THE COLOR ANALYSIS (VISUAL VARIABLE) IN DIGITAL MAPS: A RESEARCH BASED ON TESTS WITH EIGHTH GRADE ELEMENTARY SCHOOL STUDENTS IN CURITIBA – PARANÁ.

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Abstract. Cartography has made great advances propitiated by technological progress and by theoretical and experimental research. Thus, the techniques are no longer totally analog and became digital, dynamic and interactive. With the advent of new techniques and new tools for spatial representation, users have demanded more, and for those just a simple static and two-dimensional cartographic representation of space was no longer enough. In fact, the analog printed maps no longer attract most users, and an increasing number of WebMaps, multimedia and interactive maps earned place. To represent the geographical space, the use of dynamic environments, where interaction has become essential is now necessary. Thus, Digital Cartography have gained prominence, which is not only the transformation of manual methods into automated processes, but is a medium to explore new ways of representing geographical space, making the development of more dynamic and interactive maps. This research is a literature review and intends to expose some considerations relating to highlight that digital cartography has taken in academia. This paper aims to analyze the research field on the terms Analog and Digital Cartography. This is a literature review based in journals, magazines and scientific articles published in Brazil. In addition to a literature review of concepts and their history within the Brazilian science, as a result of the survey, was obtained a diagnosis of relevance in which these issues were treated at the national level in recent years, presented by products (text and graphical analysis) generated from the survey.

Keywords: Semiology of Graphics, Digital Cartography, Thematic Cartography.

1. Introduction

For a long time, paper was the most used material to create maps, but in this century most of the maps are produced using mapping software and Internet has become the most popular platform to communicate and distribute the mapping information. The maps are displayed on computer screens and mobile phones. (RYSTEDT, 2014).

Among the advances in Cartography, the main research lines are Digital Cartography, Geographic Information Systems, Cartographic Communication and Cartographic Visualization. (RAMOS and GIRARDI, 2002; GIRARDI, 2000 RAMOS, 2003; Queiroz, 2007). The possibility of integrating multiple media benefits cartographic communication, and also opens a number of research possibilities for science.

As highlighted by Ramos (2001), one of the major changes that the introduction of technology brought to Cartographic production process is related to the form of the map conception, since the researches developed in Thematic Cartography are based on reflected light, a subtractive color system, and at the computer screen the color system is based on emitted light (additive color system).

Another cartographic research line that supports this work is Semiology of Graphics (BERTIN, 1967). It is noteworthy that Bertin thought semiology for printed maps, and now the maps are increasingly in digital format.

Other research line that is also addressed here is the Cartographic Visualization, that provides the map reader the possibility to explore information, establish analyzes and that way, obtain new knowledge (SLOCUM; 1999; SLOCUM, 2009; CARTWRIGHT; PETERSON, 1999; PETERSON 1999; MACEACHREN; Taylor, 1994; RobbI, 2000). The reader is an active agent in the construction of representation, not just a simple receiver of the information.

The school uses maps and graphs to study space, so as better this space is represented, as better it will be understood. According to PASSINI (2007) the teaching of Geography and Cartography are inseparable and complementary: one is content and the other is form.

When analyzing the educational materials used by the eighth year of elementary school at Colégio Estadual São Pedro Apóstolo and Escola Estadual Dom Pedro II, both public education institutions located in Curitiba - Paraná, was found that the majority of those maps in didactic materials are chromatic, it means that they employ color as visual variable to represent qualitative aspects.

Therefore, it was decided to focus only on color visual variable through zonal implementation, among other visual variables proposed by Bertin (1967).

With the increasing use of maps in CRT, LCD or LED screens, questions had emerged about the visualization of geographic data in digital media. In that sense, this research assumes that the increase in the number of colors, chromatic proximity, color position on the maps and the influence of chromatic band could hinder the perception of mapped information.
The importance of this researh for Cartography is in the discussion of the principles of color use in maps, regarding to the success or failure of that use. Thus, a larger amount of information is still needed before the mapmaker can use the colors in maps with maximum efficiency. PATTON, J. C .; CRAWFORD, V P. (1978).

