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STATIC AND DYNAMIC MAPS, DEVELOPED FROM AN ANALYTICAL OR SYNTHESIS REASONING, IN SCHOOL GEOGRAPHIC ATLAS: THE METHODOLOGICAL FEASIBILITY

Mapas Estáticos e Dinâmicos, Tanto Analíticos Como de Síntese, nos Atlas Geográficos Escolares: a Viabilidade Metodológica

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ABSTRACT

On the teaching and learning of Geography, at least in Europe, School Geographic Atlases have earned credit among the didactic materials since the early nineteenth century. The first school atlas of the european continent was the germanic «Kleiner Atlas Scholasticus», concluded in 1710. Other similar atlases appeared, conceived as simplifications of the great General Reference Atlases. The «Atlas Général Vidal-Lablache: histoire et géographie» (1894) was a classic that inspired other derivations. The first Brazilian School Atlas was the Atlas of the Empire of Brazil, by Cândido Mendes de Almeida, published in 1868. As a result of the evolution of cartography, a wide range of School atlases, not only global but also national, regional, state, provincial and even local atlases, are currently available in print, digital and electronic media. In order to develop a School Geographic Atlas, the initial step is the interlace of two basic guidelines in which space and time are present: first, the teaching the map, considering the theoretical and methodological bases about the construction and representation of space in the child. This representation process in the child starts with its own spatial reality and later, it continues with the reality of other people; second, the teaching with the map, practiced in Geography to achieve the knowledge of the world, from the close and known experience (the place) to the distant unknown (the world space), not linearly, but going back and forth through the various levels of approach. Thus, there will be the understanding how the local reality has a strong relationship with the rest of the world. The student will be able to think on a particular context without having experienced it before. The next step deals with the definition of the Atlas contents and the delimitation of the spatial area, taking into account the methodological basis of the Geography. In addition, the Thematic Cartography can be considered as a monosemic language. As a consequence, the thematic maps can be constructed by applying various methods, with their own level of adequacy to represent the selected theme, in a static or dynamic appreciation. Moreover, the reality can be glimpsed inside an analytical or synthesis reasoning. Within the previous outlook, this speculation will give emphasis to the participation of maps, as the integral elements of school geographic atlas, constructed in accordance with a static or dynamic appreciation, developed following two distinct levels of reasoning, either analytical or even synthesis.

Keywords: Methodological Feasibility, Map Development, Static Maps, Dynamic Maps, Analytical Maps, Synthesis Maps.

RESUMO

No ensino-aprendizagem da Geografia, pelo menos naquele centrado na Europa, os Atlas geográficos escolares ganharam crédito entre os materiais didático-pedagógicos desde o início do século XIX. Um primeiro atlas escolar do continente fora o alemão "Kleiner Atlas Scholasticus" de 1710. Fora secundado pelo "Atlas methodicus" de 1719. Outros compareceram concebidos como simplificações dos grandes Atlas gerais de referência. O "Atlas général Vidal-Lablache: histoire et géographie" de 1894 foi um clássico que inspirou derivações. No Brasil, em 1868 se publicava o Atlas do Império do Brazil de Cândido Mendes de Almeida, o primeiro Atlas escolar brasileiro. Fruto de toda evolução da cartografia, atualmente conta-se com uma variada gama de Atlas escolares nos formatos impresso, digital e eletrônico, sejam mundiais, nacionais, regionais, estaduais, metropolitanos, municipais e até locais. A elaboração de um Atlas geográfico para escolares considera como primeiro passo para sua coordenação o entrelaçamento integrado de duas orientações básicas, onde estão presentes o espaço e o tempo:o *ensino do mapa*, com bases teórico-metodológicas sobre a construção e representação do espaço na criança e a respectiva representação, inicialmente, da sua própria realidade espacial e depois daquela das outras pessoas; o *ensino pelo mapa*, praticado em geografia para o conhecimento do mundo, desde o próximo vivenciado e conhecido - o lugar - ao distante desconhecido - o espaço mundial -, não de forma linear, mas mediante cotejamentos entre os vários níveis de abordagem. Assim, haverá compreensão de como a realidade local se relaciona com o todo mundial. E o aluno raciocinará sobre determinado contexto, sem tê-lo experimentado antes. Em seguida, ingressa-se nas bases metodológicas da geografia para compor o conteúdo do Atlas. Atrelado a este estaria a definição do recorte espacial. Na sequência, considera-se a Cartografia Temática como uma linguagem da representação gráfica. Assim, os mapas temáticos podem ser construídos por vários métodos, cada um mais apropriado à representação do tema selecionado, seja numa apreciação estática, ou dinâmica. Ainda, a realidade pode ser vislumbrada dentro de um raciocínio de análise ou de síntese. Dento desse panorama, a presente elucubração dará ênfase à participação, junto aos atlas geográficos para escolares, dos mapas elaborados segundo as apreciações, estática e dinâmica, desdobradas nos encaminhamentos do raciocínio, seja no nível analítico, como no de síntese.

Palavras-chave: Viabilidade Metodológica, Elaboração de Mapas, Representação Gráfica, Mapas Estáticos, Mapas Dinâmicos, Mapas Analíticos, Mapas de Síntese.

1. INTRODUCTION

Since the first collection of maps called Atlas, the "Atlas sive cosmographicae meditationes manufactures mundi et fabricati figure" by Mercator, was published in 1585, there has been a significant effort towards the appropriate use of the contents of such works.

It must be remembered that, in fact, the first prominent Atlas was the "Theatrum Orbis Terrarum" by Abrahm Ortelius in 1570, suggested and encouraged by Mercator himself. After this, the collection of Gerhard de Jode, entitled "Speculum Orbis Terrarum" in 1578. Note that these did not receive the name "Atlas".

Mercator was the first to employ this word to designate a set of maps. He gave it this name to compare his effort in composing his work to that which the fable attributed to Atlas. He decorated the frontispiece of the volume with a figure of the legendary hero but replaced the celestial sphere by the Earth globe!

Considering the teaching and learning of Geography in Europe, since its introduction as a discipline for the elementary, secondary and higher at the beginning of the nineteenth century which followed the model of German geography, the school geographic atlases have earned credit among didactic-pedagogical materials, becoming more and more adequate to this task in the classroom.

Thus a first school atlas, the Germanic "Kleiner Scolasticus Atlas", was published in 1710 by Homann of Nuremberg. It consisted of a selection of 18 maps without any supporting text for courses. A later edition, under the name of "Atlas Methodicus", was designed specifically to courses on Geography in 1719.

Other prototypes also appeared in the same period; however, they followed an approach to Geography in the sense of Cosmography, hence, giving more attention to cosmic space than Earth space. The "Nouvel Atlas des Enfans ..." by Sepp, published in 1782, is often cited as an example. Later they began to consider spaces exclusively based on Earth, in accordance with the work done by great pedagogues.

