: 1975, “World Biogeographical Provinces” (Map). The CoEvolution Quarterly, Sausalito, California.

TEEB, 2008, The Economics of Ecosystems and Biodiversity: An interim report Wel-zel+Hardt, Wesseling, Germany.

Hägerstrand T.: 1967, Innovation Diffusion as a Spatial Process. Chicago University Press. Chicago.

Hägerstrand T.: 1983, In search for the sources concepts. The Practice of Geography. Longman. London.

Kirkley M. J., P. S. Naden, T. P. Burt, D. P. Butcher: 1987, Computer Simulation in physical geography. John Wiley and Sons. Chichester, New York, Brisbane, Toronto, Singapore.

Robinson A. H., R. D. Sale, J. L. Morrison, Ph. C. Muehrcke: 1984, Elements of Cartography. John Willey and Sons. New York.

Smyth C. S.: 1998, Spatial and temporal reasoning in GIS. Uni Press. Oxford.

Shilkrot, G. S.: 1970, Lake as water nature complex, Bulletin of USSRAS, Geography 2, Moscow.

Zhelezov, G.: 2007, Spatial modeling and analysis of the wetland system. In Inventory of Bulgarian wetlands and their biodiversity, Edited by Michev, T. & M. Stoyneva. Elsi-M, Sofia, 131–137.

Zhelezov, G.: 2010, Clasification of the wetlands in Bulgaria. Proceeding of the international conference "Geography and Regional Development", Sofia, 428–436.

Maps for the Future:
Children, Education and Internet
Joint ICA Symposium

Diversity in Cartography

DEVELOPING MAP DATABASES: PROBLEMS AND SOLUTIONS

István Elek, Gábor Gercsák
Department of Cartography and Geoinformatics, Eötvös Loránd University (ELTE), Budapest (Hungary)

Abstract: This article is an introduction to a several-year long development focusing on the building of a digital map database, named EDIT [1]. The theoretical background, the applied technology, the developed information system, and its perspectives will be described. The classical relation database technology and the object oriented, document based database management [2, 3, 4] are applied beside those web based tools and technological solutions which are in the world of the WEB2. The system is not only a rich data source for researchers but also a virtual laboratory of the database technology where various database management systems related to GIS can also be investigated. The EDIT system has become an ordinary data source of the research and education at Eötvös Loránd University and its partners in Hungary [5]. The role of the system is of remarkable importance in the doctoral training too [6].

1. Introduction

Research projects and teaching at the university missed the availability of digital maps for long, although there were many paper maps in the map collection. A large number of map databases are now accessible in the Internet: some of them are free, but they mostly charge for their use [7, 8, 9, 10, 11, 12, 23, 24]. The laws regulating the use of maps are very different from country to country, and the data policy changes from government to government. It is not surprising that "sharp" maps are rarely found on free web pages. As for the fresh satellite images and aerial photos, the case is the same. It is even more difficult to find free vector maps, particularly those that have link codes to databases.

University researchers and teachers very much need a well-organized cartographic database that is available for everyone at the university. The Department has done important steps in this direction by setting up an information system named EDIT. (The acronym stands for the Hungarian words of University Digital Map Collection.) More than ten thousand maps have been entered into the database, which is completed with a data loading application and an online query system (Figure 1). Although the original plan only counted with users from the university, and the data loading is not complete yet, and a part of the users of the system already comes from outside the university. In the beginning, the EDIT system was only accessible from the nodes in the "elte" domain, that is for the teaching and research units that take part in the training of students of earth sciences and computer science. Later, the range of users greatly expanded. The University of Debrecen and the University of Pécs were the first to join the system. Further members include the University of Szeged, two Academic institutions (the Geographical Research Institute and the Balaton Limnological Research Institute), and the Institute and Museum of Military History.

This paper introduces the EDIT system and its major parameters.

2. University Digital Map Collection (EDIT)

The EDIT is an information system built on the principle of relation databases and made for the management, inventory, and service of raster and vector map data. The raster data include scanned maps, orthophotos, and hyperspectral aerial images, while the vector data are mostly available in ESRI shape and Mapinfo tab formats.

The logic and the background structure of the system, and the applications of the database provide the users with an easy and fine-tuned query, and a quick presentation of the results (alphanumerical and graphical or map data). Further, the access to the system can be easily regulated.

The system consists of two major parts: the EDIT is for data loading and maintenance, while the EDITKE is for online query (Figure 1). The online query system is accessible at http://mapw.elte.hu/edit for those on the elte domain. The clients of the Virtual Private Network (VPN) can reach this URL through the certificate of the VPN. The data maintenance application runs on the map server of the system.

Figure 1. First page of the online query system

The system was made in Microsoft VisualStudio 2008. The loading application is a win32 application. The online query was made in ASP.NET. István Elek developed both application programs.

3. Structure of the database

The great differences between the formats of the raster and vector maps caused difficulties for the planning of the database. Although there are various raster formats, they all contain an m x n matrix, which stores the intensity values of a picture according to a colour model in rows and columns. These data may come from scanned paper maps or from the signals of digital images. They all follow the simple structure of raster data models. Descriptive data such as scale, time of making, sheet number can be added to the maps (namely, to each raster file).

This logic cannot be used for vector maps, because these maps are organized into layers and feature classes. Several types of information, layers, and feature classes together can only express the complexity of classical paper-based maps. In addition, some of the usual descriptive data (e.g. scale, title, and sheet number) cannot be interpreted for these data. It is obvious that different data structures must be used for storing the raster and vector maps due to their basic differences. Further, the vector data are often available organized in relation databases even though they are exported into file groups (e.g. ESRI shape or Mapinfo tab files). Consequently, the raster maps need a database structure completely different from that of the vector maps.

3.1. Storage of raster maps

In most cases, the raster maps can be stored in a table structure in which one record represents one map with all its descriptive data as shown in the table below.

map_id	title	sheet number	scale	…
3455	Ödenburg	P48	300 000	…
…	…	…	…	…

The present large capacity database managers allow the binary storing of raster files, graphical data and various kinds of data in BLOB type fields. BLOB is an abbreviation of binary long object, which term expresses that it contains the original information converted into a series of bytes. To display the content of these fields is not as simple as that of the usual alphanumerical fields. However, a great advantage is its secure storage, because the authentification system of the database manager automatically protects the BLOB type data too. This is very important for the information systems that have a high risk of security.

However, the map collections do not belong to the category of high risk. In addition, it may also happen that the raster files of the maps must be modified (e.g. due to noise filtering, improving the quality of the image, georeferencing), when the storage in the BLOB fields would cause problems. Therefore, the maps are stored in another way. The descriptive data are stored in data tables, while the maps are stored in file systems outside the relation database. The descriptive tables contain the name of the maps only, which is a reference in the map_id field. Therefore, if the raster file is modified in any way, it will be immediately visible in the system without changing the database.

The raster map data are stored in two data tables. One stores the groups of maps (table of groups, Figure 2), the other one stores the data records of maps (rastermaps) (Figure 3). Individual maps are sorted into groups by referring to the table of groups.

gr_id	nev
1	Atlaszok
2	Budapesti kataszteri térképek régről
3	Egyéb térképek
4	EOV 1:10.000-es topográfiai térképek georeferálva
5	EOV topográfiai térképek NEM georeferálva
6	Földgömbök
7	Gauss-Krüger térképek az 50-es évekből
8	Gauss-Krüger térképek a mából
9	Hadtörténeti Intézet térképei
10	Hazai szelvényezésű térképek
11	III. katonai felmérés térképei
12	I. katonai felmérés térképei
13	Kogutowicz-féle térképek
14	OSZK térképei
15	ELTE Térképtudományi Tanszéki térképtár térképei
16	Világtérkép sorozat
17	Ortofotók

Figure 2. Table of groups

Column Name	Datatype	NOT NULL	AUTO INC	Flags	Default Value
cim	VARCHAR(255)			☐ BINARY	NULL
tema	VARCHAR(100)			☐ BINARY	NULL
meretarany	INTEGER			☑ UNSIGNED ☐ ZEROFILL	NULL
vetuleti_rendszer	VARCHAR(100)			☐ BINARY	NULL
felbontas	INTEGER			☑ UNSIGNED ☐ ZEROFILL	NULL
leltari_szam	VARCHAR(25)			☐ BINARY	NULL
ev	INTEGER			☑ UNSIGNED ☐ ZEROFILL	NULL
kiado	VARCHAR(255)			☐ BINARY	NULL
tipus	VARCHAR(100)			☐ BINARY	NULL
tartalmi_leiras	VARCHAR(255)			☐ BINARY	NULL
letrehozo	VARCHAR(255)			☐ BINARY	NULL
kozremukodo	VARCHAR(255)			☐ BINARY	NULL
forras	VARCHAR(255)			☐ BINARY	NULL
nyelv	VARCHAR(100)			☐ BINARY	NULL
jogok	VARCHAR(255)			☐ BINARY	NULL
kapcsolat	VARCHAR(255)			☐ BINARY	NULL
megjegyzes	VARCHAR(255)			☐ BINARY	NULL
grformat	VARCHAR(4)			☐ BINARY	NULL
csoport	INTEGER			☑ UNSIGNED ☐ ZEROFILL	NULL
map_id	INTEGER	✓	✓	☑ UNSIGNED ☐ ZEROFILL	NULL

Figure 3. The structure of table rastermaps

This simple relation (of 1 : n type) link describes the grouping of maps. Several other field values may be chosen for this purpose from the collection (e.g. scale), but as the present project is a pilot plan, we decided to have a simple structure first.

3.2. Storage of vector maps

There are various kinds of vector maps, and they are built up on different logic. Their models are much more complicated than that the raster data models. This explains why the present 3.0 version of the EDIT system does not store the vector maps organized in relation tables, but in the file system in a hierarchical structure. When planning the system, its simple use was highly considered, and the table structure designed for the raster data was not used for the vector subsystem. Figure 4 presents a vector layer of the borders of blocks in Budapest, which can be accessed by a hierarchic control (Tree View) shown in the figure. The layers are sometimes grouped according to a region they belong to (e.g. Budapest), sometimes according to the name of data products (e.g. ADC-WorldMap).

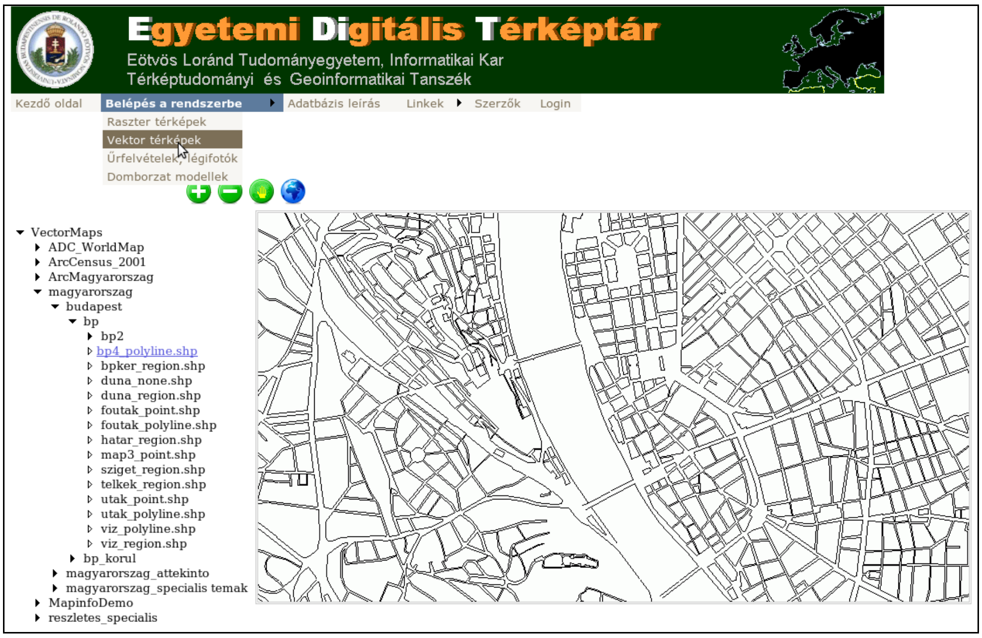


Figure 4. Navigation in the vector subsystem with a hierarchic control

The layers of the vector subsystem are available in ESRI shape or Mapinfo tab formats. Although there are other file formats (e.g. ArcInfo personal database in mdb file formats), we decided that these two standard formats provide the system with enough flexibility, because every GIS software can now read or import these file formats.

3.3. Query in the database

You can search in the raster subsystem according to the SQL (structured query language) standard. The full functions of this kind of online search are only available for special users with the help of a series of SQL commands and to a very much limited extent for users without personal identification (such as queries from any elte domain). Naturally, the whole arsenal of SQL can be applied in the process of data loading and database building, because the data loading application supports these processes.

There is no SQL interface in the vector subsystem. The expressive names of libraries and files make the navigation easy in the file system. A table of metadata might be put into service with the pure task of querying in the future, but it is certainly not going to be a part of version 3.0.

4. Authentification, security and data loading

The authentification of the database against hackers in the cyber space is a very important issue. It is not worth building large databases if we cannot protect the server from the attacks of hackers, because the frequency and complexity of the attacks will surely lead to data loss.

The protection must be guaranteed at two levels. Namely, the server and database must be protected. The protection of the server is the task of the administrator of the operating system, which includes the following tasks: virus protection, setting up of the firewall, setting up of the Internet Information Service, and the regular refreshing of the operating system of the server. The server is not accessible from a local network. It has only one public directory, into which certain files (e.g. tif, jpg, tab, shp) can be loaded from a few dedicated computers. In this case, the data loading application imports the requested maps.

Although the protection of the server protects the database too, but the efficient protection of the database needs additional settings. It must be decided in the administration of the database management system that which users have the right to access the database tables and to what extent. There are users who, without personal identification, have the select right only. (These are requests from URLs on the elte domain.) Others, who have personal authentication, have not only the select right to access the database. The series of SQL commands is also available for them, and they can download the selected maps on their client computer.

Only users with special rights are allowed to load and maintain the data. They have the right to not only select, but also to update and delete information. However, they do not have the right to delete large amount of data, to drop tables or to perform any other operation that would corrupt the data. The administrator only has full rights over the database.

The loading and maintenance of data is performed by a win32 application running on a server, which is available for registered users only. This application allows the editing of the existing map data, the changing of the attribute data, as well as updating the data and the manipulation of the existing maps (Figure 5). In addition, the new maps are entered into the system by using this program

(Figure 6). The directory of the server that receives the uploaded data is only accessible with the right of writing from a few client computers. The map data to be uploaded into the database are placed here, in the buffer. After loading the map into the database, the buffer becomes free. The configuration file of the system includes, among others, this place as well, which is specified at the setting of the system.

