

## CARTOGRAPHIC INITIATION FOR YOUNG STUDENTS, USING AERIAL PHOTOGRAPHS AND SATELLITE IMAGES

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### ABSTRACT

It is unquestionable the importance of the cartographic formation, as part of the whole educational process of children and young people, taking into account the needs of human relations with the geographical space and the modern maps technologies. The alphabetising process have been always a problem that attracts the attention of educators, being faced as a teaching/apprenticeship process of reading and writing in a certain language. However, educators did not give to "map" the same treatment they give to reading and writing. In Brazil, maps are not used in the school as means of expression and communication, as they could and should be. Thus, because of the lack of didactic material for cartographic initiation, this work was developed with the objective to prepare a map initiation textbook, using remote sensing products (aerial photographs, satellites images), having as study area the São José dos Campos Municipal District, situated in the São Paulo State. The text book was divided into two parts, i.e., the first one related with the "cartographic initiation", presenting to the students basic orientation, providing them with the main steps of cartographic process, formed by a sequence of actions, as observation, selection and representation of the chosen phenomena to be mapped, their dimensions, proportions and the graphic language of the maps. The second part refers to the "cartographic products interpretation process", the map language reading, in which students read and interpret maps, aerial photographs and satellite images. The examples presented in this textbook were of the environs of São José dos Campos, the Paraíba River Valley and São Paulo North Coast Regions, familiar to the students. This cartographic initiation textbook intends to put the young people in contact with maps and the new technologies used to prepare and use them, as well as will contribute for young students citizenship, permitting them positive attitudes with nature, as members of a particular city and region.

### 1 INTRODUCTION

A map is a form of language older than writing. It is known that the ancient people, that were not able to register their happenings through writing expressions did it through graphic language. Map-making to represent ideas about the geographical space is so antique as human civilisation itself.

Thus, maps utility is proved since the first drawings done by the cavern men. Map-making is really a human necessity to know where things are located and where the events occur in earth surface. Maps preparation appeared as a manifestation of an immediately utility, influenced by the pressure of fundamental human needs, as for instance location, orientation, showing an efficient tool in terms of defence, security and movement (Oliveira, 1977).

## 1.1 The Historical Background

Few maps prepared by the ancient people reached us, due to the materials they used. Some of them became famous in Cartographic History, as for instance the Ga-Sur map, prepared in thick clay tablets, with approximately 7cm x 8 cm. The clay tablet from Ga-Sur was found in the Ga-Sur ruins, situated about 300 km far from the ancient Babylonian region, today Iraq. History of maps presents others ancient map examples, as the Bedolina Map, discovered by shepherds approximately 70 years ago, in a mountain region of Italy. This geographical space representation was done from the top hill, from where it was possible to see all the valley. This map is dated of the second millennium before Christ (Oliveira, 1977), representing a terrestrial surface portion in a plain surface (the rock), selected and collected from the real world; showing an organisation pattern of the geographical space represented.

It is possible to infer that these maps were used as a communication material, showing these regions through a graphic language, composed by nature, houses, animals, agriculture fields, roads etc. History shows that the main purpose of maps differs according to different cultures. Along the time, maps registered different cultures, geographical and cartographic acknowledges and the technical progress of people in cartographic acknowledges utilisation.

## 1.2 Cartography in the Past and Today

From the maps outlined in the cavern walls, in rocks, in rustic texture, in clay tablets, till the ones of the space age, it was man's need to know the place of things and people that made this spectacular development of cartography possible. Today, most maps are made of paper, cheaply and easily carried.

Nowadays, the map is a current useful instrument in scientific researches, as well as in territorial planning or in daily life. Maps are seen and used in school, are presented in television programs, used in newspapers, magazines, scientific papers etc. However, for most people, maps serve at most to situate a place or to prepare an itinerary, that nor always they know how to use.

Oliveira (1977) presents an important point related to maps, that is, the process of mapping does not occur disconnected from all the others individual mental developments. The maps are drawn by human hands and controlled by human mind. It is also man who selects facts and the technique to complete mapping, revealing a certain subjectivity, when representing objective realities.

A map is only one of the most possible forms to represent reality. The writing and spoken languages are closed related to mind activity. The researches about the "act of mapping" have the main objective of understanding mental processes involved in the perception, comprehension, memorising and problem solution tasks related to maps. The "map users" must be actives, with a real capacity to filter information, to act in a selective form, accumulating experiences and creating acknowledges, refuting the image of "passive information consumers".