2. Objectives

- Evaluate the influence of the amount of hues on perception in digital media by students of the eighth grade of elementary school;
- Evaluate the influence of the chromatic band on the perception of color as visual variable (hue) in digital media by students of the eighth grade of elementary school;
- Evaluate the influence of chromatic distance on the perception of color as visual variable (hue) in digital media by students of the eighth grade of elementary school;
- Analyze the effect of the position of hues in relation to spatial proximity (hue position on map) in digital media by students of the eighth grade of elementary school.

3. Materials and Methods

The students were distributed as follows: 100 in the State School Dom Pedro II and 160 in State College St Peter Apostle. On average, each student answered two questions per quiz, totaling 455 responses.
The monitor brightness and contrast options were reconfigured so that there was no difference between them, that could affect the interpretation of colors by the students. The monitors used by Paraná Digital are the CRT type.
The software used for making the maps was the ArcGIS version 10.1, comerciallized by Environmental Systems Research Institute (ESRI).

Through the HSV color palette, saturation and value variables remained at 100%, and the tests were performed over the hue, that could range between the values 0-360.

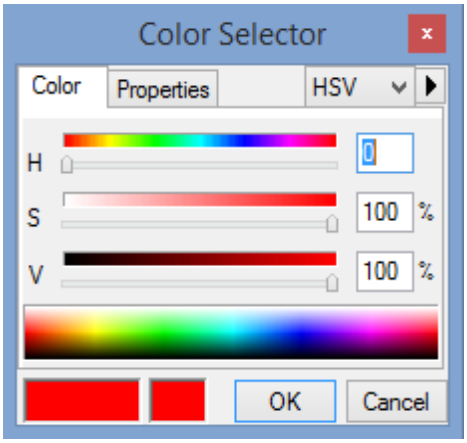
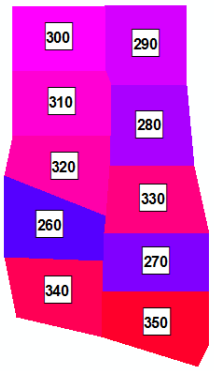
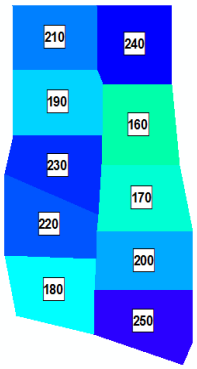


Figure 1- HSV model at ArcGis software.

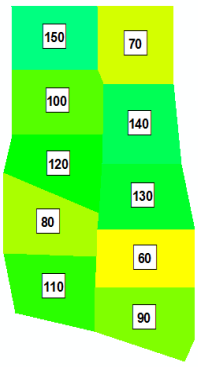
Eight maps were elaborated to survey, maps nominated 1A, 1B, 1C, 2A, 2B, 2C, 3A and 3B. For each map were formulated questions about the amount of themes (represented by colors) present in them.
The maps were combined to make it possible to assess the ability of differentiation and quantification of colors employed.
The first combination aimed to evaluate the influence of chromatic band on the differentiation capacity of color as visual variable in digital media. For this purpose, the maps combined were: 1A, 1B and 1C.
These maps were made with 10 polygons, and chromatic distance of 10 points (HSV model). The map 1A shows variations 260-350, 1B map 160-250 and 1C from 60 to 150.
The question referring to these maps was: This is a map of land use where each color represents a different type of use. How many types of land use can you differentiate?