In this diffusion, numerous imaginations and innovations took important role such as the Lithography, enabling the publication of

atlas with high print runs, making them more accessible to students, while Geography began to be consolidated in the programs of schools. In fact, it is known that such discipline had an undeniable presence in the school teaching in Prussia in the 18th century. Consequently, from this country initiative, it became relevant in the Western Europe in the 19th century (VLASH, 2009).

The first atlas for the elementary education was the French "Petit Atlas Geographic âge du Premier" by Cortambert, in 1840. In this country, in the late 19th and early 20th centuries, the starting point for the teaching of Geography was the study of the place where people live, and gradually reach the Earth as a whole.

In Portugal, school atlases emerged in the same period. An important example is the "Cartas elementares de Portugal para uso das escolas" which was published by Gomes de Barros, in 1878. Once they contemplated primarily the function of the location, the Portuguese atlas began gradually to focus on more adequate thematic representations for schools. In addition, the geographic studies used to start from the place in this country.

Following this new assignment, such atlases began their structure and elaboration as selections and simplifications of the great general reference atlas, as the universal by Adolf Stieler in 1817 and others. However, they had an evolution: moved from simple collection - easy forms to gather maps - to a systematic organization with specific intellectual purpose certainly crystallized by the capitalist mode of production in the history of human society.

The "Atlas Général Vidal-Lablache, histoire et géographie" by Paul Vidal de La Blache, in 1894, was a classic atlas that inspired many others, not only in France but also in other countries in the Old Continent. Basically, it was composed by two parts: historical and geographic maps. The purpose of such work was to provide an overview of each considered territory. The political map of each country to be studied was accompanied by the correspondent physical map. The author stated that the two maps would make clear the understanding of one another. The detailed examination of certain features would have the value of glimpsing a fact. Hence, the maps would acquire scientific value only when they were conceived in the connecting chain to which they belong. That would be the only way to have full meaning.

The "Atlas de Géographie Physique, politique et historique" by Grosselin Delamarche, published in Paris in 1896, was directed specifically to courses in geography and French history.

Despite this remarkable impact, "O Atlas do Império do Brazil" by Cândido Mendes de Almeida, was published in 1868 in Brazil, dedicated to Emperor Dom Pedro II, which became the first Brazilian school atlas. That was planned to be used in the Imperial College of Pedro II, in Rio de Janeiro, for the teaching of the "principles of geography," in accordance with the requirements of the admission exams for the Law school from 1831 (VLACH, 2009).

In 1922, "O Pequeno Atlas do Brasil" was also considered as a school atlas, by Mario V. da Veiga Cabral from the Normal School of Rio de Janeiro. In 1927, the "Novo atlas de geografia" by Monteiro and D'Oliveira was spread in Rio de Janeiro. The "Atlas geográphico geral e especialmente do Brasil" by Father Gerard Joseph Pauwels, published by the Companhia Melhoramentos (the first edition occurred in 1936) had a remarkable presence in schools from the state of São Paulo and many others in Brazil.

In 1970s, the "Atlas para Estudos Sociais" by Rodrigues (1977) was a true model for other publications of the same genre that followed it. Its specificity was the adequate format to be employed in schools, besides the objective content, according to the discipline syllabus at that time.

As a fruit of all epistemological evolution and transformation of atlas cartography and the affirmation of a market economy increasingly globalized, a wide range of School atlases, not only global but also national, regional, state, provincial and even local atlases, are currently available in print, digital and electronic media.

2. METHODOLOGICAL BASES OF ATLAS

The elaboration of a school geographic atlas is not simple. It does not deal with simplifying maps or making them more attractive, not even selecting easier topics to comprehension. These issues should be considered, but they are not truly essential. Such perception has

persisted nowadays by neglecting the specific methodological foundation.

The main references are, among others, the psychogenetic studies by Jean Piaget and his research team; the work by Vygotsky on the relationship between the speech and symbolic activity, the structuring of time and the construction of memory; the studies by Wallon on the learning process seen as dialectical; and the works by Bertin and his disciples on the language of graphical representation to assimilate the contents of the map (BERTIN, 1967, 1973, 1977; PIAGET and INHELDER, 1972; BENIN 1975, 1979, 1982; BONIN, 1989; WALLON 1995; VYGOTSKY, 1998).

In Brazil, there are numerous contributions by Livia de Oliveira, who defined the guidelines for proper orientation of these works, having established a truly school with her high qualified disciples (OLIVEIRA, 1978).

When designing an atlas of such a category, the basic premise is that they do not constitute itself as a collection of maps, but a systematic organization of graphical representations conceived for a specific intellectual purpose. In order to develop a School Geographic Atlas, the initial step is the interlace of two basic guidelines in which space and time are present:

- First, the teaching the map, considering the theoretical and methodological bases about the construction and representation of space in the child. This representation process in the child starts with its own spatial reality and later, it continues with the reality of other people;
- Second, the teaching with the map, practiced in Geography to achieve the knowledge of the world, from the close and known experience (the place) to the distant unknown (the world space), not linearly, but going back and forth through the various levels of approach. Thus, there will be the understanding how the local reality has a strong relationship with the rest of the world. The student will be able to think on a particular context without having experienced it before.

After the definition of the basic guidelines, we must consider the methodological basis of geography and related sciences in order to organize the content of the Atlas. It is based on a basic lucubration of the current geographic knowledge: the society shaping the nature. In this context, the maps show the nature with its own specific movement by evaluating it as a natural resource. In addition, the maps present the society with its production mode of the space, the technical-scientific informational environment, and finally its relation with the environmental issue.

One may consider, therefore, the proposal by Nimer et al. (1988), establishing an agenda of representations, formed by three sectors intrinsically related to reality:

- the natural resources, congregating biotic and abiotic components, seen as fundamental to meet the needs of human society within a given historical framework with dynamic character, as well as exhaustible, requiring an appropriate use.
- the spatial organization, showing through elaborate forms of society, distinct patterns of spatial arrangements arising from human activity developed in composition with nature.
- the environmental changes, as a result of the transformations made by the society on the nature, mediated by the work which might trigger disastrous imbalances to the common welfare.

Connected to the definition of the Atlas contents is the delimitation of the spatial area, which can be situated between the local and global levels, in a suitable scale dependent on the level of approach. This will provide the ability to understand, in a more integrated way, how the reality of certain spatial plan is related to the world as a whole.