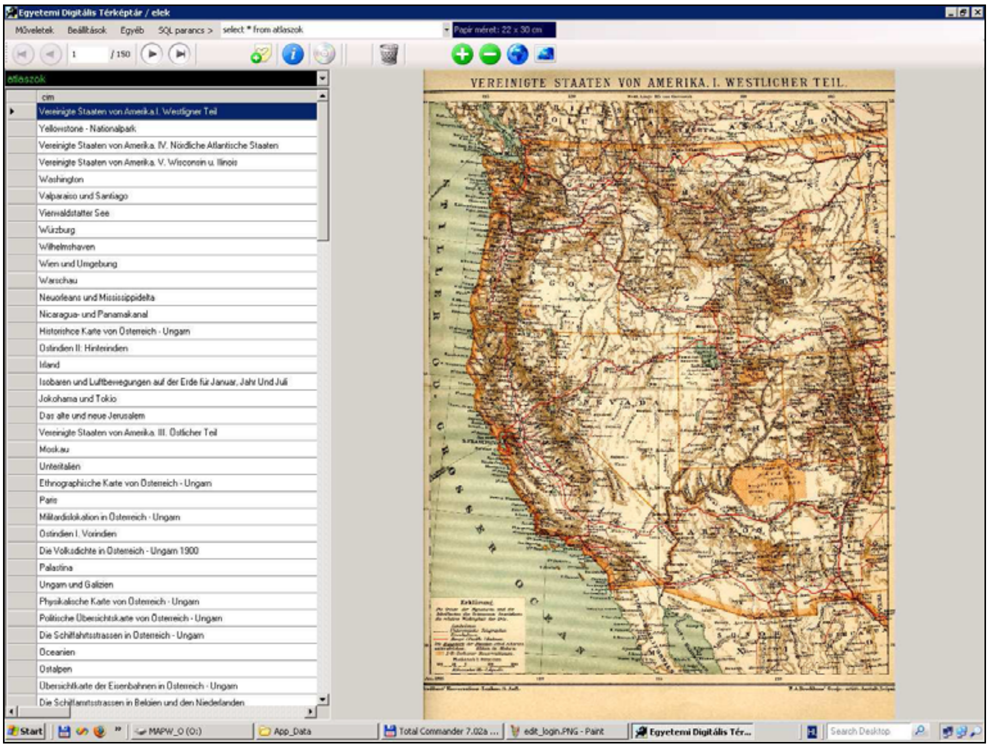


Figure5. After starting the data loading application, you enter the database. You can edit the data of a selected group of maps and you can move and select in the table to view the chosen map. Browser and mapped windows help view the data.

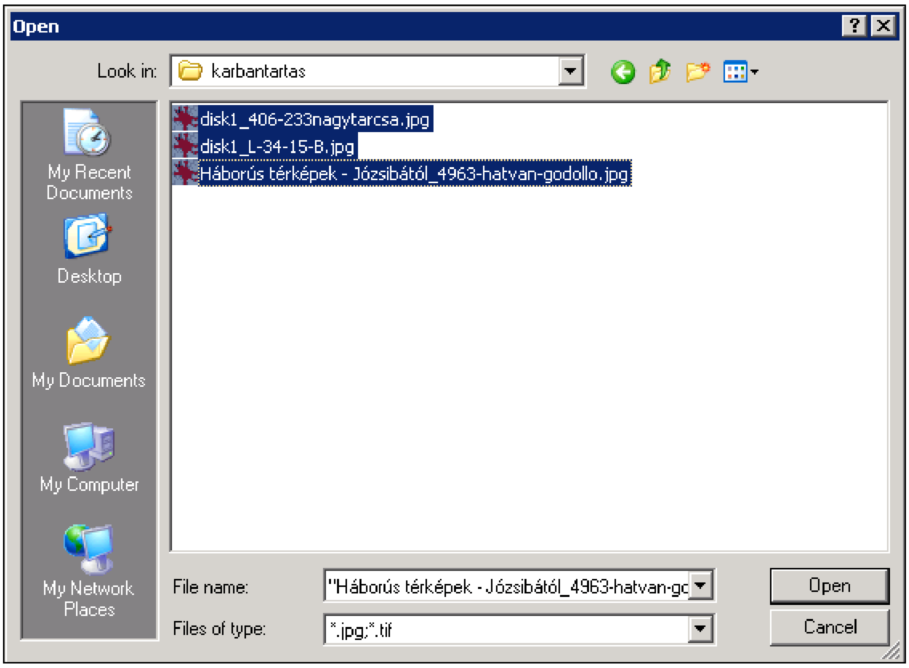


Figure 6. The data loading application can import not only single maps, but also groups of maps into the system

5. Query and servicing

The system includes a configuration file, which contains the parameters necessary for the operation (Figure 7). This file ensures that the places that are needed for the access to and management of the data and maps are flexibly specified. This guarantees the smooth running of the system even if the operation system is completely reconfigured. In this case, the accessibility and addresses of the modified places have to be rewritten in the config file only. There is another parameter file, which gives the names of the data columns to be displayed online. This is necessary because not every user is interested in every data column. This parameter file allows us to specify which data columns should be visible for the online query.

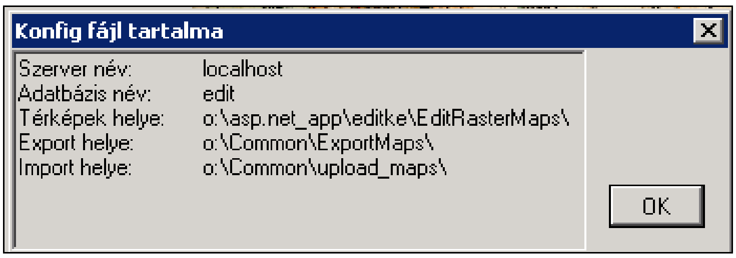


Figure 7. The contents of the configuration file of EDIT

When uploading data, complicated queries may be necessary. This is offered by a series of SQL commands, which allows the user to make a combination of SQL commands at wish (Figure 8).

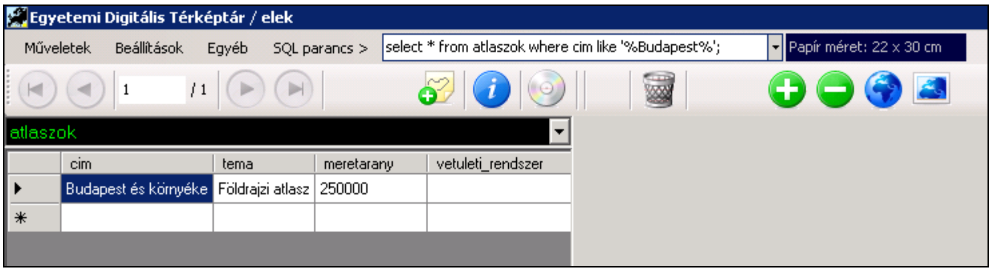


Figure 8. In the series of SQL commands you can give optional commands such as find all those raster maps that have the word Budapest or 1 : 100 000 in the title

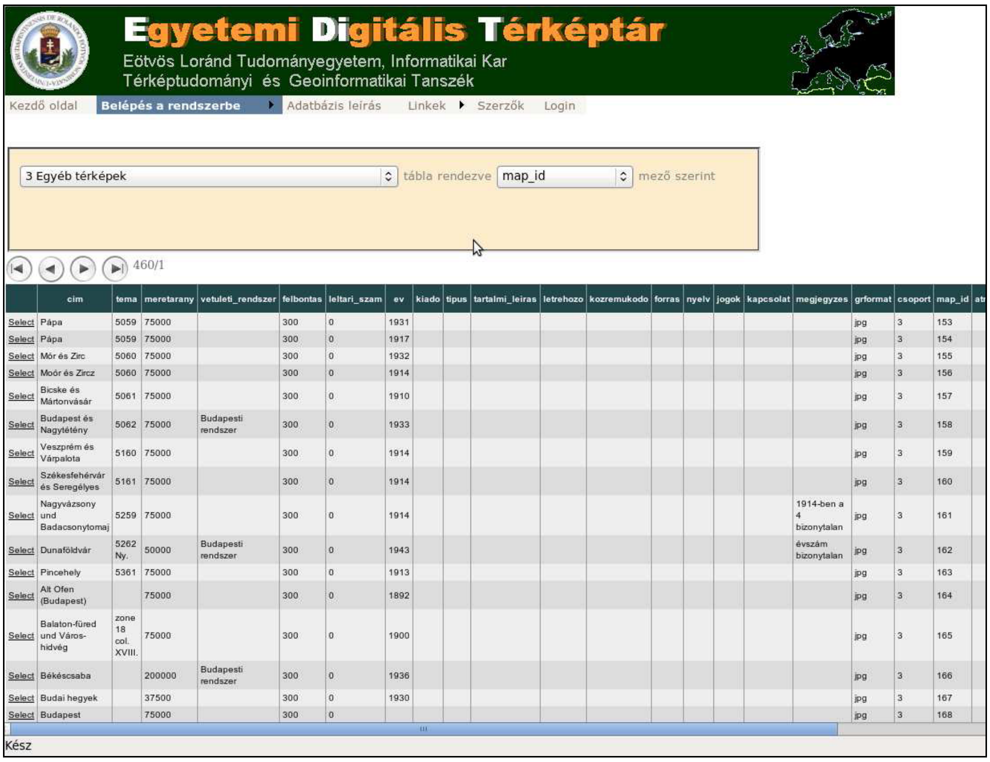


Figure 9. The screen image of EDITKE shows the attribute data of the first twenty maps in the egyéb (other) group of maps arranged according to the field map_id. The SQL commands are not visible here, because the user did not have the necessary authentification.

The data uploading application offers a function that allows us to copy the selected map into a specific place. (Its role is very much similar to that of the Download function of the online query.) The user can copy the map into any place from here. One of the major aims of EDIT system is to provide the researchers and students with free access to any map stored in the system. This place, among others, is included in the configuration file of the system.

The web and the database technology together led to the building of an on-line search and query system, EDITKE (KE stands for the Hungarian word keres). The program in ASP.NET is an application of the server, which displays the data of the maps that satisfy the given conditions (Figure 9) and the selected map (Figure 10).

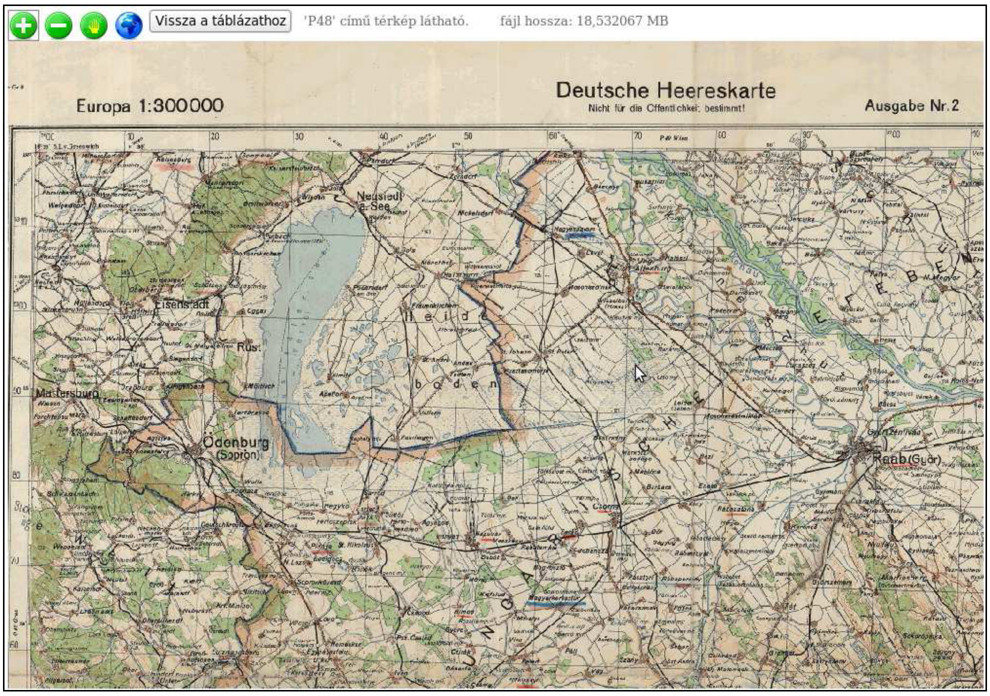


Figure 10. Viewing the selected map. The downloading function is active for the user with authentification, who can now download the map on a local client computer.

6. Conclusions

The latest EDIT system is version 3.0, and it has been more or less continuously developed. More and more research institutes and universities outside Budapest use it. Several interested students of informatics and cartography choose the problem of developing large map databases as their research topic.

This is an extremely rich topic, although the problems seem to be simple. Namely, we have the digital maps completed with descriptive data. Organizing them into a relation database is not a difficult task. The size of the raster maps can be very large (between 25 MBytes and 500 MBytes), while the vector maps have very varied structures. The size of a hyperspectral image can be extremely large (even 4–4.5 GBytes). As a result, the total size of the images for a certain area may exceed 1 TByte (1000 GByte). Handling such a large amount of data is not easy at all, not to mention displaying them. Displaying the images of several megabyte size on the Internet is particularly problematic, and moving these images on the web is really difficult. It is necessary to develop special programs (services) on the server side that generate such images the size of which do not exceed the size offered by the resolution capacity of the given video card. This is the way to eliminate the barriers caused by the differences in the bandwidth.

The development must consider some other aspects that are not included in the present 3.0 version. One of these aspects is the transfer to or at least the study of transferring to object-oriented database management (e.g. the use of Mongo-DB) in the map server. Another aspect is the tracking of changes in time. The relation database managers always face the difficulty of tracking the changes in time, particularly if complicated graphic data (such as maps) change.

The present EDIT system runs in Windows server environment (Windows server 2008, Internet Information Service, VisualStudio, ASP.NET), but it would be interesting to test it in Linux environment (Linux, Apache, Postgresql, Java). The increasing popularity of open source systems cannot be stopped: therefore, limiting the system to Windows environment would not follow the trend.

These are important questions, because the EDIT map collection is an experimental system, the terrain of informatical and cartographic experimenting, where all kinds of new technologies, algorithms and ideas can be tested.

The project is supported by the European Union and co-financed by the European Social Fund (grant agreement no. TÁMOP 4.2.1/B-09/1/KMR-2010-0003).

References

[1] I. Elek: Nagyméretű térképi adatbázisok fejlesztési és működési tapasztalatai., GEOGRÁFIA–2010–PÉCS: V. Magyar Földrajzi Konferencia. Pécs, Magyarország, 2010.

[2] Zs. Máriás, B. Dezső, R. Giachetta, I. Elek: Cartographic Symbol Detection Using Local Segmentation and Other Methods. In: Bhanu Prasad (Ed.) International Conference on Artificial Intelligence and Pattern Recognition (AIPR-10). Orlando, USA, 2010. 07. 12–2010. 07. 14. Orlando: Paper 196.

[3] R. Giachetta, I. Elek: Developing an Advanced Document Based Map Server. 8th International Conference on Applied Informatics. Eger, Magyarország, 2010.

[4] I. Elek, R. Giachetta, Zs. Máriás: Egyetemi digitális térképtár fejlesztése az ELTE-n. In: Kákonyi Gábor (szerk.) Fény-Tér-Kép konferencia. Dobogókő, Magyarország, 2009. 11. 12–2009. 11. 13.

[5] I. Elek, B. Kovács, K. Verebiné Fehér: Digitális térképtár az ELTE-n. Magyar Földtudományi Szakemberek VII. Világtalálkozója, Magyarhoni Földtani Társulat, p. 80., 2004.

[6] P. Rigaux, M. Scholl, A. Voisard: Spatial Databases with Application to GIS. Morgan Kaufmann Publishers, 2002.

Relating websites:

[7] Map server of Berkeley University :
http://www.lib.berkeley.edu/EART/topo.html

[8] Web pages with cartographic content at the homepage of Department of Cartography and Geoinformatics, Eötvös Loránd University:
http://lazarus.elte.hu/hun/index.html

[9] Web pages with special cartographic content at the homepage of Department of Cartography and Geoinformatics, Eötvös Loránd University:
http://lazarus.elte.hu/gb/linkek.htm

[10] Web page of NASA: www.nasa.gov

[11] David Rumsey's web page http://www.davidrumsey.com/

[12] Web pages with special cartographic content at the homepage of Stanford University:
http://library.stanford.edu/depts/branner/collections/sovietmil.html

[13] Web page of Terraserver: http://www.terraserver.com/

[14] Hiking routes: http://turistautak.hu

Maps for the Future:
Children, Education and Internet
Joint ICA Symposium

Diversity in Cartography

USING RASTER TECHNIQUES IN THE LACUNARITY ANALYSIS OF SPATIAL DISTRIBUTIONS

Rufino Pérez Gómez
Technical University of Madrid (Spain)
rufino.perez@upm.es

Abstract: The main objective of this work is to carry out some mathematical analysis, with the help of GIS concepts and tools, in order to investigate the applicability of fractal modelling to express the complexity of the soil surface system in Europe. In the last decade, soil scientists have developed the field of pedodiversity – the study and measurement of soil diversity – in a similar way that biologists and ecologists approach to biodiversity. Because the complexity and difficulties of the subject matter under study, this work represents a joint effort of a multidisciplinary team: soil scientists, cartographers and mathematicians.