1A



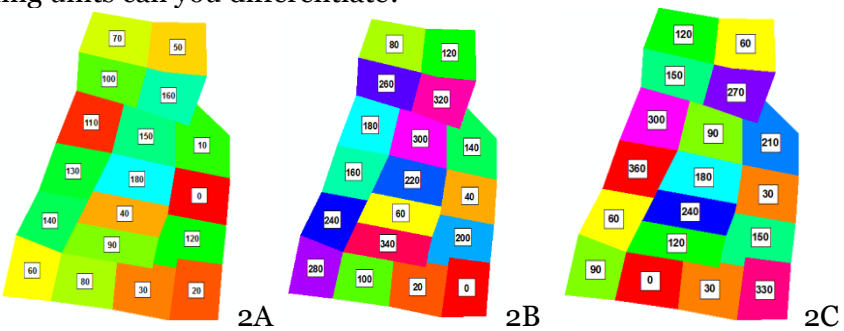
1B



1C

Figure 2- Series of maps 1.

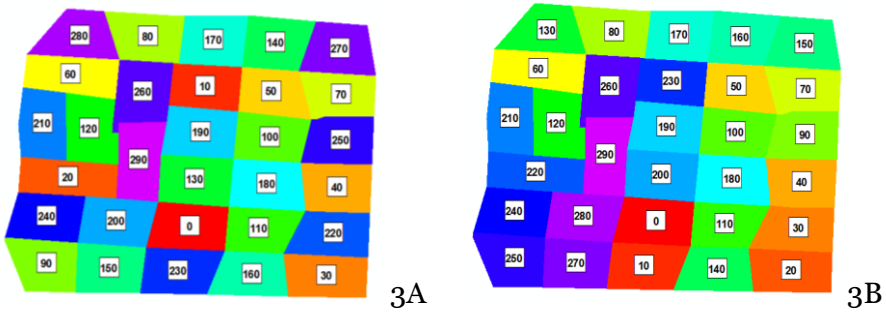
The second combination of maps aimed to evaluate the influence of chromatic distance on the differentiation of color as visual variable in digital media. And for both, the answers given were compared to maps 2A, 2B and 2C.
These maps have 18 color distance polygons 10, 20 and 30 (HSV model), respectively. The map 2A shows changes from 0 to 180, the map 2B 0-340 and 3C from 0 to 360.
The question referring to these maps was: This is a map of planning units where each color represents a different type of unit. How many kinds of planning units can you differentiate?



2A 2B 2C

Figure 3 – Series of maps 2.

The third combination of maps aimed to analyze the effect of the position of hues in relation to spatial proximity (hue location on map) in digital media. Thus, they compared the responses of 3A and 3B maps.
The maps were developed using 30 polygons with chromatic distance of 10 points (HSV model). 3A and 3B show variations maps from 0 to 360.
The question about maps 03A was: This is a map of census tracts where each color represents a different type of industry. How many types of census tract you can differentiate?
The question about 03B maps: This is a map of zoning where each color represents a different kind of planning zone. How many kinds of planning areas you can differentiate?



3A 3B

Figure 4- Series of maps 3.

The fourth combination of maps aimed to evaluate the influence of the amount of hues on the differentiation of color as visual variable in digital media. In this sense, the responses were compared to the total set of maps (1A, 1B, 1C) with the maps 2A and 3A.
So they were compared with 10 maps, 18:30 hues, respectively, all with chromatic distance of 10 points (HSV model).
The only map where there was repetition of hues was the 2C map. Once so that the chromatic distance of 30 points in the HSV model, housed repeating the hues (360/30 = 12 polygons with 12 + 6 hues repeated hues).

4. Conclusion

The research aimed to evaluate the distinction ability and perception of color as visual variable in digital maps by students of the eighth grade of elementary school through four main issues.

The first test showed that the amount of colors (chroma) to be used in digital maps, for students in the eighth grade, is similar to indications for printed maps by Robinson (1995) and Healey (1996).

When testing the influence of chromatic range (HSV model), were showed different responses for the colors distintion in maps for each chromatic range.

The test of chromatic distance influence (HSV model) indicated that the perception decays when using close neighbor colors.

As a final research question, the test of influence of hues position in maps showed that it‘s possible to improve the ability to differentiate colors by students.

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