INTERACTIVE AND ANIMATED MAPS INTERFACE DESIGN FOR A SCHOOL ATLAS

Lígia Manccini de Oliveira Barros
manccini@gmail.com

Mônica Modesta Santos Decanini
monca@fct.unesp.br

UNESP - Universidade Estadual Paulista
Programa de Pós-Graduação em Ciências Cartográficas
Rua Roberto Simonsen, 305, C. Postal 467
CEP 19060-900, Presidente Prudente, SP

Abstract

The cartography can be understood as an information science, in which the communication between the user and the map maker occurs through a map. This communication system is known as *cartographic communication*, which the initial aim was to determine the user response with regard to map design elements to study and improve the map design process. With the increasing of digital technology, the map was transformed in a *user-controlled type of display* that allows more control to the map user, by the adjusting of the map display to their needs and abilities. In the digital environment, the interactive and animated elements of a map interface are used to improve the message, by modifying the user mental structure, in order to facilitate the information recognition and provide more comprehension about geographic space. The *multimedia cartography* can be helpful to achieve educational goals, with the objective to encourage and promote learning, and nowadays it is very used on school atlases. Some cartographic multimedia resources like animation, interactivity and hyperlinks, can help to customize school atlases to the students' interest and experience. Additionally it instigates them to explore the resources and provides strategies to lead users to a correct interpretation of map contents. Thus, an Interactive School Atlas (ISA) prototype was designed and produced in order to guide teachers in cartographic and environmental education, for sixth grader students. This Atlas was developed in two stages: Cartographic Design (user demand analyses, general composition design including the geographic data modeling, graphic and interface design) and Production (geographic database and atlas interface implementation). This paper aims to present the production stage of the ISA development, focusing in the map interface design and its interactive and animated resources. The Atlas implementation was developed in Microsoft Visual Basic v.6.0 and ESRI MapObjects v.2.1. The animation resource used was created with Macromedia Flash Mx 2004 Educational version. Also, the maps were designed with regard to children cognitive development, as well as the visual balance of display for the Atlas interface. The tasks implemented on ISA were arranged in two main menus: the *cartographic education menu* that contains tasks for symbols,

projections, coordinates and scale, and the *environmental education menu*, in which the tasks include Brazil's climate and vegetation maps, Brazil's population maps, synchronized maps of São Paulo State's deforestation and spread of coffee plantation, UGRHI's (Water Resource Management Unit) polluter industries and ratio of population with sewerage system maps. For ISA animation and interactivity it was used the following resources: coordination of point-of-view in the perspective task, fixed zoom for scale resize in the scale task, change of cartographic symbols in the symbology task, toggling, simple data search from database, highlighting, and dynamic variables such as synchronization and frequency for the environmental education tasks. In general, these resources have a medium interactive degree and can help in the comprehension of geographic information, both temporal and non-temporal, once these resources allow an uninterrupted dynamic display of an event. Once the ISA was designed to be applied on sixth grade geographic study, it is recommended the implementation of new tasks with the goal to embrace the other grades of educational stages. Further studies are necessary in order to evaluate this product.

INTRODUCTION

With the increasing of digital technology, the map was transformed in a *user-controlled type of display* that allows more control to the map user, by the adjusting of the map display to their needs and abilities. Castner (1987) points out that simple map making and atlas use have been significant components of geographic education. To teach about maps and make sure that they will be understood by children, it is required to provide opportunities for them to use maps on a highly repetitive and structured basis (Petchenick, 1987). Moreover, it is most needed to pay attention in how the students process, arrange and understand the received information (Winn, 1987). Techniques of multimedia can be helpful to achieve educational goals and, therefore, can represent a major improvement in atlas design, as pointed by Lingaard et. al (2005)

Thus, it was developed an Interactive School Atlas (ISA) prototype that attempts to provide cognitive strategies in order to guide the teachers in cartographic and environmental education 6th grader students. The ISA was developed in two stages, which are: cartographic design (user demand analyses, general composition design, including the geographic data modelling, graphic and interface design) and production (geographic data base and atlas interface implementation). This paper aims to present the map interface design and the interactivity tools and animation resources used in ISA production.

ANIMATION AND INTERACTIVITY

In the digital environment one new aspect is introduced to the basic model of cartographic communication: the user-map feedback (Peterson, 1995). According to Valente (1999) the feedback is a response mechanism, an action cycle where the processes are described and performed. The conceptual improvement obtained with the

feedback cycle, which involves interactive interface elements, stimulates a change in the user mental structure, what facilitates the information acquisition (Valente, 1993; 1999).