The GIS analysis conducted in this project considered two main aspects: fractal analysis and lacunarity analysis. In the first case, some fractal analysis concepts were applied to the 133 second level soil classes of the World Reference Base (WRB) as extracted from the European Soil Database (V2.0). In order to evaluate the fractal behaviour of the spatial distribution of soils the box-counting method was applied considering three orders of magnitude (20, 200 and 2000 km). For this purpose, different GIS procedures were undertaken: database re-structuring, attribute queries, vector to raster conversions, parameter calibration and statistical analysis of the soils raster layers. We have also conducted other GIS procedures in order to perform multi-scale analysis using lacunarity indices. This is made, as a supplementary measure of the fractal analysis, to evaluate the heterogeneity of the different soils in Europe as spatial structures.

In 1983 Mandelbrot introduced the concept of lacunarity to differentiate spatial patterns that may have the same fractal dimension but with different texture appearances. Lacunarity is an analytical multi-scale measure of the heterogeneity of a spatial texture and is related to the distribution of gap sizes in a geometric object. At a given scale, lacunarity represents how similar are parts from different regions of a geometric object to each other.

Our findings suggest that lacunarity, as a supplementary measure of the fractal analysis, might be highly valuable to evaluate the heterogeneity of the different soils in Europe as spatial structures. The results also suggest that lacunarity analysis is a promising tool for spatial heterogeneity measurement within a GIS environment in many application fields

Introduction

Many measures have been devised and applied in quantitative geography in order to conduct spatial analysis. On the other hand, many natural objects such as rivers, mountains and coastlines, are so complex and irregular that models of classical geometry are insufficient to describe them efficiently. It was due to the work of Mandelbrot (1983), fractal geometry, what opened new ways to model and describe natural phenomena.

Spatial heterogeneity is a relevant concept while studying geographical distributions because it does exit in both natural and man-made phenomena. Mandelbrot (1983) introduced the concept of lacunarity to differentiate spatial patterns that may have the same fractal dimension but with different texture appearances. Lacunarity is an analytical multi-scale measure of the heterogeneity of a spatial texture that has often been used by researchers in the last years in many fields. In the literature search many applications of the lacunarity concept can be found related to landscape ecology, earth sciences, remote sensing, computer vision, urban and environmental studies, geological and geophysical analysis, etc., see Dong (2000, 2009) for a detailed list and brief description of the use of lacunarity as analysis measure. Some authors try to relate the different patterns, when studying spatial heterogeneity, with the forming factors of a particular geographical distribution. As an example, Escolano Utrilla (2007) tries to relate the lacunarity analysis of the socio-spatial segregation in urban areas with some social, economical, cultural and spatial elements as influent factors.

On the other hand, GIS concepts and tools are very well suited to process 1D, 2D and 3D datasets in order to implement complex spatial pattern processes. In this paper, the main objective is to describe some GIS raster processes used in the implementation of lacunarity analysis while trying to evaluate the spatial heterogeneity of soil maps in Europe as geographical distributions. But before going into detail in this study, some context information and previous work is briefly provided.

Previous work: The spatial distribution of soils across europe

The initial work intended to carry out some mathematical analysis, with the help of GIS concepts and tools, in order to investigate the applicability of fractal modeling to express the complexity of the soil surface system in Europe. In the last years, soil scientists have developed the field of pedodiversity – the study and measurement of soil diversity- in a similar way that biologists and ecologists approach to biodiversity. This work was designed as a joint effort of a multi-disciplinary team of soil scientists, cartographers and mathematicians.

In order to investigate the fractal behavior of the spatial distribution patterns of the most abundant pedotaxa in Europe (45 soil types that cover 92% of Europe), the European Soil Database (V2.0) (EU-European Soil Bureau, 2004) was used. This largely consists of a digitalized map of the whole of the European continent at 1 : 1 000 000 scale We use the soil classification of the World Reference Base (WRB) version of 1998 (FAO, 1999) at the second level. Figure 1 shows these soil maps in a GIS environment.

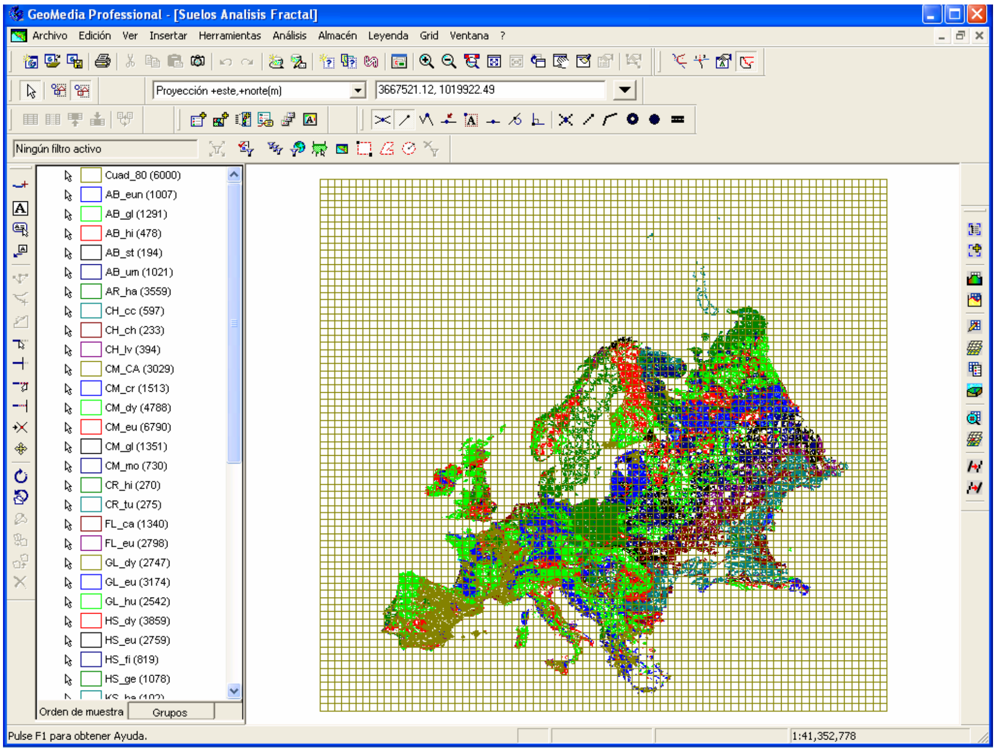


Figure 1. The 45 most abundant pedotaxa (92% of the surface of Europe)

After organizing and re-structuring the different soil maps within a GIS environment, these were further rasterized (vector–raster conversion). In this way, 45 “data layers” were obtained, one for each pedotaxa, as starting point for the analysis. Afterwards, the box-counting method, that is the most often mentioned in the literature review, was used to estimate the fractal dimension.

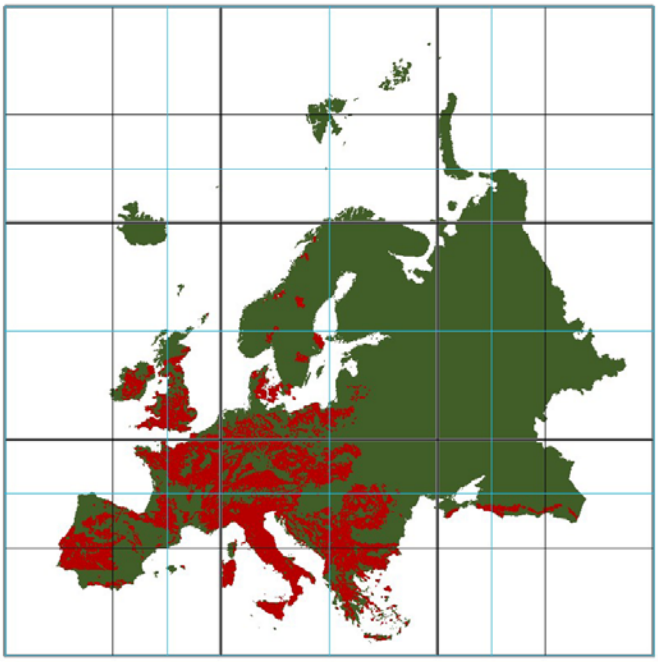


Figure 2. Spatial distribution of the soil type CMeu (Eutric Cambisol)

The vector polygons of each soil type were rasterized at different resolutions including three orders of magnitude (20, 200 and 2000 km) with some values in between as control points. Afterwards, it was counted the number of cells were that particular soil type was present in any of the raster datasets with different resolution. In the next step, these values were arranged in graphic plot were the x-axis represent the logarithm of the cell or grid size and the y-axis shows the logarithm of the numbers of cells occupied by the corresponding pedotaxa. The final step in this stage is to estimate the fractal box-counting dimension from the slope of the linear regression line adjusted in the previously defined dataset. The figure 3 shows the results of applying this method to the Eutric Cambisol soil type.

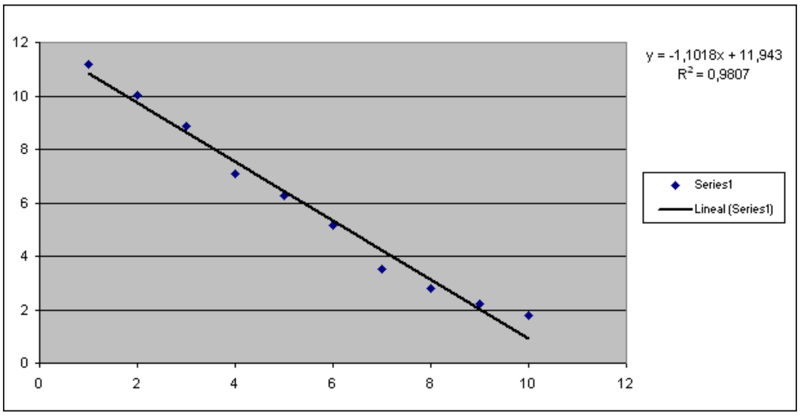


Figure 3. Box counting method applied to the soil type CMeu (Eutric Cambisol)

It's known that power laws are a fingerprint of fractal geometry as expressed by Mandelbrot (1983). Just in this study, our analysis showed a remarkable presence of power laws in the distribution of pedotaxa across Europe. Therefore, the pedotaxa fractal dimension may well play an important role when analyzing soil systems in Europe. See Ibañez et al. (2009) for a more extensive and detailed explanation of the concepts and processes that have been briefly mentioned here.

Lacunarity analisis of soil types.

After applying the box counting method to the different pedotaxa in Europe, a supplementary lacunarity analysis was applied to gain more information about the mathematical behaviour of soils as spatial distributions. Lacunarity is an analytical multi-scale measure of the heterogeneity of a spatial texture. It was introduced by Mandelbrot (1983) in order to differentiate spatial patterns that may have the same fractal dimension but with different texture appearances. The lacunarity concept is related to the distribution of gap sizes in a geometric object. Basically, if the gaps are of similar size and have a more or less regular distribution, the lacunarity values are low, on the contrary, gaps with significant differences in size and presenting irregular distribution produce high lacunarity values. At a given scale, lacunarity represents how similar are parts from different regions of a geometric object to each other.

The most widely used algorithm for lacunarity estimation was initially proposed by Allain and Cloitre (1991), and later disseminated through the works of Plotnick et al. (1993,1996). They apply the "moving windows" concept and is rather straight forward to implement in a GIS environment. Basically, the method consist in computing the number of cells, within the moving window, where the geographical feature is presence (1 = presence, 0 = absence). This value is called mass (S) of the window. Moving the window from left to right and from top to bottom a raster layer with "mass values" is obtained.

For any soil type of our study, the lacunarity value is computed with the method and formula as published by Plotnick et al. (1993, 1996):

$$\mathbf{\Lambda(r) = 1 + [Sd^2\,(S) / E^2(S)]}$$

where Sd(S) is the Standard deviation and E(S) is the mean value of the mass values.

The process is repeated with different window size in order to get the distinct points of the lacunarity curve. In order to avoid inconsistencies in the results, a mask may be required to skip the areas without data. In our case, we will mask out the waster-sea zones to focus our analysis in the areas above see level. This will require some pre-processing of the initially rasterized layers before applying the appropriate mathematical algorithm.

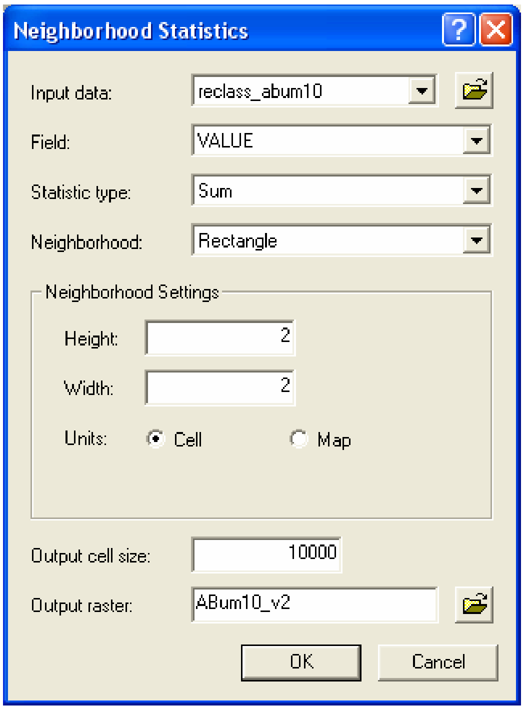


Figure 4. Neighborhood statistics as part of the moving window concept in lacunarity estimation.

To implement the previously described formula and algorithm, the Spatial Analyst extension of ArcGIS was used. Firstly, any raster dataset was pre-processed to mask out the water areas and exclude them from our analysis. Next, some neighborhood statistics methods were applied to compute the "mass value-S" at any particular location of the moving window. This represents the number of cells, within the moving window, where the geographical feature is presence (1 = presence, 0 = absence). By going through the original raster, from left to right and from top to bottom, a new raster with mass values are obtained. This new cell values represent a statistical dataset that, in turn, will allow to estimate the lacunarity values by the above described formula.

The process described in the previous paragraph is jus to get one point in a lacunarity curve. In order to draw the curve itself we need more points. This is obtained by repeating the methodology with different window size (2, 4, 8, 16, 32, 64, 128, 256). At the same time, an attempt of "multiscale analysis" was tried by rasterizing the original soil polygons with different cell resolutions: 10, 20 and 40 km as different starting point of the described methodology.

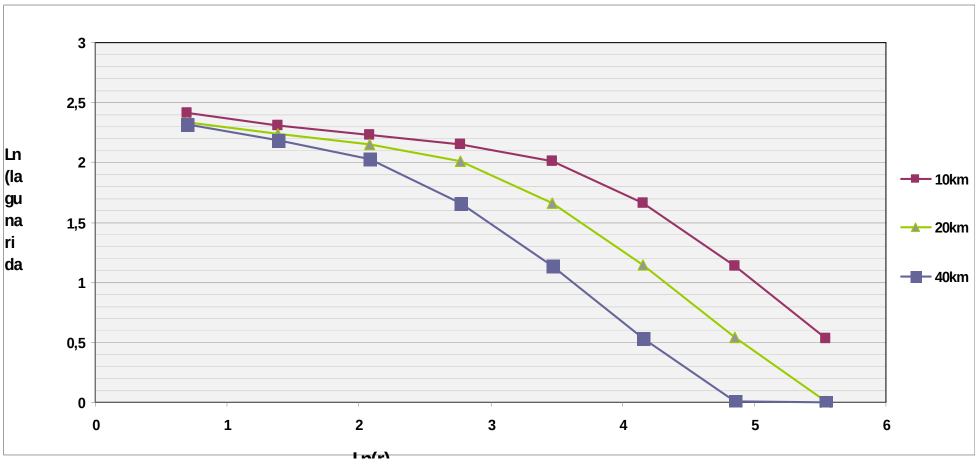


Figure 5. Lacunarity curves obtained for the ARha soil type (Haplic Arenosol)

Figure 5 illustrates the describe processes applied to the Haplic Arenosol soil type. As expected, there is a significant decrease of lacunarity values with the increase of the window size and with the cell resolution of the input layer.