In the following, we take into consideration the Cartography. Although one can consider the topographic cartography in some specific cases, is the thematic one that has a greater presence. Given this approach, it is necessary to compose clarity and practicality to achieve a consistent thematic cartography. That must be set according to the methodological proposals. Among several, one can adopt one that is based on the structuralist paradigm. It is considered to manufacture the map as a construction inside

the parameters for the graphical representation as a language, integrating a semiotic monosemic of unique significance (BERTIN, 1967, 1973, 1977).

In addition, the selected thematic representations must be compiled from consistent data, to reveal the information concerning the current time, providing the student with the comprehension of certain issues that he might face, seeking knowledge of reality that surrounds him/her (WURMAN, 1989).

Therefore, maps cannot be seen as mere illustrative figures of textbooks, but revealing representations of situations that are addressed and discussed in the geographical discourse, giving an opportunity for critical and conscious reflection in the classroom, between the teacher (mediator) and students.

3. METHODOLOGICAL BASES OF THEMATIC MAPPING

As mentioned previously, we assume the premise that both thematic maps and maps in general belong to the structure of monosemic language, as proposed by Bertin (1967) in his "Sémiologie graphique". Consequently, the maps of Atlases might be constructed from a broad range of methods. Each method can be more appropriate to the characteristics and forms of manifestation (a point, a line, an area) of the facts and reality phenomena considered by applying either qualitative, ordered or even quantitative approaches.

Regarding thematic representations, cartography can classified as either static or dynamic, depending on the choice of point of view. In addition, different phenomena from the reality might be represented on a map according to an analytical or synthesis reasoning. As a matter of fact, the analytical cartography addresses themes in analytical maps, taking into account their constitutive elements - places, paths or areas - characterized by their attributes or variables. On the other hand, the synthesis cartography deals with themes in synthesis maps, developing the fusion of its constitutive elements in "types". Such fusion provides groups of places, paths or unit areas of analysis, which are characterized by groups of attributes or variables (RIMBERT, 1968, 1990; BERTIN, 1967, 1973, 1977).

The methods of representation of thematic cartography became consolidated in the late 17th and early 18th centuries, due to the transformation of the world perception. Instead of concerning on the exhaustive record of reality, the main idea was to highlight only one element of interest. Thus, the thematic cartography assumed the task to meet the required demands from the several emerging studies in the late 18th and early 19th centuries, as a consequence of the division of scientific work. In fact, leaving aside the eminently analogical record, cartography began to deal with topics that were gradually added to topography, initially by considering the qualitative themes and later the quantitative ones (ROBINSON, 1967; ROBINSON, 1982; PALSKY, 1984, 1996).

4. STATIC MAPS

Static maps are able to record a fact, a situation, a reality phenomenon at a given time and place. For instance, one can mention the geology and the population distribution in a certain space and time. In the first case, data may be either collected in the field or acquired by indirect methods, while in the second case, data is obtained from a census. Static maps can represent the reality instantaneously. Hence, they do not provide additional information to predict potential changes.

Nowadays we need to clarify that, in the field of Multimedia Cartography, when some information displayed on maps is available on the user's computer at the moment of consultation is considered as "static maps". They are classified into "read-only maps", when static images inserted in the WWW-sites, and "interaction maps and/or interactive content maps", when they provide basic levels of interactivity, such as the clickable maps (KRAAK and BRAWN, 2000; KRAAK, 2001; RAMOS, 2005).

4.1 Analytical static maps

When considering the static appreciation of the phenomena, one can perform a representation by using either a qualitative, quantitative or even ordered approach. Static maps can also be developed taking into account an analytical or synthesis reasoning, which constitutes in distinct mode of appreciation of the reality.

Even being static on a determined issue, such maps may suffer successive updates, in accordance with the occurred changes and, consequently, they are elaborated and presented once more with the latest information.

In the past, maps used to be outdated representations due to the long period of time required to manufacture them. Currently, digital cartography has indeed shortened this development time.

Moreover, static maps demonstrate more interest in shapes, patterns, and immediately observable facts. They generally focus on aspects that are related to a specific date.

Even if it is seen as static anywhere, every object, event, phenomenon or any combination of them, in the analysis level, brings a heritage of the past and has a particular potential to project itself into the future. Thus, all spatial organization acquires in such moment, a unique remarkable feature (JOLY, 1990).

Such category of map is easier to be learned by students and the public in general; additionally, the production cycle is short. Due to these characteristics, they constitute themselves as the most employed in the atlas of any kind.

Within the analytical reasoning, static maps deal with a commitment towards an analysis of the geographic space, which requires classification procedures, combination and search for fact explanations or phenomena from the reality. They are rational constructions, whose structure is expressed in the legend. Mental operations undertaken on these maps will allow the expert to formulate conjectures about what the geography of the phenomena would elucidate.

4.1.1 The qualitative approach

Qualitative static maps express the existence, location and extension of occurrences in a given situation, which are characterized by its nature and kind. They can be classified in accordance with the criteria defined by the associated sciences. Among others, we can mention some topics, namely political-administrative division, watersheds, navigable rivers, mineral resources, air masses, natural vegetation, land use, soils, indigenous lands, national parks, education, media, network transportation, airlines, maritime routes, international organizations and sports.

Consider the map "Brazil: Natural vegetation". Natural vegetation is the grouping of plant species in their primitive state, according to the environment.

The cartography of natural vegetation deals with the presentation of the boundaries between vegetation formations, distinguished by their own features, especially physiognomic. In order to record the diversity of formations, the chorochromatic method is normally chosen because the use of diversity of colors is the most appropriate solution.

Once the map is finished, its visualization allows the reader to determine whether there is great homogeneity or, conversely, if it persists much diversity. One can also check what the predominant vegetation is and what is less significant. At the analytical level, the reader might observe the plant formations that exist in a given federal state (Fig. 1).

4.1.2 The ordered approach

By employing an ordered approach, analytical maps can show, in a given date, categories that are part of a unique sequence. Moreover, they can define hierarchies, classes in a growing sequence of relative values, or even peculiarities of a territory that has been consolidated over time. We can also mention a few examples of themes, namely Natural Hazards, Potential agricultural land, Hierarchy functional urban centers, Population density and Geology.

Consider the map "Brazil: agricultural potential of soils - 2007".