The cartographic practices varies from different societies along the time. So, maps could be seen as true "cultural texts". Some maps researchers say that "maps are not impartial", because they transmit a certain vision of the geographical space, showing people acquirements and carrying the way of life of persons that prepared them. A map is considered an image socially constructed, thus, it is desirable to comprehend the society that produced it.

The history of maps and map-making showed an intense technical refinement process and also several scientific improvements. The "cartographic techniques" passed through complex and differentiated process, according to each culture interests, each one inserted in a special context and epoch, being some of these historical moments particularly relevant (Raisz, 1962). The acquisition of the environment notion is a complex and progressive process of great importance for individuals development. This notion is not only restricted to geographic and cartographic subjects, but is inserted in almost all the fields of knowledge. So, it is important do promote cartographic initiation since the first years of children in school. Thus, Geography and Cartography should conduct the students to better understand "the reality", facilitating their intervention in the environment. It is necessary to develop individual mapping experiences.

Modern maps chart the earth in details and new technologies facilitate this work. According to scientific progresses, the schools should prepare young students to read and to make maps. The cartographic language study is becoming more important, since the first years in the school.

The cartographic initiation supposes the development of certain notions as: a) vertical and oblique visions; b) tridimensional and bidimensional images; c) structure and legend notions; d) proportion and scale; e) lateral notions, reference and

orientation. Raisz (1962, p.30) presents the principles of map making as “scale, selection, symbolisation and generalisation”. These cartographic elements should be developed combined with other knowledges and abilities of the students. Based on spatial relations development, children or young students could read and prepare maps, and make a lecture of reality, comparing the changes occurred in the geographical space.

Oliveira (1977) comments about the complexity of map making, which originates, consequently, a complex product to the map user. She refers to this communication process between the map maker and the map user. As the map is a symbolic system, the complete cycle of the map, as a model, constitutes a generalised communication system. Thus, it is necessary a psychological relation between the map maker and the map user. It is possible to conclude that the most important map function is that one related with the “audience”, for whom the map is prepared. Both general and thematic maps are made for a variety of audiences. These range from young schoolchildren to college students, or to the technical engineers (Robinson et al., 1984).

### **1.3 The Textbooks in Brazil**

The bibliography research was made in order to select the cartographic initiation educational textbooks published in Brazil, as well as the Cartographic references in general. It was identified two educational publications, considered as “Mapping Textbook”, i.e., that presents the cartographic subjects little by little, increasing in difficulty till the end of the publication, when the student are able to understand cartographic basements and to “produce” and “read” cartographic information.

Through this bibliographic research, it was registered a number of researchers working in cartographic initiation, forming groups concentrated in the Brazil Southeast Region (São Paulo, Rio de Janeiro, Minas Gerais States), coincident with the most progressed area of the country. In fact, the cartographic basic notions are found in Geography, Cartography books, Thesis and Atlases.

The Institute for Space Research (INPE), with headquarters in São José dos Campos, São Paulo State, is the responsible for the space researches in Brazil, as well as by the remote sensing researches and products. Brazil, with a continental dimension, has been benefited with the remote sensing progress and with its natural resources monitoring. INPE receives and processes satellites images, transferring this technology to researches institutes, universities, non-governmental organisations, in graduate and undergraduate levels, with less significant works directed to children and young students.

To face this problem, it was planned and prepared this Cartographic Initiation Textbook for young students, using aerial photographs and satellite images. This book is organised into nine Chapters and a Glossary, forming a set of 150 pages volume.

### **1.4 Aerial Photographs and Satellite Images Importance in Map Making**

Remote sensing by airborne and satellite collection system, a means of observing and measuring the environment, is an essential method for managing vital resources everywhere in the world. With the coming of the “space age” and new ways of “looking” at the earth, Brazil became one of the countries that has been using remote sensing products and also designing and building satellites. Since 1968 researchers in Brazil has been using aerial photographs and after 1972, satellite imagery.

A single set of remotely sensed images can serve a wide variety of uses, including different kinds of mapping. Modern maps chart the earth in detail, and even nearby space as well. Satellite imagery has been shown as an important tool for mapping subjects. From the seventies, the remote sensing activities started to be done through satellite imageries.