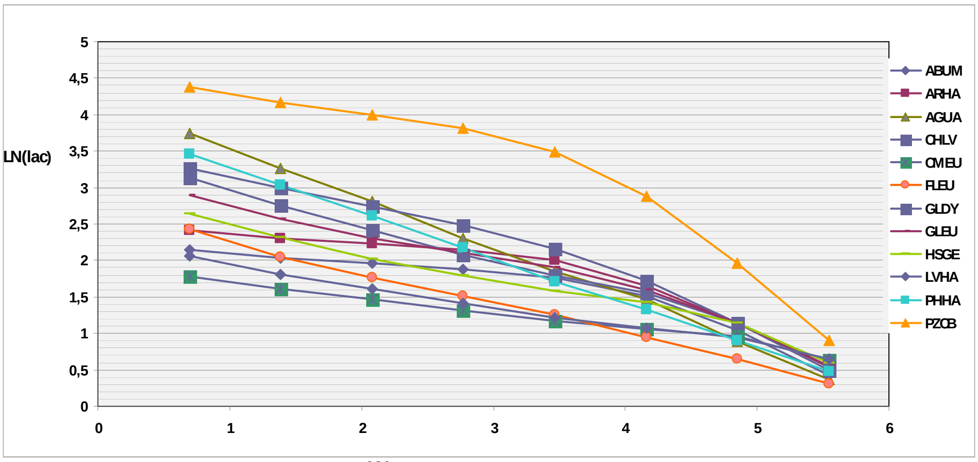


Figure 6. Comparison of Lacunarity Curves of different soil types

The interpretation of the lacunarity concept and formula leads us to see that as a sequence of progressively changing patterns. In one extreme is when the data representing the phenomenon occupies the space with a "random pattern" producing low lacunarity values. As the geographical distribution evolves towards a more clustered pattern, we will find areas with greater density of data points in some areas and larger gaps in others what will result in extremes values (high and low values) when applying the moving window. The more clustered is the pattern, more extremes will be the "mass" values and more often will appear in the output raster dataset. This will increase the standard deviation of the statistical dataset and, in turn, the final lacunarity values. To have this concept clear might help to understand and interpret the lacunarity curves.

Figure 6 represents the lacunarity curves of different soil types. The set of curves show significant differences in lacunarity values, shapes and ranges. Currently, there is an ongoing research and in depth analysis, with the help of soil scientists and mathematicians, to try to relate these heterogeneity estimation with the forming factors of the different soil types geographical distributions.

Results and conclusions

In relation to the previous fractal analysis, our results show a remarkable presence of power laws in the distribution of pedotaxa across Europe. These findings strongly suggest the fractal nature of pedotaxa distribution across Europe. In turn, this fractal structure may be associated with physical models that would give an insight into the processes acting at those particular spatial scales and which produce the complex patterns of soil surface systems as it was previously appointed by some soil scientists (Ibañez et al., 2009).

On the other hand, the lacunarity, as a supplementary measure of the fractal analysis, might be highly valuable to evaluate the heterogeneity of the different soils in Europe as spatial structures. Finally, our results also suggest that lacunarity analysis is a promising tool for spatial heterogeneity measurement in a GIS environment in many other application fields.

Future work

To complete the previously described work, the following tasks have been identified and listed here:

- To finish the fractal analysis to all the 133 soil types present in Europe,
- To apply the lacunarity analysis to the previous soil types,
- To analize the results together with soil scientists and mathematicians.

Acknowledgements

We would like to express our gratitude to our students Elsa Mª Benayas and Eduardo Nieto for his hard work during his final study project where they cooperated and contributed to get the results of this work. His work and commitment is very much appreciated.

References

Allain, C., Cloitre, M.: 1991, Characterizing the lacunarity of random and determined fractal set. Physics Review A 44, 3552–3558.

Escolano Utrilla, S.: 2007, La medida de la segregación residencial urbana: análisis multiescala mediante índices de lagunaridad. Geofocus (artículos), Nr. 7, p. 216–234. ISSN: 1578-5157.

Dong, P.: 2000, Test of a new lacunarity estimation method for image texture analysis. International Journal of Remote Sensing 21, 3369–3373.

Dong, P., Leblon, B.: 2004, Rock unit discrimination on Landsat TM, SIR-C and Radarsat images using spectral and textural information. International Journal of Remote Sensing 25, 3745–3768.

Dong, P.: 2009, Lacunarity analysis of raster datasets and 1D, 2D and 3D point patterns. Computer & Geosciences 35, 2100–2110.

Ibáñez, J. J. et al.: 2009, The spatial distribution of soils across Europe: A fractal approach. Ecological Complexity 6, 294–301

Ibáñez, J. J., Pérez, R.: 2009, Cartographic and GIS Processes supporting the characterization of the spatial distribution of soils in Europe. Internacional Congress of Soil Geography: New Horizons Huatulco Santa Cruz (Mexico), November 2009.

Mandelbrot, B.B.: 1983, The Fractal Geometry of Nature. Freeman, San Francisco, CA.

Plotnick, R. E., Gardner, R. H., O'Neill, R. V.: 1993, Lacunarity indices as measures of landscape texture. Landscape Ecology 8, 201–211.

Plotnick, R. E., Gardner, R. H., Hargrove, W. W., Prestegaard, K., Perlmutter, M.: 1996, Lacunarity analysis: a general technique for the analysis of spatial patterns. Physical Review E 53, 5461–5468.

Maps for the Future:
Children, Education and Internet
Joint ICA Symposium

Diversity in Cartography

ONTOLOGIES IN CARTOGRAPHY: POWER OF REASONING

Otakar Čerba
University of West Bohemia, Pilsen (Czech Republic)
cerba@kma.zcu.cz

Abstract: Who is the current user of maps? It is not possible to give an unambiguous answer. But the important group of users could be defined as "people being able to create and distribute their own maps via web technologies, but they have not any cartographic education and knowledge". Such users (or map makers) can create for instance choropleth maps or cartograms, but they do not know anything about these cartographic methods. They do not see restriction of methods, their advantages, signification or limits of usage.

The opportunity of cartographers consist in a cooperation on development of a solution supporting automatic providing of cartographic information and knowledge. Such agents are known as expert systems. On our poster we do not want to describe a complete expert system but only ontology as its fundamental part focused on a sharing of semantic information and knowledge. Ontologies and "reasoning" process should be the very important part of common cartographic expert system. Reasoning based on explicit information and knowledge written in ontology can recommend appropriate cartographic method based on detail description of source spatial data sets and purposes of map. This paper presents just a proposal (or prototype) of proposed cartographic ontology as well as steps of following development.

Introduction

In the paper with a little bit strange title "Cartografia Catholica" (Čada and Čerba, 2009), which was published two years ago, we (as the authors) emphasized the importance to connect the cartography as the science and practical activity and the Latin word "catholica". This word is translated as not only "catholic" but also it means "general" or "universal". According to the above-mentioned paper

(Čada and Čerba, 2009) the term "catholic" should express the main future movement of cartography. Cartographers should come back to essentials of their activities. This approach is among other things represented by a saturation of user needs as much as possible. User needs and requirements are main accelerators to develop new or improved cartographic products and methods. Cartography should be ingrown but it should be focused mainly on users of the map and other cartographic products to provide the maximum quantity and quality of useful information as much as quickly.

But this paper does not discuss the above-mentioned future movement of cartography. It tries to introduce ontologies and the reasoning (both terms are described in following parts of this paper) as a tool enabling a focus on the users. Because ontologies enable to describe, share, combine and understand (spatial) data and information as well as knowledge.

This document is composed of four main parts (except introduction) – motivation to applying ontologies in cartography, description and explanation of important ontological terms, introduction of the created prototype of ontology and results of reasoning process, and conclusion including future steps.

Background and objectives

What do current users of maps and other cartographic products really need? It is hard to say, because it is necessary to have some detail information on user. The tools and processes described in this paper (ontologies & reasoning) be stead to a group of users, who are focused on creating and constructing their own maps without high-level cartographic knowledge and education – so called map makers. Such users are able to use many different software products (e.g. Geographic Information Systems, Web 2.0 technologies, Map portals or web services). They also have an access to large spatial data sets, including products of voluntary and community activities (e.g. OpenStreetMap). The data capturing and visualisation could be provided by easily available hardware equipments (e.g. computers, smart phones, GPS or PDAs). We can say that the need and possibility of creating maps whenever and wherever represents the important characteristics of these users.

Users with potentialities depicted in previous scheme need one help from cartographers. As was described in the previous paragraph and in the Intro-duction – users have data and technologies. But the knowledge is missing. They are not able to select appropriate cartographic technique (or method) – for example users can create choropleth maps or cartograms, but they do not know anything about these cartographic interpretation methods. They do not see restriction of methods, their advantages, signification or limits of usage. Contemporary software and hardware products do not provide any or only limited information. The output maps are influenced mainly by skills of software and not by cartography and its rules and principles. And such maps can result a wrong decision on the user side.

Cartographers should be able to advise them simply, rightly, quickly, whenever and wherever. Of course it is impossible in the real life. The opportunity of cartographers consist in a cooperation on development of some solution supporting automatic providing of cartographic information and knowledge. Such agents are known as expert systems. In this paper we do not want to describe a complete expert system but its fundamental part focused on a sharing of semantic information and knowledge. This component is composed of different types of tools designed for data description (detail information in Čerba, 2009) and the most abstract level of data description (through not exact information and knowledge) is provided by ontologies (detail information on ontologies are in the next part). It is possible to give account of principal of cartographic ontology as the sentence (Figure 1) – "Describe your data and conception of cartographic visualisation (map) and the system allows for suitable cartographic tools (e.g. cartographic interpretation method, colour scheme or scale)".

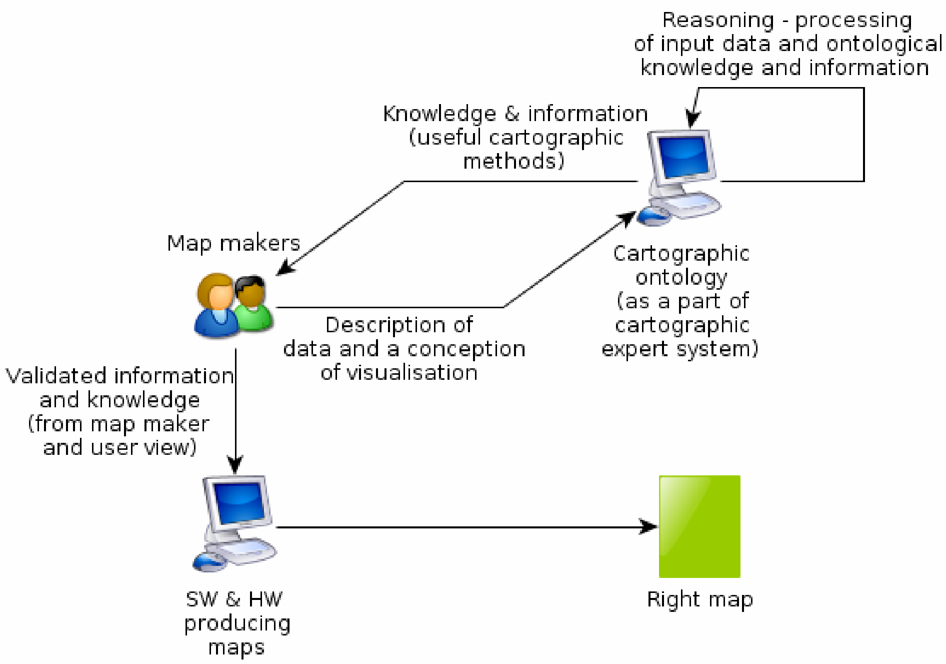


Figure 1. Cartographic ontology as a part of expert system

Approach and methods

The fundamental term of this paper "ontology" is very popular and very often used (so-called buzzword) in the world of information technologies (IT). The word "ontology" is very old – it was used by ancient Greek philosophers (e.g. Socrates or Aristotle). According to the (Hay, 2006) this word is about 2500 years old. Ontology in philosophy means "Theory of existence" (Mizoguchi & Ikeda, 1998).

One of the first definition of ontologies in the information technologies was formulated by T. Gruber – "An ontology is an explicit specification of a concetualization." (Gruber, 1993). More than ten years later he described the ontologies in the following way (Gruber, 2009): In the context of computer and information sciences, an ontology defines a set of representational primitives with which to model a domain of knowledge or discourse. The representational primitives are typically classes (or sets), attributes (or properties), and relationships (or relations among class members). The definitions of the representational primitives include information about their meaning and constraints on their logically consistent application. In the context of database systems, ontology can be viewed as a level of abstraction of data models, analogous to hierarchical and relational models, but intended for modelling knowledge about individuals, their attributes, and their relationships to other individuals. Due to their independence from lower level data models, ontologies are used for integrating heterogeneous databases, enabling interoperability among disparate systems, and specifying interfaces to independent, knowledge-based services.

W. Borst (Borst, 1997) extent the original Gruber's definition: "An ontology is a formal specification of a shared conceptualization". R. Poli (Poli, 2002) recommended to use and distinction between two words connected with ontologies – formal (application of formal terms) and formalized (formal way of coding).

Ontologies, which are defined as the formal specification of a vocabulary of concepts and axioms relating them, are seen playing a key role in describing the "semantics" of the data (Dou et al., 2004). The domain ontologies (sometimes called sharing vocabularies) represents the most often used type of ontologies used to describing semantics of data.

Domain and task ontologies capture knowledge at a level of abstraction free from implementation concerns – that is, they reflect the true nature of a domain or task. Domain ontologies are intended to provide a source of predefined concepts that provide descriptions about specific domain knowledge. They are intended to be reused by others wishing to build their own domain or task ontologies with the aim of merging different knowledge descriptions about similar domains or data. (Dolbear et al., 2005)

There are some examples of domain ontologies defined for geoinformation sciences including cartography: CartoOWL (Karam et al., 2010), ontology developed in the project CartoExpert (Peňáz, 2010) or ontology Land-Use/Land-Cover Ontologies created in the project HarmonISA (Hall, 2006).

Results

Ontology described in this paper represents a opportunity of an application of ontologies in cartography. The majority of current "cartographic" ontologies such as CartoOWL (Karam et al., 2010) or CartoExpert (Peňáz, 2010) is focused on definition of terminology and its structure. For purposes mention in previous sub-chapters it is necessary to extend such ontologies and to add a reasoning process. Just the reasoning is able to generate new information based on original asserted model. In this case the result of reasoning is the cartographic methods assignment to a described spatial data sets.

The development of ontology is composed of six steps (based on Číhalová et al., 2010, Fernandez et al., 1997, Pundt, 2007 and Rector et al., 2007):

- Capturing, identification and defining of fundamental concepts (classes)

- Building of hierarchy of concepts – we use such terms in accordance with following publications – (Slocum et al., 2009), (Dent et al., 2009), and (Robinson et al., 1995).
- Capturing, identification and defining of attributes, including their hierarchy
- Interconnection of concepts and attributes – description of concepts with use of attributes (so-called classificators or modificators)
- Transformation of all rules to ontology (formalization of ontology) – application of ontology editor (e.g. Protégé) and ontological data format (e.g. Web Ontology Language – OWL).
- Reasoning – this process derive a new multihierarchical ontology based on original hirarchy of concepts and classificators.