This representation takes into account a classification criterion that defines a three-level hierarchy. In order to represent it in a map, the ordered chorochromatic method is selected, which employs a visual order between colors, ranging from dark to light green. The representation shows the spatial arrangement of soils in accordance with their potential order. (Fig. 2)

4.1.3 The quantitative approach

Quantitative maps can express two categories of values, namely absolute and relative. Absolute values highlight the proportionality between quantities that characterize places,

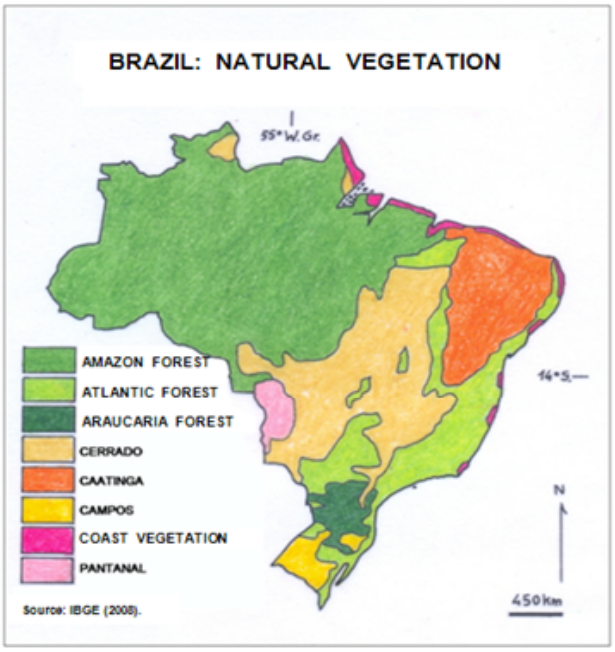

Fig. 1 – Map of natural vegetation elaborated by using a diversity of colors, showing the great extension of Amazon forest.

Fig. 2 – Map of potential agricultural of soils, presented by using a visual order.

paths or areas for a certain occasion. Examples of topics are the relief, rain, temperature, wind, population, agricultural production and industrial production, land use in agricultural establishments, workforce, trade, tourism and finance.

Relative values emphasize the relation of order between them. Among the possible themes, we can mention, for instance, the population density, human development index, rate of urbanization, child birth rate, activity rate, dependency ratio, infant mortality rate and average people per household, illiteracy rate.

4.1.3.1 The quantitative approach in absolute

As an example of quantitative maps in absolute values, we consider the map "Brazil: land use in agricultural establishments - 2006". The data employed for this representation regard the land use in establishments by the type of utilization, according to the Brazilian Federation

Units - 2006. From these data, one can elaborate the representation of the structures of land use related to the total area for each state. Then, the method of proportional geometric figures can be applied for this task. The sizes of the selected figures show the proportionality between the total areas. The components of the structures will be represented by the sectors which are proportional to the total area (Fig 3).

4.1.3.2 The quantitative approach in relative values

For the quantitative approach in relative values, we consider here the map **"Brazil: population density - 2008"**. The development of this map requires the utilization of the choropleth method, which employs the growing visual order between hot and cold colors. The value order in population densities grouped into meaningful classes will be transcribed according to a visual order among the selected colors. The produced map allows us to notice the presence of densely populated areas as opposed to those sparsely populated (Fig 4).

4.2 Synthesis of static maps

When one reaches the level of synthesis reasoning, the development of static maps becomes a much more complex task. Despite the fact that such maps - conceived from the synthesis approach - appear in atlases, they are not shown with the analytical maps that were employed to generate them. This absence causes a great difficulty for their understanding by teachers and students.

In synthesis maps, the composing elements are not available but only their fusion into "types ", as we already announced previously.

In school geographic atlases, the following maps might appear, namely climate types, relief types, landscape types, environment types, geosystems types, types of biomes, agrarian systems, geo-economic spaces etc.

The synthesis is an accurate search towards the visualization of integration, in such a way that new configurations will emerge. However, we have to emphasize that the resulting configurations are not obtained from a simple sum of elementary configurations. By having these directions in mind, we might reach an overall view of reality.

In the field of synthesis cartography, we can mention a few examples such as the regional or zone maps (for instance, the natural regions maps), ecological maps, administrative maps, metropolitan regions maps, agricultural regions maps, industrial maps, ports maps, tourism maps, forests and urban zones maps.

Gimeno (1980) presented a relatively simple way to explain the process from the analytical reasoning to the synthesis reasoning.

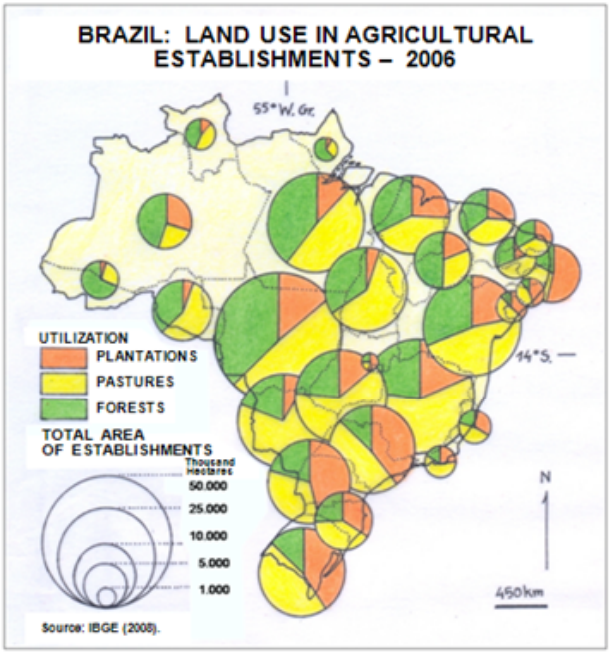

Fig. 3 – Map of land use in agricultural establishments – 2006 shown by using sectors which are proportional to the total area.

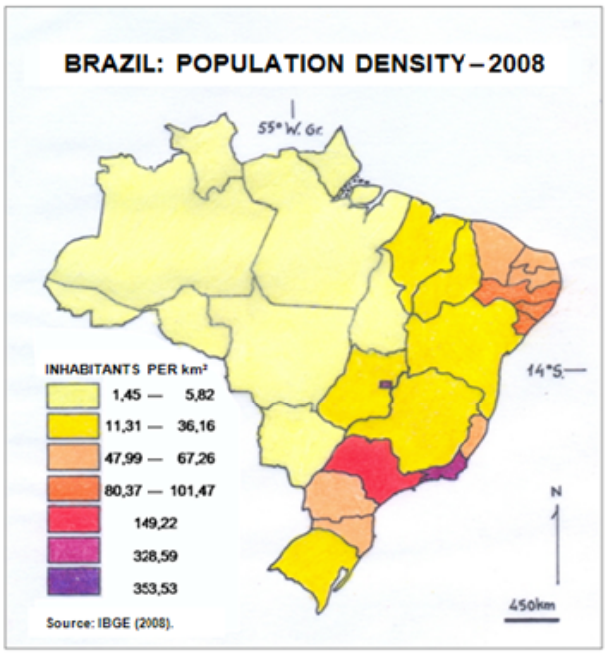

Fig. 4 – Map of population density represented by a growing visual order between colors, showing densely populated areas in the east in contrast with the sparsely populated in the west.