Aerial photographs and orbital images are considered sources of information of great quality, permitting frequent information of the geographic environment. Nowadays, most maps are prepared using aerial photographs and satellite images, facilitating map making activities and offering quality to maps. The impact of man’s penetration into space has already been felt in cartography (Raisz, 1962). Knowing the lack of cartographic material for cartographic initiation in Brazil, and also the potentialities of remote sensing techniques and products, this work uses this material for educational purposes, for mapping initiation activities.

Rangel and Targino (1997) emphasises the value of cartographic knowledge for young students, as well as the appropriation of the cartographic language, considered an important point in young people education, to prepare them to a new dialogue

with the present moment and with the future. Le Sann (1997) comments that maps have great potentialities for young students, because as they “translate” the information, using a graphical language, they are increasing their capacity of logic reasoning.

The present moment is rich, has a strong dynamic, in such a manner that strongly presses schools for adapting their education curriculum to the new times. There can be no doubt that Cartography for educational purposes is one of the subjects most affected by the technological progress, considering that the map could be and should be the “image of the world” (Filizola, 1996). The changes in the process of making maps illustrate recent mapping progress. Analysing the value of maps for teachers, it means that maps are important instrument in the teachers’ hand, that uses it as a “model of the real world”, applying it to different situations and needs during their Geography, History or Cartography classes. Because of this, the teaching maps didactic problem falls on teachers formation. Many times, in Brazil, teachers are not prepared or do not have specific competence in Cartography, having no conditions to treat maps as a communication and expression form.

This analysis also indicates that it is necessary to prepare young students to use maps and to make maps, putting them in contact with the remote sensing products.

## 2 JUSTIFICATION

Graphic representations have an important role in the current communication era. It is necessary to find new forms to facilitate the access to cartographic information for children and young students. It is important to take care of this acquisition process methodologically, with the same care used in the alphabetical language (Passini, 1997). The need to prepare children and young students to the new demand of life, with updated information, is a requirement of the schools. There can be no doubt that the cartographic language should be inserted in the first years of children in school.

In Brazil, normally the schools do not give to the map the same treatment they give to reading and writing processes. Besides this, as mentioned before, the great part of teachers are not prepared to introduce the students in reading and making maps experience, in the comprehension of symbols, what would give to the students support to better understand the geographical space.

Today, the world is more and more connected to maps, codes, legends, related to cartographic products, in different scales, as photographs at ground level, aerial photographs, orbital images, as well as with the great Computer Science evolution. It is obvious the need to prepare children and young students to face technological challenges. They already live together with virtual realities, through electronic games, the Internet, television, as well as they use or observe several scales, for instance when they observe the city from their apartments or when they travel by plane. Many of them have some perception of the environment they live and are in condition to “interpret” this space. However, the great majority of them should be prepared for it. All maps are abstractions of reality. The real world is complex, requiring special orientation.

Knowing the difficulties of didactic material for cartographic purposes, this work is planned to prepare a special audience, i.e., specially for young students to read, use and prepare maps.

## 3 OBJECTIVES

In spite of the great effort of the scientific community, it is considered that there are few works about Cartographic Initiation in Brazil. So, in view of this need, it is necessary to produce educational material, specific about cartographic basic notions. Thus, this work had as main objective to propose and develop a Cartographic Initiation Textbook for Young Students, using Aerial Photographs and Satellite Images.

To attain this General Objective, it were defined some Specific Educational Objectives, as follows:

- a) To evaluate the existing material about Cartographic Initiation, through specific bibliographies, as well as interacting with specialists on this area.
- b) To plan and develop a Cartographic Initiation Textbook for young students, using aerial photographs and satellite images of São José dos Campos Municipality, the Paraíba River Valley, and the North Coastal Region of São Paulo State, Brazil.

- c) To test and evaluate the Textbook, through an interaction with Specialists in Cartography, verifying their efficacy and need for modification.
- d) To test and evaluate the textbook with young students (14 years old), through an interaction with a group of students, verifying the comprehension they have of the text and of the cartographic products.

This work considers that, using remote sensing products, the students could have more interest to learn Cartography, what will influence in a better apprenticeship of the cartographic process.