Prototype of ontology describing cartographic terms and rules contains three groups of concepts:

- Description of data sets which will be visualized. Except items called “Data” there are also elements “Map”, which represent data sets incorporated into map.
- Cartographic tools – at the present time only some types of cartographic interpretation methods (e.g. choropleth maps) and data classification are applied.
- Parameters – this part of ontology so-called modificators makes for description and classification of rest of ontology. The object attributes are constructed based on parameters.

As mentioned earlier the main benefit of proposed ontology it the application of reasoner. The software connected with used ontology editor Protégé is able not only to check the consistency of ontology but also the reasoner can analyse the structure of ontology and derive new information based on logical rules and original ontology. Described ontology with use of reasoning is capable of finding appropriate cartographic methods and assign them to data sets and maps depending on description of all parts of ontology. Such result can be expressed with above-mentioned sentence – “Describe your data and conception of cartographic visualisation (map) and the system allows for suitable cartographic tools (e.g. cartographic interpretation method or scale)”.

Conclusion and future plans

This paper presents only a short fragment of proposed ontology. To be fully and efficiently operational the ontology needs to add following components:

- Complete system of description of spatial data (to find or to establish a closed set of spatial data attributes)
- Complete system of description of maps, their components, include the methods of construction

- Interconnection of different existing terminology systems
- Re-use of existing ontologies
- Multilinguality – implementation of various languages
- Graphical User Interface (GUI) or implementation of ontology to some expert system
- Interconnection with other types of spatial data description

In accordance with the above-mentioned article (Čada and Čerba, 2009) the openness, clarity, accessibility, interaction with other scientific disciplines, and the absorption of new technologies will signify not only a greater use of cartography in new and non-traditional areas, but also a prominent position in the market for geoinformation. In this context, the marketability of cartographic products, but inevitably also their quality will increase. Because informed and experienced users supplied a wide range of cartographic products will prefer the quality at the expense of easy access. Just ontologies as a new technologies go towards the openness, clarity, accessibility, interaction with other scientific disciplines.

References

Borst, W. N.: 1997, Construction of Engineering Ontologies for Knowledge Sharing and Reuse. University of Twente.
URL: http://doc.utwente.nl/17864/1/t0000004.pdf

Čada, V., Čerba, O.: 2009, Cartografia Catholica. In 18. kartograficka konference, Olomouc (Czech Republic).

Čerba, O.: 2009, GMES Needs Described Spatial Data. In INSPIRE, GMES and GEOSS Activities, Methods and Tools towards a Single Information Space in Europe for the Environment. Charvat, K., Alberts, M., Horakova, S. (eds.). Wirelessinfo, Tehnologiju attistibas forums, Riga (Latvia). 978-9934-8105-0-3.

Číhalová, M. et al.: 2009, Methodology of Ontology Building. In Advances in Geoinformation Technologies. Horak, J., Halounova, L., Kusendova, D., Rapant, P., Vozenilek, V. (eds.). VSB – Technical University of Ostrava, Ostrava (Czech Republic). 178 s.

Dent, B. D. et al.: 2009, Cartography: thematic map design. 6. vyd. New York: McGraw–Hill Higher Education, 2009. 336 s. ISBN 978-0-07-294382-5.

Dolbear, C. et al.: 2005, Semantic interoperability between topographic data and a flood defence ontology. Technical Report. Ordnance Survey. URL:
http://www.ordnancesurvey.co.uk/partnerships/research/publications/docs/2005/Semantic%20Interoperability_CDolbear_sem.pdf

Dou, D. et al.: 2004, Ontology Translation on the Semantic Web. In S. Spaccapietra et al. (Eds.): Journal on Data Semantics II, LNCS 3360, str. 35-57, 2004. Springer-Verlag Berlin Heidelberg.
URL: http://www.cs.yale.edu/~dvm/daml/ontomerge_odbase.pdf

Fernandez, M. et al.: 1997, METHONTOLOGY: FromOntological Art Towards Ontological Engineering . In AAAI Technical Report SS-97-06.

Gruber, T.: 1993. A Translation Approach to Portable Ontology Specifications. In Knowledge Acquisition, 5(2): 199–220.

Gruber, T.: 2009, Ontology. In the Encyclopedia of Database Systems, Ling Liu and M. Tamer Ozsu (Eds.), Springer-Verlag, 2009.
URL: http://tomgruber.org/writing/ontology-definition-2007.htm

Hall, M.: 2006, Automatisierte Semantische Harmonisierung von Landnutzungsdaten. In AGIT, Salzburg (Austria).
URL: http://users.cs.cf.ac.uk/M.M.Hall/files/papers/Hall2006.pdf

Hay, D. C.: 2006, Data Modelling, RDF & OWL – Part One: An Introduction To Ontologies. In The Data Administration Newsletter – TDAN.com.
URL: http://www.tdan.com/print/5025

Mizoguchi, R., Ikeda, M.: 1998, Towards Ontology Engineering. Technical Report AI-TR-96-1, I.S.I.R., Osaka Univ. URL:
http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.78.7101&rep=rep1&type=pdf

Karam, R. et al.: 2010, Cartographic Integration on Mobile Devices from Several Providers' LBS by Means of Map Symbol Ontology. In WebMGS 2010, Como (Italy).

Penaz, T.: 2010, Konstrukce ontologickeho modelu pro aplikacni vyuziti znalosti z domeny tematicke kartografie. In XXII. Sjezd Ceske geograficke spolecnosti, Ostrava (Czech Republic).

Poli, R.: 2002, Ontological methodology. In International Journal Human-Computer Studies, 56, s. 639–664. Elsevier Science Ltd.

Pundt, H.: 2007, From Idea toward Ontology. In 10th AGILE International Conference on Geographic Information Science, Aalborg University (Denmark).

Rector A. et al.: 2007, Foundations of the Semantic Web: Ontology Engineering, Lecture 2 Building Ontologies & Knowledge Elicitation.
URL: http://www.cs.man.ac.uk/~rector/modules/CS646/Lecture-Handouts/Lect-2-Ontology-building-2007.pdf

Robinson, A. H. et al.: 1995, Elements of Cartography. 6. vyd. John Wiley & Sons, Inc. 674 s. ISBN: 0-471-55579-7.

Slocum, T. A. et al.: 2009, Thematic cartography and geovisualization. 3. vyd. Upper Saddle River: LinkPearson/Prentice Hall, 2009. 561 s. ISBN 978-0-13-229834-6.

Poster

SURVEY ON CHERNOFF FACES IN HUNGARY AND AUSTRIA: FUTHER RESEARCH AND EXPERIMENTS

José Jesús Reyes Nuñez[1], Eszter Simonné Dombóvári[2]
1 Eötvös Loránd University (Hungary)
jesus@ludens.elte.hu
2 Vienna University of Technology (Austria)
eszter@cartography.tuwien.ac.at

Abstract: The poster presents the results of the theoretical research and the survey on using and understanding of the Chernoff faces method by pupils in an international comparison of Hungary, Argentina and Austria. This method for data visualisation was originally created for the graphic representation of statistical data published by Hermann Chernoff in 1973. The research on the map use of this method began later, starting from the 90's. However, its use in cartography was rare and did not concern school cartography. From this point of view, two Hungarian-Argentinean projects in 2004–2005 and in 2008–2009 can be considered as pioneer projects for testing the general comprehensibility and the learn effect of the Chernoff principle in the field of thematic cartography for pupils. The results emphasized the need for further research and experiments in different countries. The Hungarian–Austrian bilateral scientific co-operation concentrates on further research and surveys concerning the use of Chernoff faces in school maps (http://cartography.tuwien.ac.at/chernoff/). The aim is the extension of the theoretical research, studying the possible uses of Chernoff faces in school cartography for pupils of grades 3–4 (9–11 years old), seeking for new solutions and enable future research to create more efficient thematic maps for children. On the other hand the purpose is to extend the Hungarian-Argentinean project by organizing a survey in Austria and to compare this data with the previous results. The questionnaire is designed for pupils of grades 7 and 8 (13–15 years old) in Austrian Secondary Schools with some experience of using maps and school atlases. The final proposals about the use of this method in school publications will be elaborated, based on the results of the test.

The current research is developed in the framework of the Agreements on Scientific and Technological Cooperation, financed by the project AT-3/2009 and HU 07/2010 of the National Office for Research and Technology of Hungary and Federal Ministry of Science and Research, Austria, and counting with the financial support of the European Union and the European Social Fund under the grant agreement no. TÁMOP 4.2.1./B-09/1/KMR-2010-0003.

Poster

THE WORLD IN THEIR MINDS – A MULTI-SCALE APPROACH OF CHILDREN'S REPRESENTATIONS OF GEOGRAPHICAL SPACE

Veerle Vandelacluze
Lecturer in Primary Geography, Open Higher Education
Excellence Centre for Distance Education
Catholic University College of South-West Flanders, KATHO
Pre-primary and primary school teacher training, Campus Tielt, PHO (Belgium)

Abstract: During the last decades a number of studies have explored primary school children's spatial representations at one particular scale e.g. earth's land masses or the familiar home–school area. Little is known however on children's mental constructs of the geographical space as a whole. The omnipresence of digital mapping tools in everyday life has made such an understanding increasingly important. Elaborating effective teaching strategies for the introduction of visualization tools like Google Earth or GPS into the primary school classroom, requires a basic understanding of children's mental maps at different scales.

In this study 94 Flemish children aged 9–12 represented their world at three scale levels. They drew their route from home to school (test 1), composed a map of the world given the outline of the continents (test 2) and marked out how sun, moon and earth revolve around one another via arrows and a forced choice question (test 3). Despite great individual differences the results of this sample demonstrate that a majority of the children (even among 12-year-olds) show an incomplete and defragmented geographical world view. Only between test 2 and 3 a significant correlation was found ($r = 0,42$; $p < 0,01$). This supports previous psychological research pointing out at least a partial dissociation between large-scale spatial abilities, needed for way-finding in the local neighborhood (test 1), and small-scale spatial abilities, applicable when internalizing a large geographical space through symbolic representations such as maps and models (test 2 & 3).

Consequences of this findings for map education, in general, and the use of digital mapping tools in the primary school classroom, more specifically, are discussed.

Maps for the Future:
Children, Education and Internet
Joint ICA Symposium

Poster

A CARTOGRAPHIC JOURNEY WITH STUDENTS FROM A SMALL FISHERMAN TOWN SCHOOL IN MARANHÃO STATE, BRAZIL

Regina Araujo de Almeida[1], Alexandre Vítor de Lima Fonsêca[2]
1 Universidade de São Paulo, USP (Brazil)
reginaaa@usp.br
2 Universidade Federal do Maranhão (Brazil)
UFMA, alexandre@ufma.br

The paper presents and discusses a journey through the ocean coast of S. José de Ribamar in Maranhão State, Brazil (Figure 1), as a cartographic experience done with students in a fisherman town school.

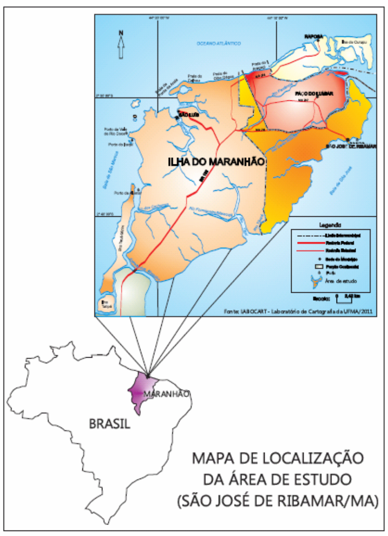


Figure 1. Study area location: S. José de Ribamar in Maranhão State, Brazil (org. by A. Fonsêca)

The activity called Coastal Geographic Journey is part of the methodological proposal directed to schools which have a large number of kids with parents engaged in fishing as a way to earn their living. They are considered indigenous population and their tradicional knowledge includes several concepts related to distance, orientation and natural processes such as ocean tides, winds and navigation.

The research is part of a doctoral thesis which has as main goals: 1. To gather the geographical knowledge of students coming from fishermen families and to analyse the possibilities to include these themes in primary and high school, as cartographic activities inside and outside the classroom; 2. To discuss the geography curriculum used at the local schools and its relation to concepts such as orientation, location, space perception and representation; 3. To propose a methodology which takes into consideration their traditional knowledge and daily life, in geography and cartography teaching.

In order to aply this proposal, an activity were developed and tested with one class of 6th grade students from the Municipal Ribamar School (Figure 2), in October, 2010. A journey through the coast were planned, involving teachers and students, also with the participation of parents which were invited to take part in some events.

It was an opportunity to introduce school cartography, using an innovative approach to teach and learn geography. Several meetings took place at the school, for preparation of the field trip activity. A map were produced to be used during the journey (Figure 3 and 4). Each group of 5 to 6 students did the journey accompained by the researcher and their teacher, carrying the map, blank paper and a camera. Several trips of 3 hours each were made to complete the one chosen class of 6th grade kids.

Figure 2. Municipal School in S. José de Ribamar and the 6th grade class (photos by A. Fonsêca)

Students were asked to take notes, to make drawings of scenes or anything that called their attention, also to take photographs as they pleased, mainly to record facts, objects, people, places during the 4 hours walking, with many views, different scenarios and lots of explanations were given. Students were very participative during the whole time and they did the drawings and took photographs along the way.

Natural facts such as ocean tides, fishing as economic local activity, environment issues and problems such as the amount of litter going to the coastal areas and waters, received the attention of the group. They all received white caps with the journey's name printed on them (Jornada Geográfica Litorânea) which gave them a feeling of some important field work to be done. Maps had a relevant role before, during and after the journey.

Figure 3. Field trip location, distance and stop points, at the planning stage (org. by A.Fonsêca)

Figure 4. Geographical Journey Map used in the field trip through the coast of Ribamar (org. by A. Fonsêca)

At the end, it was organized a big event at school when each group of students presented their work, drawings, photos and comment. Parents were invited and they participated during the event, listening to their kids and also making comments which were recorded.

Five months later in March 2011, after the beginning of the new school year, we visited the students of the selected class to gather their impression and memories from the experience. The results were very positive, in terms of what they learned and how much they enjoyed the activity. Above all, a different way of studying geography and cartography brought a kind of interest which they do not have in normal classroom routines. The experience proved that there are good reasons and ways to include tradicional knowledge in the geography curriculum. Field work and cartography can both play an important role in achieving this goal, enhancing the motivation of students to learn and helping to keep traditions and local identity alive in the community.

Poster

A CASE STUDY ON SCHOOL CARTOGRAPHY AND AMAZONIAN RIVERINE COMMUNITIES

Regina Araujo de Almeida[1], **José Camilo Ramos de Souza**[2]
1 Universidade de São Paulo, USP (Brazil)
reginaaa@usp.br
2 Universidade do Estado do Amazonas, UEA (Brazil)
josecamilo@usp.br

This paper brings the initial results of a research being developed by the authors, in Parintins area, at the Amazonas State, in the north region of Brazil (Figure 1). The study main goal is to explore the role of maps at traditional communities living at the Amazon River margins, including low lands exposed to severe floods and higher lands, above the flood level, in most times.