In a work done with elementary school children, he showed the relationships between a set of animals and their associated features.

Initially, the relationships are registered in a table. The table corresponds to a matrix with six rows and seven columns; hence, there are 42 elementary data which record the correspondences between the animals and their characteristics. This is the *analysis*.

Then, the next step is to find out a typology of the animals. The basic idea is to identify groups of animals that are characterized by groups of attributes through a rearrangement of the elements of the original matrix. After a manipulation of the matrix, we obtain three groups instead of the 42 basic data. The three groups of animals are characterized by three groups of attributes. This is the *synthesis* (Fig.5).

4.2.1 The static approach synthesis

A clear demonstration of how to carry out this process is evident in the transition from the analytical map of Land Use in Figure 3 to the corresponding representation of synthesis. Once this corresponds to a three-component structure, we will apply the triangle chart as the algorithm for processing data. After building this chart, the arrangement of points cloud is visually analyzed, which means the structures in each observation unit, checking the formation of these clusters,

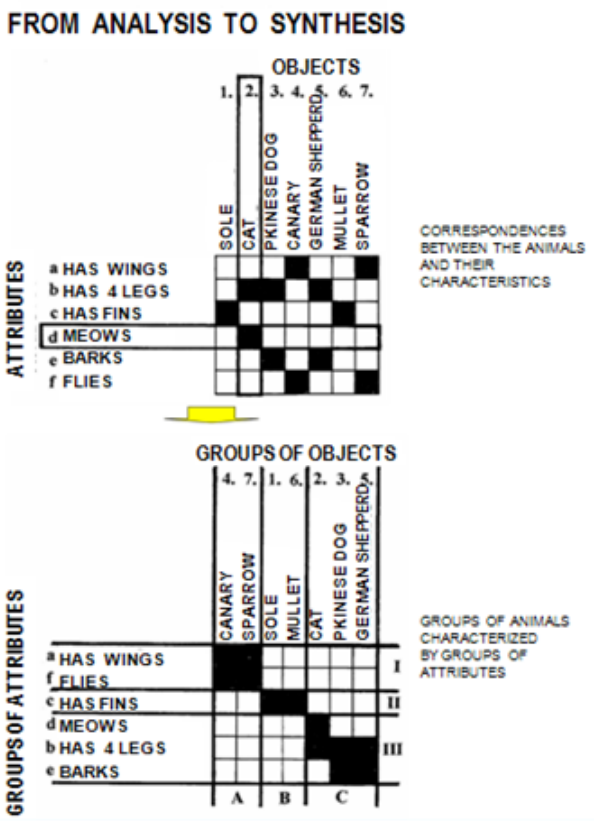

Fig. 5 – The permutation between similar rows and columns allows us to find out the groupings. Fonte: Gimeno (1980).

which express types of structures (Fig 6).

In the last step to obtain the representation of synthesis, taking into account the types of structures that would keep some opposition between them, to elaborate the map **"Brazil:**

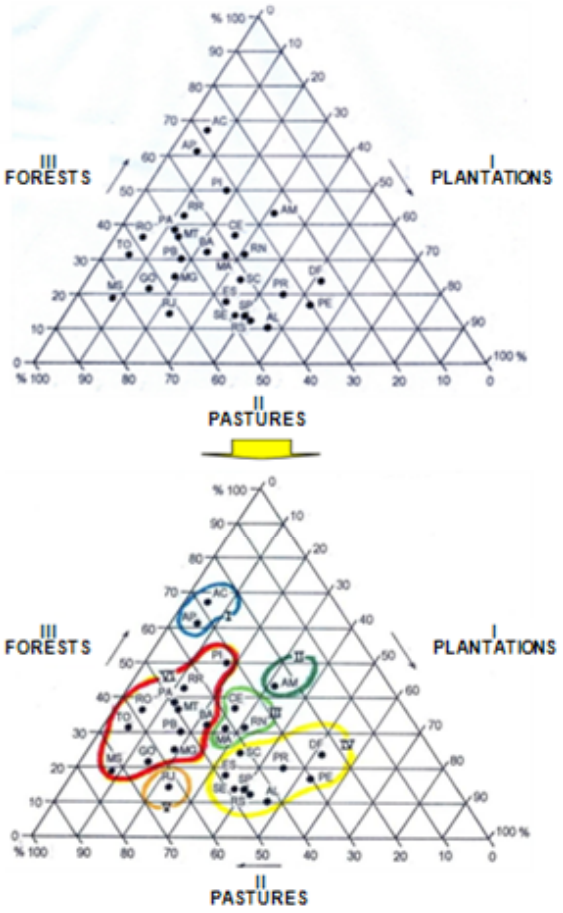

Fig. 6 – The first chart shows the structures while the second, the groups that are formed.

types of structures of land use of agricultural establishments – 2006" we employ the ordered Corochromatic method, which defines colors to the Brazilian states in two opposite orders, which means the items described in the map legend (Fig 7).

5. DYNAMIC MAPPING

Today's reality is not static. More than ever, it is essentially changing, fluid. There is movement. A mosaic of land use changes, forest areas are reduced, new areas are occupied, rivers change their ways, cities expand, the population grows, new roads are deployed, industrial production increases, new residential clusters emerge, life expectancy increases etc. The perspectives of the people suffer an evolution.

Therefore, once dynamic maps focus on the process instead of the forms, they have the advantage of providing explanations. They go beyond the appearances and try to decipher the processes that have developed them. Then, the cartography will have the opportunity to provide better representation of the dynamics through the maps in its full content.

5.1 Dynamic analytical maps

By integrating an analytical reasoning with a desirable methodological approach of well-systematized thematic cartography, the phenomena dynamism can be appreciated in two distinct ways: the changes in time and the movements in space. Regarding the movements in space, the dynamism corresponds to qualitative, ordered or even quantitative movements, changing the location of many elements through different paths, with sense and direction, employing a given time. When considering the motion with respect to time comes into play the notion of speed, as well as the evaluation of the duration for performing a certain route. Hence, it is impossible to dissociate time from the space (CUENIN, 1972; STEINBERG and HUSSER, 1988).

5.1.1 Change in time

As changes occur in time, the phenomena dynamism is represented on one hand, by the qualitative or ordered changes in time of the states of a situation and, on the other hand, by quantitative variations, either absolute or relative, which follow in time to the same place, path or area.

5.1.1.1 Changes in time: the qualitative transformations

In the field of change over time, in terms of qualitative transformations, consider the map "Brazil: changes of the natural state of vegetation in the territory used by society - 1950/2000". By evaluating the diversity as function of the vegetation formations that became part of the used current territory, we apply the qualitative chorochromatic method that defines the use of distinct colors in the map. For the year 2000, we can notice that the largest amount of transformation occurred in the Atlantic forest (Fig 8).