In this textbook the students are orientated about the cartographic process. In the broad sense, cartography includes any activity in which the presentation and use of maps is a matter of basic concern. This constitutes in a sequence of actions, since the observation, selection and representation of phenomena to be mapped, till the map interpretation process. Using the remote sensing products, this work contributes for the establishing of relation between “the real world” and the “represented world”, facilitating the process of how to prepare, how to understand and how to read graphic messages properly.

#### **4 METHODOLOGY**

To develop this work, that includes a Cartographic Textbook for young students, using remote sensing products (aerial photographs and satellite images), it was necessary a series of methodological procedures, beginning by a bibliographical research about Cartography.

After this research, it was started the planning of the textbook structure, dividing it into Cartographic Basic Notions Chapters, constituting the First Part. Second Part is dedicated to Map Reading Chapters. The planned structure of this textbook has been discussed with the specialists in Education and Cartography, in order to obtain the “textbook structure”, according to the Brazilian Educational Ministry requirements and to the Cartographic Initiation subjects.

These efforts were important to support next task, i.e., to prepare each Chapter, the necessary revisions to correct the information distributed along the Chapters, as well as the need for illustration. These data were acquired from many sources, using illustrations already prepared, adapting or preparing another ones, especially for the textbook. To complete this phase, each Chapter required sometimes four drafts till the final version.

Among the material used, it was really important to select specific remote sensing products, which supplied the “textbook” with the best aerial photographs or satellite images of São José dos Campos Municipality, the Paraíba River Valley Region and the São Paulo State North Coastal Area. So, remote sensing products are considered as an important methodological basis for this textbook, constituting the central point of this cartographic initiation. Remote sensing products constitutes an important part of mapping, increasingly so with modern developments in electronic data processing and satellites. Young students must be aware of and understand these developments in remote sensing in order to make the most use of them.

The Chapters of this textbook were prepared following a structure common to the nine ones, i.e., the presentation of the cartographic subjects (with text and figures) at the beginning, and the last part is dedicated to the exercises. A bibliographic list ends the Chapters, with the objective to put the students in contact with names of researchers, as well as have conscious of mentioning details of books and authors.

The test phase with the students is considered a methodological step of great importance to “evaluate” this material. The test program was done with four students (14 years old), during a nine meetings period (October/November, 1999). This contact with young students showed that the use of aerial photographs and satellite images contributes to motivate them to study cartography as well as to certify them of the importance of this technology.

#### **5 THE TEXTBOOK STRUCTURE**

Next the textbook division in Chapters (nine), with two parts, Cartographic Basic Notions and Reading and Map Interpretation is presented.

## **CARTOGRAPHIC INITIATION FOR YOUNG STUDENTS, USING AERIAL PHOTOGRAPHS AND SATELLITE IMAGES**

### **Presentation**

#### **First Part - Cartographic Basic Notions**

#### **Chapter 1 – Maps History**

Definitions, Ancient and Modern Maps, the History of Map making  
Selected References

#### **Chapter 2- Forms, Contours and Forms Combinations**

The real world seen from different positions.  
Vertical and Oblique aerial photographs: forms, shapes and forms combination  
Selected References

#### **Chapter 3 – Map Scales: Differentiation, Importance and Measurements**

Measurements and Proportions in Mappings. Graphic or Bar Scale and Area Scale.  
Selected References

#### **Chapter 4 – Localization: Orientation and Geographical Coordinate Systems**

Means of Orientation, Orientation through Instruments. Geographical Coordinates (Localization of Points in Earth Surface). Latitude (Length of a Degree of Latitude) – Longitude (Length of a Degree of Longitude)  
Selected References

#### **Chapter 5 – Introduction to Map Projections - The Classification of Projections**

Terrestrial Globe, World Maps, Maps. Classification of Projections (Cylindrical, Conic and Azimuthal Projections). Mercator Projection  
Selected References

### **Second Part – Reading and Maps Interpretation**

#### **Chapter 6 – Planimetric Maps**

Cartography: Steps to read Maps: Titles, Legends (various symbols used, arrangements of the components), Scales, Geographical Coordinates, Directions on the Earth, Localization, Data, Source of Data, Authorship, Data Interpretation.  
Selected References