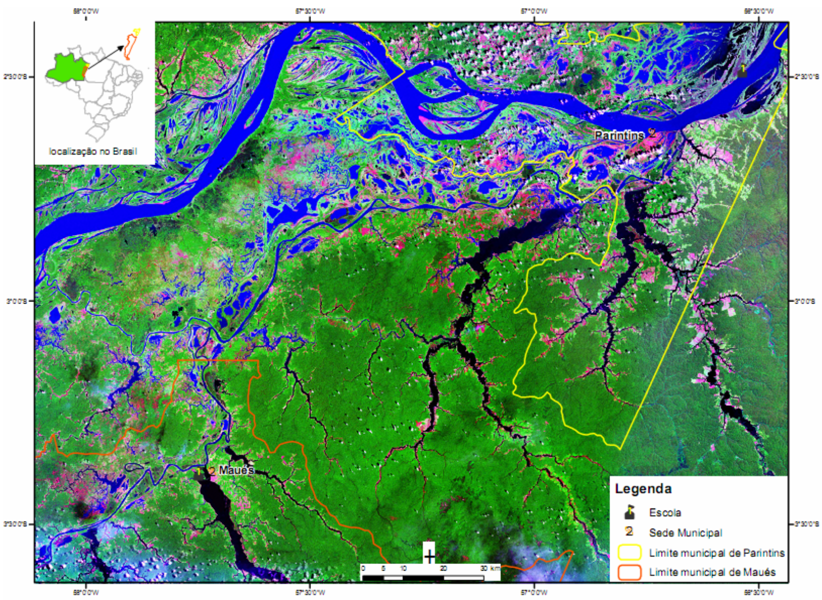


Figure 1. Study Area Overview: Parintins and Maués in the Amazonas State (Org. by Willer Pinto, september/2010)

Communities in both areas depend entirely from the forest and the river systems, their cultural identity is totally connected with this way of living. Schools have to adapt their hours and vacations in order to survive the flooding periods when there are no classes. These are considered rural schools and their reality vary in a great deal. First, the number of students are quite different, so their age groups. In some cases there is only one teacher for all disciplines and students of all ages study together in one room. Other times, geography is concentrated in a 2 months module with classes given only at this period in a year. These conditions influence the teaching of cartography and they put limits in when and what can be learned.

Figure 2 shows examples of this environment which define the way people live, work and learn geography and cartography. The two schools (Tiradentes and Tukasa Uetsuka), are located in the municipality of Parintins, in the Amazonas State, Brazil, reached only by boat.

Figure 2. Study Area Municipal Schools in two periods: floods in May/2010 and the dry season in August/2010 (photo by J. Camilo R. de Souza)

Cartography can help to understand these riverine communities, the schools and the people. Their maps depict their reality, their space perception and the way they live and see the environment. For most people, it is not easy to imagine a school which has a different year calendar because of river system and cycles, classes suspended for months waiting for the water to clear classrooms (Fig. 3).

Figure 3. Amazonian river waters inside classroom

These communities, considered traditional groups living mainly on fishing, hunting and agriculture, have a deep sense of identity connected with the cycles which control nature, their sense of place and knowledge of the environment is profound and this is why geography and cartography must have a relevant role at school. The curriculum should also include their reality and their knowledge.

The research will evaluate how maps are being introduced and their participation at the geography teaching. The first results show that teachers are not prepared to work with maps, and neither students are ready to involve themselves in mapping activities. Cognitive maps and graphic representations of geographical space, in all its forms and content, including cultural issues, usually are not inside classrooms. Teachers could start to deal with the cartographic and geographic information in the students imagination and inside their minds. In a matter of fact, their reality must be the initial step, the local scale as a way to reach the global space, to acquire knowledge of our world.

Practical Activities and teaching materials related to the curriculum content for geography and cartography were developed and proposed to be used in classrooms. Some experiences and tests are already been analyzed with significant results found, at the present stage. The maps and graphic representations made by students and teachers from rural schools at these communities express their space organization, as social constructs of a reality based on their relationships with the rivers, going up and down, to school, to work or to fish. These places have no roads, sometimes only small pathways inside the forest can also be used, but their transportation means are boats, they are the municipal school buses which take children to classes. It is not difficult to imagine that geography and cartography can not be the same as the one taught at urban schools in cities.

School cartography means asking kids to draw their daily life, their culture, their traditions. Mapping has to be connected with the fishing activities, with walking through the forest to collect food and what they need to survive. These facts were perceived, learned through their social life, at school, at home and the community they spend their life. Mental maps, drawings in a piece of paper, can highlight the relevance of a not conventional cartography. Mapping in this perspective can reveal the traditional knowledge, giving it a new value, unfolding and bringing to light hidden geographies, their culture, keeping history, past experiences and achievements alive inside maps. Learning cartography and making maps can be means to get information they need for now and for the future.

The preliminary research findings confirm the relevance of maps and drawings in the lives of these people, in geography teaching as well. In this way, geographic knowledge have new meanings, answering old questions such as what, how and why they learn, bringing together feelings, perceptions of reality, even memories with the physical material world. Places which are in their imagination and places where they work and study everyday both become part of cartographic representations. Water pathways transporting lives and traditions are more than lines in a map, in this context, they can be bridges to empower people living at Amazonian areas, their students and schools. A different view of maps and mapping is highlighted in this proposal for a school cartography at the Amazon region and its riverine communities.

Poster

TEACHING GEOMATICS WITH WEB 2.0

Václav Čada[1], Radek Fiala[2], Karel Janečka[3], Karel Jedlička[4], Jan Ježek[5], Martina Vichrová[6]
University of West Bohemia, Pilsen (Czech Republic)
1 cada@kma.zcu.cz
2 fialar@kma.zcu.cz
3 kjanecka@kma.zcu.cz
4 smrcek@kma.zcu.cz
5 jezekjan@kma.zcu.cz
6 vichrova@kma.zcu.cz

Abstract: Spatial services and applications are one of main part of Web 2.0. Due to this fact a lot of things has changed and lot of methods that were essential in the past are not used today. Following this fact we have started a project focused on building and upgrading of learning materials for specific parts of Geomatics that is focused on modern technologies and approaches. These materials are also as such build and teached on web 2.0 technologies.

In the scope of our project we are working on bringing multimedia and interactive upgrade to learning material and presentations to catch new approaches as much as possible. This materials are then distributed and discussed through Internet platforms like blog posts and social networks. Student can then easily access it and discus related issues. This approach is also very important for distance education that is becoming very popular in EU.

The aim of this poster is to show and describe samples of the best outcomes of this project. In general main topics of materials are focused on Geographic information technologies and Cartography. New applications and web based examples will be demonstrated. Some of the learning tools and examples focused on mobile devices and smart phones will be also mentioned.

Poster

CARTOGRAPHIC MAPPING OF THE ICY SATURNIAN SATELLITES BASED ON CASSINI ISS DATA

E. Kersten[1], Th. Roatsch[1], M. Wählisch[1], A. Hoffmeister[1], P. C. Thomas[2]
1 Institute of Planetary Research, German Aerospace Center (DLR), Berlin (Germany)
2 Center for Radiophysics and Space Research, Cornell University, Ithaca (USA)
elke.kersten@dlr.de

Abstract: The sizes and shapes of seven icy Saturnian satellites have been measured from Cassini Imaging Science Subsystem (ISS) data, employing limb coordinates and stereo-grammetric control points. Mimas, Enceladus, Tethys, Dione and Rhea are well described by triaxial ellipsoids; Iapetus is best represented by an oblate spheroid. The ISS acquired many high-resolution images (< 800 m/pixel) during close flybys of the medium-sized satellites (Mimas, Enceladus, Tethys, Dione, Rhea, Iapetus, and Phoebe). We combined these images with lower-resolution coverage and a few images taken by Voyager cameras to produce high-resolution mosaics of these icy satellites. The global mosaics are the baseline for high-resolution atlases. The atlases consist of 15 tiles each for Enceladus, Dione, and Tethys, whereas the Iapetus, Mimas, and Phoebe atlases consist of 3, 3, and 1 tile, respectively. The nomenclature used in these atlases was suggested by the Cassini-ISS team and approved by the International Astronomical Union (IAU). The whole atlases are available to the public through the Imaging Team's website (http://ciclops.org/maps/) and from the Planetary Data System (PDS, http://pds-imaging.jpl.nasa.gov/).

Poster

STUDYING THE HISTORY OF THE BATTLESHIP «GEORGIOS AVEROF»: A PROJECTION IN SPACE AND TIME

Efstathios Arapostathis[1], Eleni Gkadolou[2], Emmanuel Stefanakis[3]
Georgios Kritikos[4]
Department of Geography Harokopio University (Greece)
1 sarapos@hua.gr
2 egkadolou@hua.gr
3 estef@hua.gr
4 gkriti@hua.gr

Abstract: This paper presents a web mapping application for the history of the battleship «Georgios Averof», the world's only surviving heavily armored cruiser of the early 20th century. The battleship was a legendary warship of the Greek fleet during the first half of the 20th century with an active role in three wars (Balkans, World War I and II); currently it is a museum. Our scope was to virtually deliver the battleship's history in an eloquent and attractive way for students and visitors. The end-user through an interactive web interface navigates through the main historical periods of the ship's life, retrieves related information by forming queries as well as edits or updates the content (if authorized). The content can be visualized on top of Google Maps and it comprises a rich historical collection in various multimedia forms (photographs, images, maps, charts, videos, sound recordings, etc.) mostly retrieved by the museum's archives and stored in a database server supported by Postgres/PostGIS DBMS. A map server (UMN MapServer) delivers the content appropriately and the web interface, developed in Geomoose Javascript Framework, generates the interactive interface offered to the end-user.

Poster

AN EXHIBITION OF CHILDREN’S DRAWING OF THE RED SLUDGE DISASTER: CARTOGRAPHY, ART AND A SHOCKING EXPERIENCE

Henrik Hargitai[1], Pál Gábor Vizi[2]
1 Department of Physical Geography, ELTE TTK (Hungary)
hhargitai@gmail.com
2 KFKI RMKI (Hungary)

Abstract: On October 4, 2010, in Hungary's worst ecological disaster, a spill of toxic red sludge from an aluminum plant in western Hungary flooded three nearby localities. The children expressed their feelings related to the tragedy in many ways, including psychosomatic disorders. A way for relief, a method also used in psychotherapy, was to let the children draw images of the tragedy thus process the shock mentally. There have been several cases in the past when children affected by traumatic events, mainly war situations, were encouraged to draw their stories, mainly in order to be exhibited and to draw attention to the effect of war, conflict and violence on children, but from the perspective of the children. Encouraging children to draw is considered to be one of the methods of obtaining the children's perspectives on issues that are important and relevant for them which importance is emphasized by much recent research. In this poster we present a selection of the drawings.

BIOGRAPHY OF AUTHORS

List of Authors

Gáspár ALBERT

Researcher/Scientific contributor
Geological Institute of Hungary
14, Stefánia rd., 1143 Budapest
HUNGARY
Tel: +36 1 2510999/134
albert@mafi.hu

Dr. Gáspár Albert is a geologist and cartographer at the Geological Institute of Hungary. He is also a lecturer of the Doctorate School of Earth Sciences at the Eötvös Loránd University Budapest. He specialized on the methodologies of the 3D geological modeling and the GIS background of geological models. In his research he recently concentrates on the visualization of the 3D models, especially on those, which disseminate the geological information on the internet. Besides the office work he participates in classical field operations as well. He is member of the International Cartographic Association Commission on Geospatial Analysis and Modeling.

Efstathios ARAPOSTATHIS

PhD Student
Department of Geography, Harokopio University
70, El. Venizelou Ave, 17671 Kallithea, Athens
GREECE
Tel: +302109549162
sarapos@hua.gr

Efstathios Arapostathis is a PhD student at Harokopio University of Athens. He holds a degree in Geography from the University of the Aegean and a Master of Science in Applied Geography and Area Management from Harokopio University of Athens. His main research interests include Web Mapping, Spatial Databases and Volunteered Geographic Information.

Regina ARAUJO DE ALMEIDA

Universidade de São Paulo, USP
Faculdade de Filosofia Letras e Ciências Humanas,
Departamento de Geografia
Av. Prof. Lineu Prestes, 338 Cidade Universitária
05508-900 São Paulo, SP
BRAZIL
Tel: (11) 30913737
Fax: (11) 30913159
reginaaa@usp.br
http://www. geografia. fflch. usp. br

Temenoujka BANDROVA

Department of Photogrammetry and Cartography
University of Architecture,
Civil Engineering and Geodesy (UACEG)
1, Chr. Smirnenski Blvd. 1046, Sofia,
BULGARIA
Tel: +359 887 83 27 02
tbandrova@abv.bg

She is president of Bulgarian Cartographic Association; a co-chair of the Commission of Cartography and Children (CCC) – International Cartographic Association (ICA), a member of the Association for Geospatial Information in South-East Europe (AGISEE), of Editor's group of International Journal Digital Earth, Croatian journal "Cartography and Geoinformatics. She is head of laboratory on cartography, UACEG. Her professional interests are in the fields of 3D cartographic modeling, mapping for children, cartographic symbol systems and map projections. She is an author of more than 20 school atlases and more then 70 wall maps in geography, approved by Ministry of Education for Bulgarian schools. She received a travel award for her paper in 19th Cartographic Conference by ICA, Canada, 1999. She is a project manager in DataMap Ltd. where her school atlases and maps are published.

Levon BOLIGIAN

Invited Professor
Institute of Advanced Studies and Postgraduate Courses (ESAP)
Universidade Vale do Ivaí (Univale) – Paraná
BRAZIL
Tel: +55 43 3357 2695
boligian@hotmail.com

Levon Boligian is a Doctor of Geography at Universidade Estadual Paulista (UNESP), Campus of Rio Claro, located in the State of São Paulo, Brazil. He is a professor of Methodology in Geography and School Cartography Teaching, at the Institute of Advanced Studies and Postgraduate Courses (ESAP), part of Universidade Vale do Ivaí, situated in the State of Paraná. He is also a teacher of Primary and Secondary Education and has great experience as an assessor of private schools. He has been working for many years with production, edition and authorship of teaching materials for Primary Education.

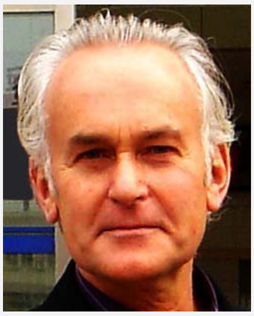
Václav ČADA

University of West Bohemia, Pilsen
CZECH REPUBLIC
cada@kma.zcu.cz

Rex G. CAMMACK

Associate Professor
Department of Geography and Geology,
University of Nebraska Omaha
6001 Dodge St. Omaha, NE 68182
USA
Tel: +402 554 2282
Fax: +402 554 3518
rcammack@unomaha.edu

Rex Cammack is an associate Professor of Geography at the University of Nebraska Omaha, Nebraska USA. His research interests are in the area of cartography and Geographic Information Science. His research emphasis is in the use of Internet services for communication and the role of Location Based Services and spatial understanding/awareness.



William CARTWRIGHT

President
International Cartographic Association
RMIT University, Melbourne, Australia
william.cartwright@rmit.edu.au

William Cartwright is President of the International Cartographic Association. He is Professor of Cartography and Geographical Visualization in the School of Mathematical and Geospatial Sciences at RMIT University, Australia. He joined the University after spending a number of years in both the government and private sectors of the mapping industry. He is a Fellow of the Royal Geographical Society, a Fellow of the British Cartographic Society, an Honorary Fellow of the Mapping Sciences Institute Australia and an Honorary Fellow of the Surveying and Spatial Sciences Institute. He holds a Doctor of Philosophy from the University of Melbourne and a Doctor of Education from RMIT University. He has six other university qualifications, in the fields of cartography, applied science, education, media studies, information and communication technology and graphic design. He is the author of over 300 academic papers. His major research interest is the application of integrated media to cartography and the exploration of different metaphorical approaches to the depiction of geographical information.