5.1.1.2 Changes in time: the ordered transformations

With respect to the ordered changes, consider the map **"Brazil: the advance stages of the territory used by society - 1950/2000"**. Once a map deals with the steps of a process that occurs

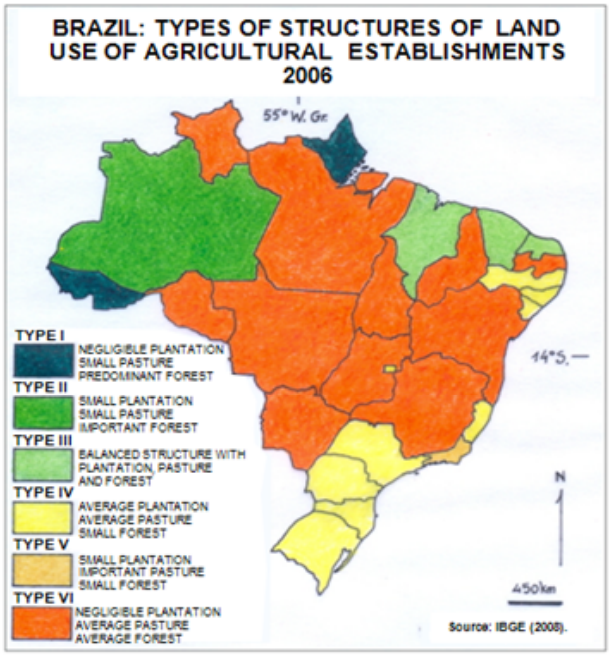

Fig. 7 - A synthesis map shows the types of land use in farms of the Brazilian states, through two opposite visual orders between the colors.

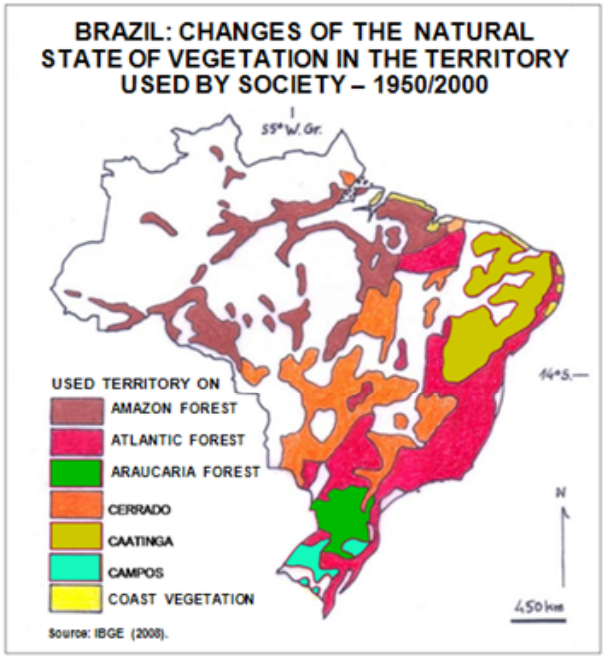

Fig. 8 - Map of the transformations that occurred in the period 1950/2000, which is evident in the Atlantic Forest.

in time, the reality must be observed in accordance with an ordered sequence. The representation will indicate that the most appropriate method is the ordered chorochromatic, which makes use of a visual order between colors, hot or cold, going from lighter in the early stages to the darker, completing the sequence (Fig. 9).

5.1.1.3 Changes in time: quantitative variations

Initially, quantitative variations can be computed by considering the absolute values associated to a certain date compared with those that belong to a second date, similarly as the comparison between two censuses. It corresponds to the growth or decline of a population between the two dates. In addition, one can also work with such variations either in absolutes values, by enhancing the algebraic differences, or even in

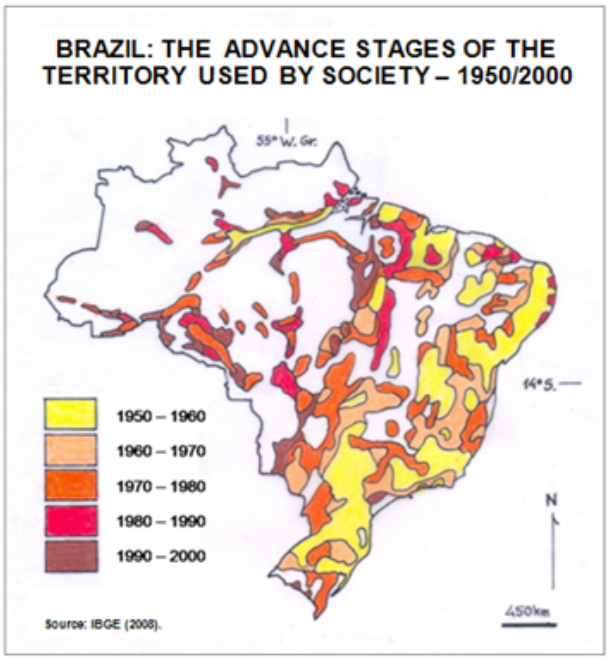

Fig. 9 - Map of the stages of advance of the territory used within this period, stating that in the 1950s the Atlantic Forest was already greatly affected.

relative values by exploiting the variation rates. Examples of themes are the population growth rate, population growth, the balance of migration, migration balance and the trade balance.

5.1.1.3.1 Absolute quantitative variations

The absolute quantitative variations can be represented in two different modes. One highlight the confrontation between the quantities in two dates and the other emphasizes the balance between increases and decreases associated to these dates.

5.1.1.3.1.1 Absolute quantitative variations: comparison between the amounts of two dates

In the domain of quantitative variations, by highlighting the confrontation of quantities for a certain date with another, with respect to censuses, consider the case of the map **"Brazil: evolution of the total population - 1990/2000"**. Once the map deals with absolute values, the method to be applied is the proportional geometric figures method. The selected figures might be circles, employed to compare their sizes, but in this case we chose semicircles, which represents a variant of the chosen method. Therefore, they will be two proportional semicircles, one for each date, placed one above the other with respect to the horizontal line. The top circle correspondent to the first date uses a lighter color, while the bottom circle correspondent to the second date receives a darker color. The increases and decreases become evident by observing the differences between the diameters of the semicircles (Fig 10).

5.1.1.3.1.2 Absolute quantitative variations: balance between increases and decreases of two dates

In order to show the quantitative variation of the population in absolute numbers in terms of balance between increases and decreases of two dates, take into consideration the map **"Brazil: absolute change of the rural population - 1990/2000"**. The method of proportional geometric figures was also employed here for this representation since the values are absolute. The circles are proportional to the number of inhabitants, showing the growth or decline that occurred in every Brazilian state, which are identified in the legend by two opposite colors, a cold and a hot color (Fig 11).