#### **Chapter 7 – Topographic Maps**

Cartography: Hill-shaded Topographic Map. Terrain Features. Styles of Contour Lines.  
Spaced Outlines on the Map. How to read Topographic Maps. Topographic Map Example: São Francisco Xavier District hill-shaded topographic map (contour interval lines - depression contours – from 2.082 meters till 800 meters of altitude)

## Selected References

### **Chapter 8 – Cartography and Remote Sensing in Landscape Representation**

Landscape Transformation by Society. Aerial Photographs and Satellite Images in surveying Geographical Space Transformations. Examples: Aerial Photographs and Satellite Images of São José dos Campos (different scales and dates) to emphasize urban transformation. Selected References

### **Chapter 9 – Remote Sensing**

The Aerial Photographs and Satellite Images Uses in Cartography. The Remote Sensing Technology. Examples of the São José dos Campos  
Selected References

### **Glossary of Technical Terms**

## **6 RESULTS**

As mentioned before, this Cartographic Primer was tested in a School of São José dos Campos city, in the São Paulo State, Brazil, with college students of 14 years old, in nine meetings; one for each Chapter.

This textbook constitute an effort to prepare specific educational material to young students, taking into consideration that this kind of material is not common in Brazil. After the bibliographic search, it was seen that there are editions of atlases and Geographical and Cartographic books, for different student ages. However, this search also showed that there are few “cartographic textbooks” for young schoolchildren and for college students, mainly using satellite images.

The Brazilian Institute for Space Research (INPE) has its headquarters in São José dos Campos city, facilitating the acquisition of remote sensing products, in order to prepare this textbook. The São José dos Campos Government Division and the Paraíba River Valley University (UNIVAP) also have data bank of aerial photos and satellite images of the city and region. Thus, São José dos Campos was chosen as the concentration example area for this textbook. The mentioned agencies hold aerial photographic coverage of the region, helping in the location of maps, photos and other spatial data. Even having facilities to acquire remote sensing products, there were many difficulties when preparing, adapting cartographic products for this textbook. Many times, “special material” should be prepared. This fact constituted a difficult phase to be completed, demanding time to complete this work.

### **6.1 Test Phase**

Four young student collaborated on this cartographic product test, reading each Chapter, analysing texts, pictures, maps and completing the exercises. After this activity, they answered a questionnaire, specially prepared for the nine Chapters evaluation. They answered a set of questions, furnishing elements to improve the Chapters, showing the positive points and the “difficulties” in language, pictures, maps. After the completion of the test period, the student also filled a second questionnaire about the whole material, also demanding answers about what is properly presented in the textbook and what should be improved. The Structure and Sequence of this Cartographic Primer Chapters were prepared in order to present notions, conceptions, practices of cartographic initiation and of map reading.

### **6.2 Interactions with the Students**

During the test period, the students showed interest in using aerial photos and satellite images, putting into practice identification tasks, selecting elements, mapping different areas, using overlays, pencils for map reproduction etc. Several contours in aerial photos and satellite images were done by the students, originating simple maps of the geographical space of São José dos Campos, presented by aerial photos or orbital images.

This motivation was based on the fact that they are using a different kind of textbook, different from the books they normally used, provoking a positive reaction on the students. Another point of interest was the fact they are using remote

sensing techniques, something new, that could be useful for them in the future. During this period, the interaction with the students proved that the use of aerial photos and satellite images in this textbook was considered useful for them. Thus, it is supposed that, in the future, when this textbook will take part of a normal class periods, teachers will have better conditions to present cartographic notions to the students, showing them the São José dos Campos environment with success.

## 7 FINAL CONSIDERATIONS

To complete this project, it is planned to prepare a “Teacher Manual”, as well as “Teachers Cartographic Training” material. Thus, it is hoped to obtain a financial support, to offer teachers other cartographic examples and details. This new phase will be important to facilitate teachers work, providing them with information about cartography and remote sensing techniques and products.

Technological advances are changing the way maps are made and the relationship between map maker and map user. Electronic technology is fast, making it possible for the map user to be directly involved, especially if mapping is being done on a display screen or with microcomputer-driven plotting devices. The result, of course, is that even cartographers or map users need to work with mapping products. Although the cartographic sophistication is present, there is the need to prepare the map user for this new reality. An important consequence is that the price of changing technology may include continuing education. This cartographic initiation textbook is one step in direction of young students mapping initiation.

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