Maria Isabel CASTREGHINI DE FREITAS

Universidade Estadual Paulista Júlio de Mesquita Filho,
Institute of Geosciences and Exact Science from Rio Claro
Department of Territorial Planning and GIS
Av. 24-A, 1515 (CEAPLA – UNESP)
13506-900 – Rio Claro, SP – Caixa-Postal: 178
BRAZIL
Tel: (19) 35269335
Fax: (19) 53249622

She graduated in Cartographic Engineering from "Universidade Estadual Paulista" (1983), Master of Geodetic Sciences in Universidade Federal do Parana (1989) and Ph.D. in Transportation Engineering from the "Universidade de São Paulo" (1995). She is currently an doctor assistant professor in Universidade Estadual Paulista. She has experience in Geosciences with an emphasis in Digital Cartography, Geographic Information System (GIS) and the Teaching of Cartography. He has developed research activities and guidance in the following areas: mappingand GIS studies in applied geography, cartography tactile and continuous training of teachers in the field of cartography.

Otakar ČERBA

University lecturer
Geomatics section, Department of Mathematics, Faculty of Applied Sciences, University of West Bohemia in Pilsen
Univerzitní 22, 306 14 Plzeň
CZECH REPUBLIC
Tel: +420 604 475 579
cerba@kma.zcu.cz
http://www.kma.zcu.cz/Cerba

Ing. et Mgr. Otakar Čerba works in Geomatics section of Department of mathematics of the University of West Bohemia in Pilsen, Czech Republic. He concentrates above all on questions of digital cartography (application of markup languages in digital cartography, using spatial data modeling in digital cartography, including ontologies, and accessibility of digital maps). He is a member of the Commission on Maps and the Internet of the International Cartographic Association, member of board of Czech Association for Geoinformation and member of the group EU Competitiveness on the Web. Otakar Čerba is involved in spatial data harmonization European projects, e.g. Humboldt, Plan4all, Habitats or SDI-EDU.

Marli CIGAGNA WIEFELS

Professor
Institute of Geosciences,
Department of Geoenvironmental Analysis,
Universidade Federal Fluminense
Niterói, RJ
BRAZIL
Tel: (55-21) 2629.5948; 2629.5981
cigagna@vm.uff.br
www.uff.br/analisegeoambiental/departamento

Marli Cigagna Wiefels is professor at the Institute of Geosciences from Universidade Federal Fluminense (UFF), in the city of Niterói, State of Rio de Janeiro, Brazil. She teaches basically thematic cartography, cartography for children, remote sensing and astronomy. She holds her bachelor degree in Geography from UFF (1977) and her DEA (1994) and Doctorate (2001) degrees in Geography from the Institut des Hautes Études de l'Amérique Latine, Université de Paris III – Sorbonne Nouvelle. She leads and coordinates this project of interactive media.

Jonas da COSTA SAMPAIO

Student
Institute of Computer Sciences;
Universidade Federal Fluminense
Niterói, RJ
BRAZIL
jonasjjj@yahoo.com.br
Homepage: www.ic.uff.br

Jonas da Costa Sampaio is involved since the beginning in the project of interactive media, bringing his enthusiasm for the theme and his knowledge in computer science and programming techniques. Scholar of the extension project "Production and dissemination of didactic material for cartography and astronomy studies".

Gábor CSILLAG

Senior Researcher
Geological Institute of Hungary (MÁFI)
1143 Budapest Stefánia út 14.
HUNGARY
Tel: +36 1 251 0999
csillag@mafi.hu

Dr. Gábor Csillag is senior researcher at the Geological Institute of Hungary. He received his MSc in geography from University Eötvös Loránd Budapest, his DESS in remote sensing from University Pierre et Marie Curie Paris and PhD from University of Pécs. His research interests are the geological mapping, the geomorphology and the nature conservation of the geological and geomorphic sites. He is member of the board of the ProGeo Hungary association.

Rosângela DOIN DE ALMEIDA

Post-graduated Program Researcher
Department of Territorial Planning and GIS,
Universidade Estadual Paulista (UNESP)
Avenida 24-A, n. 1515, Rio Claro – SP – 13 506-900
BRAZIL
Tel: +55 3523 3707
rda.doin@gmail.com
http://rdoinblogspot.com
http://lattes.cnpq.br/3974567106733210

Rosângela Doin de Almeida is graduated in Geography at the University of São Paulo. Master and PhD at the Faculty of Education, University of São Paulo. She is senior professor in Teaching Practice of Geography at the University Estadual Paulista Julio de Mesquita Filho (UNESP). She is corresponding member of the National Commission on Cartography for Children (CCC) of the International Cartographic Association. She published articles in national and foreign scientific journals and is co-authored of the books "O espaço geográfico: ensino e representação", 1989, "Cartographic Activities", 1995. She is the author of the book "Do desenho ao mapa: iniciação cartográfica na escola", 2002, organizer of the book "Cartografia Escolar" (2007), both published by Editora Contexto (São Paulo). She coordinated the publication of several municipal school atlases. She is a voluntary researcher of the Graduate Program in Geography (UNESP) and is the leader of the research group "Geography and Cartography School" of the National Research Council (CNPq). She is also advisor in Geography and Cartography School, production of municipal school atlases and teacher training.

István ELEK

Department of Cartography and Geoinformatics
Eötvös Loránd University (ELTE)
Pázmány Péter sétány 1/a
1117, Budapest
HUNGARY

Radek FIALA

University of West Bohemia, Pilsen
CZECH REPUBLIC
fialar@kma.zcu.cz

László FODOR

Senior Researcher
Geological Institute of Hungary (MÁFI)
14, Stefánia rd., 1143 Budapest
HUNGARY
Tel: (36) 1 251 0999/137, (36) 30 390 3128
fodor@mafi.hu

He received his PhD degree in 1991 from the University Pierre et Marie Curie, Paris. His current research interests are: structural geology, neotectonics, geological mapping, sedimentology and geomorphology. He is a Professor of the Eötvös Loránd University, Budapest. He is a member of the Hungarian and American geological and geophisical associations, and the International Association of Sedimentologists.

Georg GARTNER

Professor
Institute of Geoinformation and Cartography,
Vienna University of Technology
Gusshausstrasse 30/E127-2, 1040 Vienna
AUSTRIA
Tel: +43 1 58801 12611
Fax: +43 1 5880112699
georg.gartner@tuwien.ac.at
http://cartography.tuwien.ac.at

Georg Gartner is a Full Professor for Cartography at the Vienna University of Technology. He holds graduate qualifications in Geography and Cartography from the University of Vienna and received his PhD and his Habilitation from the Vienna University of Technology. He was awarded a Fulbright grant to the University of Nebraska, Omaha in 1997 and a research visiting fellowship to the Royal Melbourne Institute of Technology in 2000, to South China Normal University in 2006 and to the University of Nottingham in 2009. He serves as Vice-President of the International Cartographic Association. He is Dean for Academic Affairs for Geodesy and Geoinformation at Vienna University of Technology. He is responsible organizer of the International Symposia on Location Based Services & TeleCartography and Editor of the Book Series "Lecture Notes on Geoinformation and Cartography" by Springer and Editor of the Journal on LBS by Taylor & Francis.

Gábor GERCSÁK

Associate Professor, PhD
Department of Cartography and Geoinformatics
Eötvös Loránd University (ELTE)
Pázmány Péter sétány 1/A, Budapest, H-1117
HUNGARY
Tel: +36 1 372 2975
Fax: +36 1 372 2951
gercsak@ludens.elte.hu
http://lazarus.elte.hu

Gábor Gercsák studied cartography, geography and languages in Budapest. His first job was editing an international cartographic journal, Cartactual, at the Institute of Geodesy, Cartography and Remote Sensing. He came to teach at the university in 1991. In part-time, he worked for the Department of International Relations between 1992 and 1999, and served as the executive secretary to the rector from 2000 to 2006. He is a member of the Hungarian Committee on Geographical Names.

Cristiano GIMENEZ

BA in Geography
Universidade Estadual Paulista "Júlio de Mesquita Filho"
UNESP – Campus de Ourinhos
Avenue Vitalina Marcusso, 1500. Ourinhos – SP
BRAZIL
Tel: +55 19 82353734
cristianogimenez.geo@gmail.com

Cristiano Gimenez, bachelor's degree at the Universidade Estadual Paulista "Julio de Mesquita Filho" – UNESP – Ourinhos. Since the first year of college is working on the Group of Tactile Cartography integrated on the project "Development of Scholar Municipal Atlas of Ourinhos–SP and training tutors teachers: Proposals for the study of the locality". Currently is also working on scientific research about tactual quantitative thematic maps.

Eleni GKADOLOU

PhD Student
Department of Geography, Harokopio University
70, El. Venizelou Ave, 17671 Kallithea, Athens
GREECE
Tel: +0302109425628
egkadolou@hua.gr

Eleni Gadolou is a PhD student at Harokopio University of Athens. She holds a Diploma of Engineering in Surveying from the Department of Rural & Surveying Engineering of National Technical University of Athens and a Master of Science on Applied Geography and Area Management from Harokopio University. Her research interests include Web Cartography, Spatial Ontologies and Cartographic Heritage Management Systems.

Barbara GOMES FLAIRE JORDÃO

BA in Geography
Universidade Estadual Paulista "Júlio de Mesquita Filho"
UNESP – Campus de Ourinhos
Avenue Vitalina Marcusso, 1500. Ourinhos – SP
BRAZIL
Tel: +55 11 9660 13 88
barbaraflaire@hotmail.com

Barbara Gomes Flaire Jordão has major in Geography in the Universidade Estadual Paulista "Julio de Mesquita Filho" – UNESP – Ourinhos. This is the last year bachelor's degree at the institution. She has worked with include collectors of recyclable materials in the city during the second year's course, besides contributing in the area of environmental education through music in the mainstream of Ourinhos. Currently part of the Group of Tactile Cartography Unesp Ourinhos, production of materials and methods that contribute to the system for inclusion in the country, and works as a secretary in the Journal of Geography and Research.

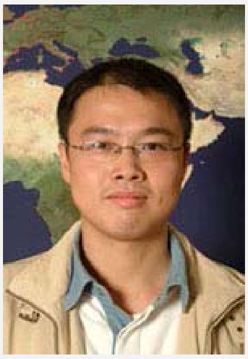
Henrik HARGITAI

Department of Physical Geography, Faculty of Sciences
Eötvös Loránd University
1117 Budapest, Pázmány Péter sétány 1/a
HUNGARY
hhargitai@gmail.com

He has specialized in planetary cartography, gaining in situ experience of Martian cartographic work at Mars Society's MDRS research station. He creates planetary maps (both printed and virtual) and teaches planetary geomorphology. He is an editor of the University Radio at ELTE University in Budapest and served as editor in chief of the local temporary radio station at the location of the industrial disaster of Devecser–Kolontár in October–December 2010, Hungary.

A. HOFFMEISTER

Institute of Planetary Research
German Aerospace Center (DLR), Berlin
GERMANY



Haosheng HUANG

Research assistant
Institute of Geoinformation and Cartography,
Vienna University of Technology
Gusshausstrasse 30/E127-2, 1040 Vienna
AUSTRIA
Tel: +43 1 58801 12616
Fax: +43 1 58801 12699
haosheng.huang@tuwien.ac.at
http://cartography.tuwien.ac.at

Haosheng Huang is a research assistant and PhD student at Research Group Cartography at Vienna University of Technology. He finished his master degree in Computer Science in 2006 at South China Normal University. Now he is involved in the projects ways2navigate and EmoMap. His research interests include Location Based Services, spatial-temporal data modelling and analysis, data mining, Spatial cognition and Web-GIS.

Karel JANEČKA

University of West Bohemia, Pilsen
CZECH REPUBLIC
kjanecka@kma.zcu.cz

Karel JEDLIČKA

University of West Bohemia, Pilsen
CZECH REPUBLIC
smrcek@kma.zcu.cz

Jan JEŽEK

University of West Bohemia, Pilsen
CZECH REPUBLIC
jezekjan@kma.zcu.cz

Elke KERSTEN

Institute of Planetary Research
German Aerospace Center (DLR), Berlin
GERMANY
elke.kersten@dlr.de

Milan KONEČNÝ

ICA Past President
Professor, Head of Laboratory on Geoinformatics and Cartography
Masaryk University, Faculty of Science,
Kotlarska 2, 611 37 Brno
CZECH REPUBLIC
konecny@geogr.muni.cz

Prof. Konečnỳ was awarded Doctor of Geographical Sciences from Masaryk University in 1982. He served as Lecturer, Associate Professor and Professor of Masaryk University, Czech Republic during 1982 – onwards. He is currently the Professor of Geodesy and Cartography of the same university, Professor of Geoinformatics and Regional Geography at University of Konstantina Filozofa, Nitra, Slovakia, Guest Profesor of Vienna University, Austria, Guest Professor in The Chinese University of Hong Kong, the Honorary Professor of the Siberian State Academy of Geodesy Novosibirsk and Doctor Honoris Causa of University of Architecture, Engineering and Geodesy in Sofia, Bulgaria. Prof. Konecny takes the leadership in many international professional bodies, during 2003–7 was President of International Cartographic Association (ICA (contemporary past president), now serves as chairman of ICA Working Group "Cartography on Early Warning and Crises Management", the Vice-President of International Society for Digital Earth (ISDE) and Academician and President of European Joint Research Center of International Eurasian Academy. He is also Director of Czech Focal Point for Geographical Information Group (GISIG). He is the member of editorial board for top journals including the International Journal on Digital Earth (IJDE), Geoinformatica and International Journal of Geoinformatics. He is the council member of Czech Cartographic Association and member of International Advisory Board of Center of Earth Observations and Digital Earth (CEODE), CHAS, Beijing. He organized many high level international conferences at his country and abroad (incl. China – EU high level seminar of EW and CM in Beijing in 2009). His research interests include the role of geoinformatics and cartography in Early Warning and Crises Management, dynamic geovisualization, creation of SDI in Europe (he is expert of INSPIRE and GMES), design of Information and Knowledge-based Society. He is a co-author of first GIS book in Europe in 1985 and editor of EW and CM book in Springer Verlag (in 2010) and two specialized issues on Geoinformatics and Cartography in Early Warning and Crises Management in International Journal on Digital Earth (Taylor and Francis, 2010).

Georgios KRITIKOS

Assistant Professor
Department of Geography, Harokopio University
70 El. Venizelou Str., Kallithea, Athens
GREECE
Tel: +302109549365
Fax: +302109514759
kriti@hua.gr

Georgios Kritikos is Assistant Professor at Harokopio University. He holds a BA in History from the National and Kapodistrian University of Athens, a MPhil in European Studies at the Department of International Relations and History at Cambridge University and a PhD in the Department of History and Civilization, European University Institute in Florence. His scientific interests include Nations and Nation-states in historical geography, Individual and collective identities in space, European space: borders, institutions and politics of Security.

Alexandre Vítor de LIMA FONSÊCA

Universidade Federal do Maranhão, UFMA
BRAZIL
alexandre@ufma.br

Shimshon LIVNI

Senior Researcher
Kaye College of Education
POB 65 Beer Sheba 84100
ISRAEL
Tel: +972 8 6519056
Fax: +972 8 6519056
livni_s@netvision.net.il

Dr. Shimshon Livni is a senior researcher in the Kay College of Education in Beer Sheva, Israel. His research interest lies in the teaching concepts of Geography and Cartography for students in Elementary and High School as well as in University level. He is an author of textbooks for teaching mapping skills in Grade 4–5 of the Elementary School.

Marcello MARTINELLI

Associated Professor
Department of Geography, Pós-graduação Programa
Geografia Humana, Universidade de São Paulo
Av. Gen. Cavalcanti de Albuquerque, 960
05638-010, SÃO PAULO, SP
BRAZIL
Tel: +55 11 3739 5220
m_martinelli@superig.com.br

Marcello Martinelli retired Associate Professor of Cartography, but active at Post Grade level in the Department of Geography, College of Philosophy, Letters and Human Sciences, at the University of São Paulo, Brazil. He holds a PhD in Human Geography and has received the title of "Livre-docente" in Thematic Cartography. Currently, he conducts methodological-oriented research and supervises post-graduate students pursuing Master and PhD degrees in thematic, environmental, tourism cartography and school geographic atlases. He is also author of geographic atlases and books on thematic cartography.