5.1.1.3.2 Quantitative variations

The same dynamic analysis as the one presented above can perform by calculating the relative variation. To accomplish that, we can conduct a proper elaboration of the map **"Brazil: relative variation of the rural population -**

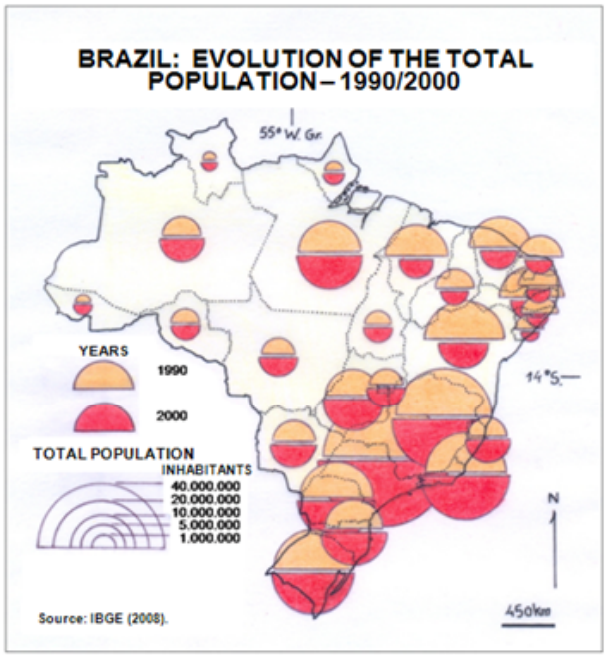

Fig. 10 - Map of the evolution of the total population in the period 1990/2000, in which it is evident that the population losses are concentrated in the Northeast.

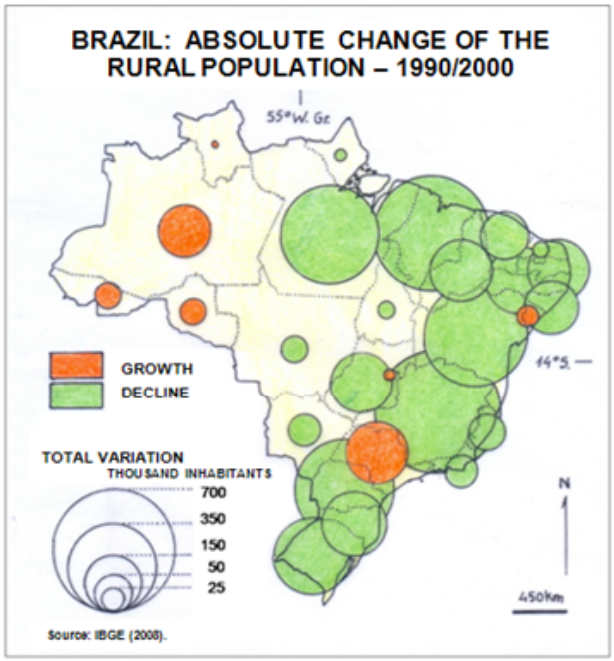

Fig. 11 - Map of Absolute change of the rural population in the period 1990/2000, in which it is evident that the loss of this population occur in almost all states.

1990/2000". Once the map deals with relative values, the choropleth method is the most appropriate. In addition, a set of negative and positive percentage data arranged in significantly classes must be considered. Such classes will appear on the map through the use of two opposing visual orders. In the case of cool colors, from the darkest to the lightest color, while for the hot colors, from the lightest to the darkest color, in a succession of the positive values of the classes (Fig 12).

5.1.2 Movements in space

The movements associated to the dynamic maps are qualitative, ordered and quantitative. Regarding qualitative movements, a few examples of themes are atmospheric circulation and sea currents. With respect to ordered movements, the representation of

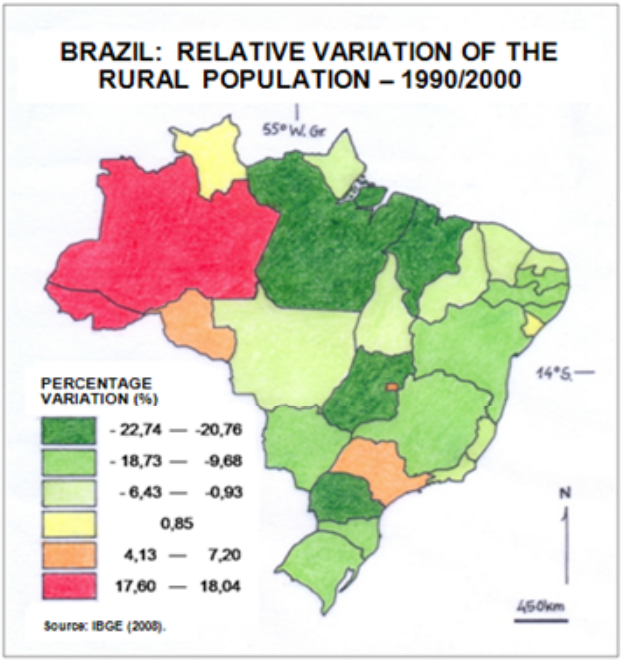

Fig. 12 - Map of the relative variation of the rural population in the period 1990/2000, in which it is evident that the loss of this population occur in almost all states.

advancement is done on the pioneer fronts. The quantitative movements are related to various flows in a given period of time such as capital, migration, tourism, passengers and goods. Other possible themes are communications, internet, maritime and air traffic.

5.1.2.1 Movements quantitative space

A great representative of dynamic maps of movements is the one employed to migration visualization. Consider the map "Brazil: Migration Flows - 1995/2005".

To record such information in a map, the method of flow is the most adequate. The map will show the departure and arrival points, the successive positions of the phenomenon in its displacement in a route, materializing the variability of its intensity and direction. The map constitutes as a set of arrows displayed in accordance with prescribed routes. If the path is not exactly known, it is considered as a curved path with a proper arrangement. The intensity of the phenomenon will be transcribed in the map by an arrow thickness by using a linear scale (Fig. 13).

5.2 Synthesis of dynamic maps

By using synthesis reasoning, one can have an in-depth appreciation of dynamic phenomena. The "types" of evolutions, such as qualitative, ordered, and quantitative, are shown. The quantitative evolutions can be measured in either absolute or relative values. For instance, we can mention the types of changes observed in the areas related to land use and types of population growth. Examples of "types" of movements in space are namely transportation types and migration types. The representations will be resolved with the presentation of ratings.