Ferjan ORMELING

Cartography section
Faculty of Geographical Sciences
Utrecht University
PO Box 80115, 3508TC
THE NETHERLANDS
Fax: +31 30 2540604
f.ormeling@geog.uu.nl

Ferjan Ormeling has taught cartography at Utrecht University since 1969. He was engaged in producing a correspondence course in cartography in the 1970s, when he was chairing the Education WG of the Netherlands Cartographic Society. Since then he was promoted to chairing the ICA Commission on Education and Training 1987-1999, together with Dick Dahlberg and Roger Anson with whom he produced the 4-book manual series Basic Cartography for Students and Technicians. With Menno-Jan Kraak he wrote the manual Cartography, Visualization of Spatial Data, now in its third edition, which has been widely translated. Currently he contributes to ICA cartography courses and organises toponymy courses for the UNGEGN worldwide.

Rufino PÉREZ GÓMEZ

Assistant Professor
Department of Surveying Engineering and Cartography
ETSI en Topografía, Geodesia y Cartografía (UPM)
Ctra Valencia Km 7. 28031 Madrid
SPAIN
Tel: +34 91 3367921
Fax: +34 913322560
rufino.perez@upm.es

Rufino Pérez Gómez is Assistant Professor of Computer Cartography at Technical University of Madrid (UPM). Currently, he is also responsible for the International Relations activities of the ETSI en Topografia, Geodesia and Cartografia (UPM). He has a PhD in Geodesy and Cartography of the Technical University of Madrid and a 2 year Master in Cartography at the ITC (The Netherlands). Among his professional experience it is also worth to mention a 4 year period at the National Geographic Institute (IGN). He is member of the ICA Commission on Education and Training. Among his fields of interest are Cartographic Education, Computer Cartography, GIS Applications and Webcartography. He has presented more than 30 papers in International and National Conferences about the related topics.

Michael P. PETERSON

Professor
Department of Geography/Geology
University of Nebraska at Omaha, Omaha, Nebraska
USA
Tel: 402-554-4805; Fax: 402-554-3518
mpeterson@unomaha.edu
http://maps.unomaha.edu

Michael P. Peterson is a Professor in the Department of Geography/Geology at the University of Nebraska at Omaha. He received his BA from the University of Wisconsin-River Falls (1976), his MA from Boston University (1978) and PhD from the State University of New York–Buffalo (1982). He was a Post-Doctoral Assistant at the University of Zürich, Switzerland in 1981–82 and subsequently joined the faculty at the University of Nebraska, Omaha in 1982 where he has taught courses in world regional geography, cartography, computer mapping, remote sensing and geographic information systems. He has served as Visiting Assistant Professor at the University of Washington, Seattle in 1985, a Fulbright Fellow at the Free University Berlin, Germany (1990–91), Visiting Professor at the University of Hawaii–Manoa (1995), Visiting Fellow at the Royal Melbourne Institute of Technology University in Australia (1998), Fulbright Fellow at the Technical University of Vienna in Austria (1999), and visiting Professor at the University of Applied Technology in Munich, Germany in 1999, 2000, 2001, visiting research fellow at Carleton University in Ottawa, Canada, in 2004, and visiting professor at the Technical University of Vienna in 2011. He is past-President of the North American Cartographic Information Society (NACIS) and former editor of Cartographic Perspectives. He has also served as member of the Editorial Board of Cartographic Perspectives, The Professional Geographer, and Cartography and Geographic Information Systems. He is currently chair of the Maps and the Internet Commission of the International Cartographic Association.

José Camilo RAMOS DE SOUZA

Universidade do Estado do Amazonas, UEA
BRAZIL
josecamilo@usp.br

Mariane RAVAGIO CATELLI

BA in Geography
Institution: Universidade Estadual Paulista "Júlio de Mesquita Filho" – UNESP – Campus de Ourinhos
Avenue Vitalina Marcusso, 1500. Ourinhos – SP
BRAZIL
Tel: +55 14 9752-7881
marianecatelli@gmail.com

Mariane Ravagio Catelli, bachelor's degree at the Universidade Estadual Paulista "Julio de Mesquita Filho" – UNESP – Ourinhos. Since the first year of college is working on the Group of Tactile Cartography integrated on the project "Development of Scholar Municipal Atlas of Ourinhos–SP and training tutors teachers: Proposals for the study of the locality". Currently is also working with tactile touristic maps of Barra Bonita and Igaraçu do Tietê–SP.

Carla Cristina REINALDO GIMENES DE SENA

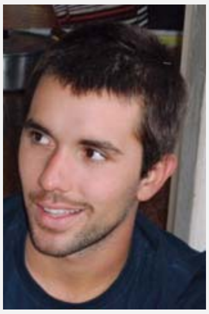
PhD in Geography
Institution: Universidade Estadual Paulista "Júlio de Mesquita Filho" – UNESP – Campus de Ourinhos
Avenue Vitalina Marcusso, 1500. Ourinhos – SP
BRAZIL
Tel: +55 14 3302-5712
carla@ourinhos.unesp.br

Graduated in Geography, MA and PhD in Geography in University of São Paulo (2009). She is currently Assistant Professor PhD from UNESP- Ourinhos. She has experience in Geography, with emphazis on Geography teaching and training of teachers, mainly in the following themes: school and tactile cartography, geography education, special education and inclusion.

José Jesús REYES NUÑEZ

Assistant Professor
Department of Cartography and Geoinformatics
Eötvös Loránd University
Pázmány Péter sétány 1/A, Budapest 1117
HUNGARY
Tel: +36 1 372 2975
Fax: +36 1 372 2951
jesus@ludens.elte.hu, jesus@map.elte.hu
jesusreyes@caesar.elte.hu
http://lazarus.elte.hu/hun/dolgozo/jesus.htm

José Jesús Reyes Nuñez is Associate Professor at Eötvös Loránd University in Budapest. His research interests lie in Cartography for Children (specifically the teaching of cartographic concepts for children in Elementary and High Schools), Computer Cartography (including GIS and the use of Web to teach cartographic concepts for children) and Cartography of Mesoamerican Cultures. He is responsible for the organization of the "Barbara Petchenik" map competition in Hungary from 1999. At present, he is Co-Chair of the ICA Commission on Cartography and Children.



Tiago SALGE ARAÚJO

Student of Science Master
Faculdade de Psicologia e de Ciências da Educação
Universidade do Porto
Rua do Dr. Manuel Pereira da Silva, 4200-392 Porto
PORTUGAL
Tel: +351 226 079 700 / +351 226 079 72
salarau@hotmail.com

Tiago Salge is graduated in Geography at the "Universidade Estadual Paulista", Rio Claro-São Paulo/Brazil. Besides teaching, researches and studies about Deafness (especially the questions of time and space). Currently doing a Master in Science of Education at the "Universidade do Porto", Porto/Portugal. Now, he is a member of the group of researchers on the project PROFACITY – Profane Citizenship in Europe: testing Democratic ownership inhybrid Situations – Portugal has been dedicated to the issues of the deaf. Coordinators: Drª. Orquídea Coelho and Dr. Henrique Vaz (Universidade do Porto).

Waldirene RIBEIRO DO CARMO

Universidade de São Paulo,
São Paulo
BRAZIL
walcarmo@usp.br

Th. ROATSCH

Institute of Planetary Research
German Aerospace Center (DLR), Berlin
GERMANY

Manuela SCHMIDT

Research assistant
Institute of Geoinformation and Cartography,
University of Technology, Vienna
Gusshausstrasse 30/E127-2, 1040 Vienna
AUSTRIA
Tel: +43 1 58801 12613
Fax: +43 1 5880112699
manuela.schmidt@tuwien.ac.at
http://cartography.tuwien.ac.at

Manuela Schmidt studied Cartography at the University of Applied Sciences, München. She now works as a research assistant and PhD student at the Research Group Cartography at Vienna University of Technology. She is involved in the projects FEMroute, ways2navigate and EmoMap. Her research interests include usability, user interface design, Web Mapping 2.0 and Volunteered Geographic Information.

Eszter SIMONNÉ DOMBÓVÁRI

Research and Teaching Assistant
Institute for Geoinformation and Cartography,
Vienna University of Technology
Erzherzog-Johann-Platz 1/127-2, Vienna, A-1040
AUSTRIA
Tel: +43 1 58801 12614
Fax: +43 1 58801 912614
eszter@cartography.tuwien.ac.at
http://cartography.tuwien.ac.at

Eszter Simonné Dombóvári is Research and Teaching Assistant at the Vienna University of Technology and PhD student at the Eötvös Loránd University in Budapest. Her PhD research deals with the development of interactive web applications in the education of cartographical knowledge (for 4th, 6th and 8th grade High Schools pupils). Her research interests lie in Web Mapping, Programming, Interactivity and Multimedia in Cartography. She is the coordinator of the "Barbara Petchenik" map competition in Austria. She has been teacher for children's workshops in geography and cartography at the "Kinderuni Wien" in Vienna since 2008.

Emmanuel STEFANAKIS

Associate Professor
Department of Geography, Harokopio University
70 El. Venizelou Str., Kallithea, Athens
GREECE
Tel: +302109549162
Fax: +302109514759
estef@hua.gr
http://www.dbnet.ntua.gr/~stefanak/

Dr. Emmanuel Stefanakis is Associate Professor at Harokopio University. He holds a Dipl. Eng. in Surveying Engineering from the National Technical University of Athens, an MScE degree in Geodesy and Geomatics Engineering from the University of New Brunswick, Canada and a PhD degree in Electrical and Computer Engineering from the National Technical University of Athens. His scientific interests include Spatial Data Infrastructures, Web Mapping and Web Mapping Services Spatio-temporal Knowledge Discovery and Data Mining and Education in Geomatics and Geomatics-Assisted Education.

Paula Cristiane STRINA JULIASZ

Post-graduated Program Researcher
Department of Territorial Planning and GIS
Universidade Estadual Paulista (UNESP)
Avenida 24-A, n. 1515, Rio Claro – SP – 13 506-900
BRAZIL
Tel: +55 3523 3707
paulacsj@rc.unesp.br

Paula Cristiane Strina Juliasz is graduated in Geography and has post graduate in Research in cartography. She developed research in cartography teaching and tactile maps for visually impaired. She has published articles in national and international scientific events related to the topic. Currently conducts research at the master's graduate program in geography the state university in the area Geography and Cartography School and is a member of the research group "Geography and Cartography School" of the National Research Council (CNPq).

Csaba SZABÓ

MSc student
Department of Cartography and Geoinformatics,
Eötvös Loránd University
Pázmány Péter sétány 1/A, Budapest, H-1117
HUNGARY
Tel: +36 30 660 2732
bahama@map.elte.hu,
http://mercator.elte.hu/~bahama/index.html

Csaba Szabó is an MSc student at Eötvös Loránd University in Budapest. His research interests lie in Computer Cartography (including GIS and Web cartography), Cartography for Children (specifically for children in Elementary and High Schools), and scientific (thematic) cartography (specifically related to geophysics and geology).

P. C. THOMAS

Center for Radiophysics and Space Research
Cornell University, Ithaca
USA

Veerle VANDELACLUZE

Lecturer in Primary Geography
Open Higher Education
Excellence Centre for Distance Education
Catholic University College of South-West Flanders, KATHO
Pre-primary and primary school teacher training, Campus, Tielt, PHO
Beernegemstraat 10, 8700 Tielt
BELGIUM
Tel: 00 32 51 42 79 00
www.kathotielt.be

Silvia Elena VENTORINI

Assistant Professor
Department of Geography
Federal University of São João del-Rei
UFSJ – Campus Tancredo Neves
Av. Visconde do Rio Preto, s/n Colônia do Bengo
São João Del Rei – Minas Gerais – CEP 36.300-000.
BRAZIL
Tel: 55 (32) 33733974
sventorini@ufsj.edu.br

Assistant Professor Level I Department of Geography at UFSJ Degree in Geography (2004), Masters in Geography (2005) and Doctorate through the Institute of Geoscience and Exact Sciences, UNESP. Has experience in the area of Geoprocessing and SIG, Cartography e Special Education (with emphasis on the education of blind and vision impaired people). Still works in the area of Continuing Education for teachers.

Martina VICHROVÁ

University of West Bohemia, Pilsen
CZECH REPUBLIC
vichrova@kma.zcu.cz

Pál Gábor VIZI

Electrical engineer, safety engineer
KFKI Research Institute for Particle and Nuclear Physics of HAS, Doctoral Program of Zrínyi Miklós University of National Defense
Konkoly Thege Miklós út 29–33.
1121 Budapest
HUNGARY
vizip@rmki.kfki.hu

M. WÄHLISCH

Institute of Planetary Research
German Aerospace Center (DLR), Berlin
GERMANY

Rizka WINDIASTUTI

Geomatics Research Division
National Coordinating Agency for Surveys and Mapping of Indonesia (BAKOSURTANAL)
Jl. Raya Jakarta – Bogor Km 46, Cibinong 16911
INDONESIA
Tel/Fax: +62 21 87906041
rizka@bakosurtanal.go.id

Rizka Windiastuti is Head of Program and Cooperation Section in Geomatics Research Division of BAKOSURTANAL. She received her Bachelor Degree in Computer Science from North Carolina State University, USA, in 1996, and her Master of Information Technology from University of Newcastle, Australia, in 2003. She is a researcher in spatial information system and is very interested in database and interactive multimedia applications. She has been involved in organizing map drawing competitions for children in Indonesia since 2005 and was assigned to chair the organizing committee for national competitions in 2007 and 2009.

László ZENTAI

Professor
Department of Cartography and Geoinformatics,
Eötvös Loránd University
Pázmány Péter sétány 1/A, Budapest, H-1117
HUNGARY
Tel: +36 1 372 2975
Fax: +36 1 372 2951
laszlo.zentai@elte.hu
http://lazarus.elte.hu

László Zentai is the Head of the Department of Cartography and Geoinformatics at Eötvös Loránd University, Budapest, Hungary. He was the Vice-dean of the Faculty of Informatics and the Vice-Rector of the university. Mr. Zentai actually is the Vice-chair-man of the Commission on Education and Training, International Cartographic Associ-ation and he is serving as the Chairman of the Hungarian National ICA Group. He is a Council member of the International Orienteering Federation. His papers are dealing with computer cartography, cartographic education, topographic mapping, orienteering maps, environmental protection and webcartography.

Georgi ZHELEZOV

Associate Professor
Department of Geography
National Institute of Geophysics, Geodesy and Geography
Bulgarian Academy of Sciences
Acad. Georgi Bonchev str., block 3, Sofia, BG-1113
BULGARIA
Tel: +359 2 979 3304
Fax: +359 2 870 0204
gzhelezov@abv.bg
http://geograph.bas.bg/

Georgi Zhelezov is Head of the Section of Physical Geography at Department of Geography, National Institute of Geophysics, Geodesy and Geography Sofia, Bulgaria. He has a PhD of Cartography and Master of Landscape studies at the Sofia University. His PhD research related to spatial modelling of wetland nature systems. He has participated in projects like Bulgaria Geographical Atlas (2010), Transliteration of Geographical Terms in World Atlas of Readers Digest (2010), Natural Geography of Dobrudzha and Ludogorie (2007), Foundation and Development of Scientific Network for Investigation of the Mountain Regions in Southeastern Europe (2009–2011). His papers are dealing with spatial modelling, landscape ecology and education, wetland studies, environmental protection and ecosystem services. He has also presented his researches in Bulgaria, Italy, Macedonia, Romania, Germany, Portugal, Slovenia and Austria.