Similarly as stated before for "static maps", we must remark that the term "dynamic maps" currently means those generated from specific data requested by the user when his/her computer is connected to the internet. These are classified as "read-only", when watched as simple cartographic animation like animated-GIFs[1], with little or no interactivity, and "interface and/or interactive content" such as animations in VRML[2] when the user interacts with them. In addition, the "virtual reality" may be applied as form of three-dimension mapping with GeoVRML[3], providing a high level of player interaction and immersion in an attempt to obtain a representation which is as close to the reality as possible (KRAAK and BROWN,

[1] Animated GIF: animation based on frames.
[2] VRML: Virtual Reality Modeling Language.
[3] GeoVRML: an extension of VRML used to present and visualize geographic data, through a special plug-in for this purpose.

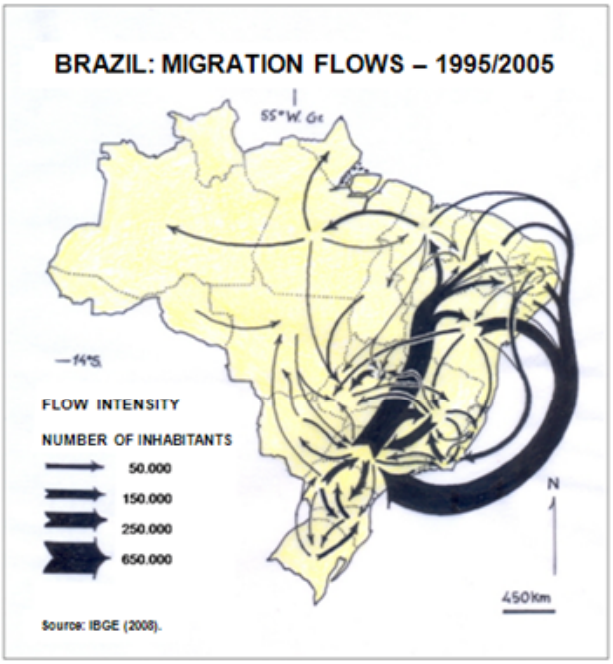

Fig. 13 - Map of Migration Flows for the period 1995/2005 shows arrows with proportional thicknesses, revealing that there are still strong movements between the Northeast and Southeast.

2000; KRAAK , 2001; RAMOS , 2005).

5.2.1 The analytical reasoning to the synthesis

In order to have a clear overview of the process that starts with the analytical reasoning and finishes with the synthesis reasoning, we present an example. This example deals with the map representation of the types of population evolutions in Brazil. To achieve this goal, a quantitative data processing must be performed, which refers to the actual population of the Brazilian states for a longer period related to the censuses that occurred in 1970, 1980, 1990 and 2000. This processing will be done by using evolutionary charts in monolog modules. With this design, one obtains the viewing patterns of evolution in each interval between the dates recorded by the slopes of the lines of the graph. Then, the evolutions are classified by grouping those that are similar and identifying them by colors (Fig. 14).

Each group will be a type of evolution that will be represented on the map **"Brazil: types of population evolution – 1970/2000"** by a color whose meaning is expressed concisely in the legend (Fig 15).

6. CONCLUSIONS

We emphasize that the methodological directions discussed here are undoubtedly required to support any project that pursues the idealization of school geographic atlases, mainly when static and dynamic maps are needed, developed from either analytical or synthesis reasoning. The consistency of such methods not only will confirm the pedagogical role of those constructs in Geography, but also will provide the citizens with a suitable tool to actively participate in the practice of social change. Certainly, the impact of such category of atlases shall be increased by the current process of making available any kind of communication media, whether they are either in print, digital or electronic media, about natural and social spaces, anytime, in any place on Earth.

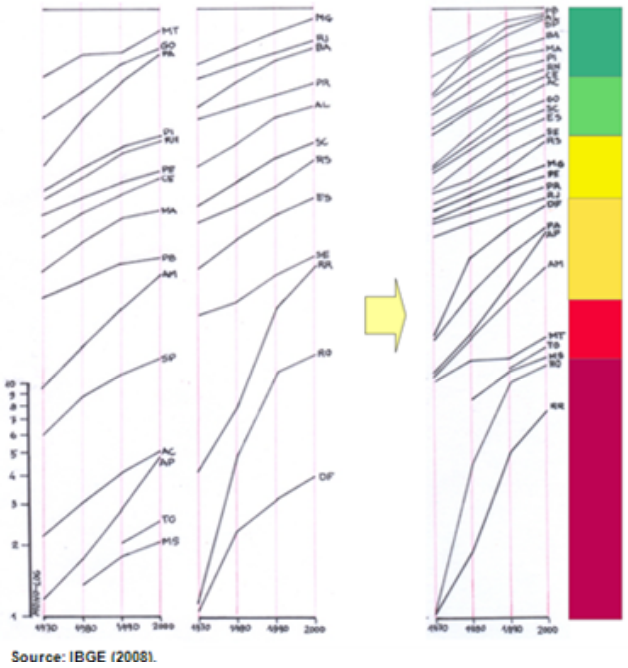

Fig. 14 - Treatment of the population evolutions of the Brazilian states for the period 1970/2000 by evolutionary charts.

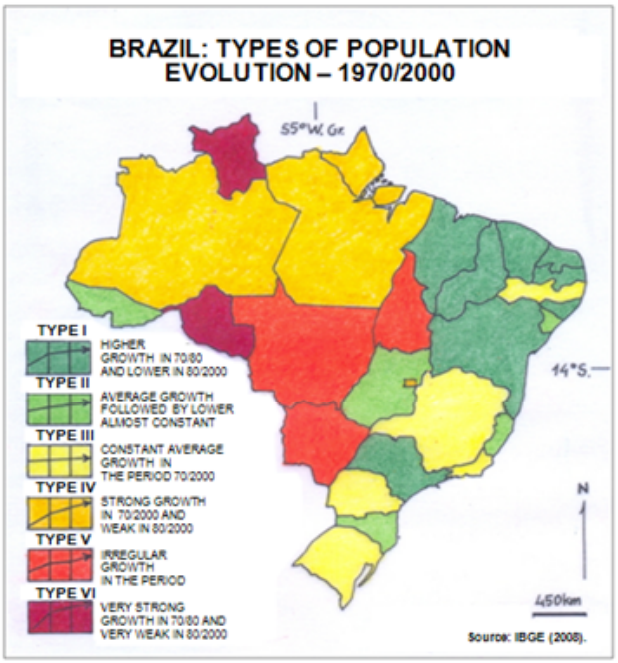

Fig. 15 - Dynamic map based on the synthesis reasoning. It represents the types of evolution of the population in the period 1970/2000 expressed by colors, revealing the contrast between states with almost constant growth and states with stronger growth in the first period and then tends to stabilize.

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