The animation is a dynamic process described by some changes in the visualization. These changes are used to detach patterns or relationships that are not clearly seen in a static way (Peterson, 1995). classifies the animation based on the changes in the basic characteristics of spatial information, which are localization, attribute and time. Temporal animation consists in changes of map feature attributes or localization in time, always preserving the temporal scale of the phenomenon (Ramos, 2005; Kraak, 1999). The non-temporal animation describes a data set behavior with no world time reference. It means that the display time and database time are not linked with world time (Kraak & Omerling, 2003). The non-temporal animation can be divided in two kinds: successive build-up animation, when there are changes in data location and attributes, and animation of changing representations, when there are no changes in the data characteristics, just in the form they are presented, such as different graphic or classification perspective (Kraak, 1999; Peterson, 1995)

An interactive map can present several types of interactivity in several complexity levels. According to Crampton (2002), the increase of interaction sophistication depends on the kind of task performed, which are ordered from the low to high level: to analyze, through the interaction with the displayed data; to compare simultaneously two or more presentations; to (re)order and (re)arrange data, by changing the type of classification or another graphic aspects; to extract or omit information, through selection and filtering, respectively; and to indentify causal relationship, through the analysis of data nature (Crampton, 2002). Based on this, Crampton (2002) classifies the interactivity in: data presentation interaction – low level (hillshading, orientation, perspective changing, zooming, resizing, symbols changing etc), spatial dimension interaction – medium level (navigation, flight simulation, toggling, data rearrangement etc), direct data interaction – high level (database queries, brushing, filtering, detaching etc) and interaction context – high level (multiples views, combined visualization levels, juxtaposed windows, linking etc).

The graphic interface design of interactive and animated maps needs to include all factors that influence the software usability and acceptance. The interface elements consists in a set of menus, windows, dialog boxes, icons and graphics related to map interactivity as mouse action over features, simultaneous presentation of maps, use of zoom-in and zoom-out for scale changes and others (Peterson, 1995; Robbi, 2000).

ISA MAP AND INTERFACE DESIGN

The interface describes the interaction user-computer. In a digital map, this interaction is performed through cartographic symbol and type, legend, map layout and other interface elements (menus, windows, dialog box, icons etc) which compose the computational interactive basis (Peterson, 1995). For a better user-software interaction,

the user needs to create a mental model of the interface through the intuitive handling (Paula Filho, 2003). Fekete et al (1995 elaborated by Robbi, 2000) point out that as the user will spend hours using the system, the handling must be comfortable and easy. Thus it must follow a repetitive routine model, in order to turn the use more intuitive, and then, avoid mistakes (Paula Filho, 2003).

To define the routine model and the appearance of ISA, it was needed to set up the graphic interface elements, such as main font type, interface color, global commands and illustrative symbology. The **interface color** were developed based on well-known computer programs as the relationship site www.orkut.com and the talkback software MSN Messenger, very often used by children. The **main font type** settled up was Comic Sans Ms that is easy to read (sans serif typeface), still keeping a childish look. The **global commands** are always visible and enabled ("go to environmental education", "go to cartographic education", "go to homepage" and "exit"). Besides, there are local commands that appear in some windows, like "go to previous page", "go to next page" and "tasks".

The symbols were chosen according its function: interface icons and map symbols. The interface icons are those used in buttons and notifications. It was used the *tombats* family fonts. For the map symbols (pictorial, geometric and alphanumeric), it was adopted the *Wingdings* and *Webdings* font type from windows and also *ESRI* family font type. Moreover, the type design for the maps has taken into account the legibility. It was chosen the Verdana family (not bold, size 12 and lower case), which is a *sans-serif* typeface, described as a simple and legible graphic symbol (Ribeiro, 2003).

The ISA windows were designed using the *Macromedia Flash* with the aim to provide an attractive interface that motivates the children to use the atlas. The animation can be used to give a clue about what kind of action is needed in a particular task. Additionally, the ISA is designed to facilitate learning, for this reason it is necessary to have an interface that encourages the children to use and explore the Atlas. The *Macromedia Flash* files were integrated to *Visual Basic* (VB) through the *shockwave flash* VB tool, which allows open swf files and embedded functions to the flash components. To manipulate *shape* files, was applied the Map component of the MapObjects library on VB.

The maps and texts layouts were designed taking into account the minimum and most popular computer configuration found at Brazilian schools (1 GHz processor, 256MB RAM, 15" to 17" monitors, windows XP). The interface layouts were designed to an 800X600 pixels window in a 15" screen, non-resizing. This specification avoids an inappropriate displacement of the interface elements. It was created three basic layouts, which are presentation layout (A), text layout (B) and map/tasks layout (C). The presentation layout has global buttons, thematic buttons and window title as illustrated in Figure 4.
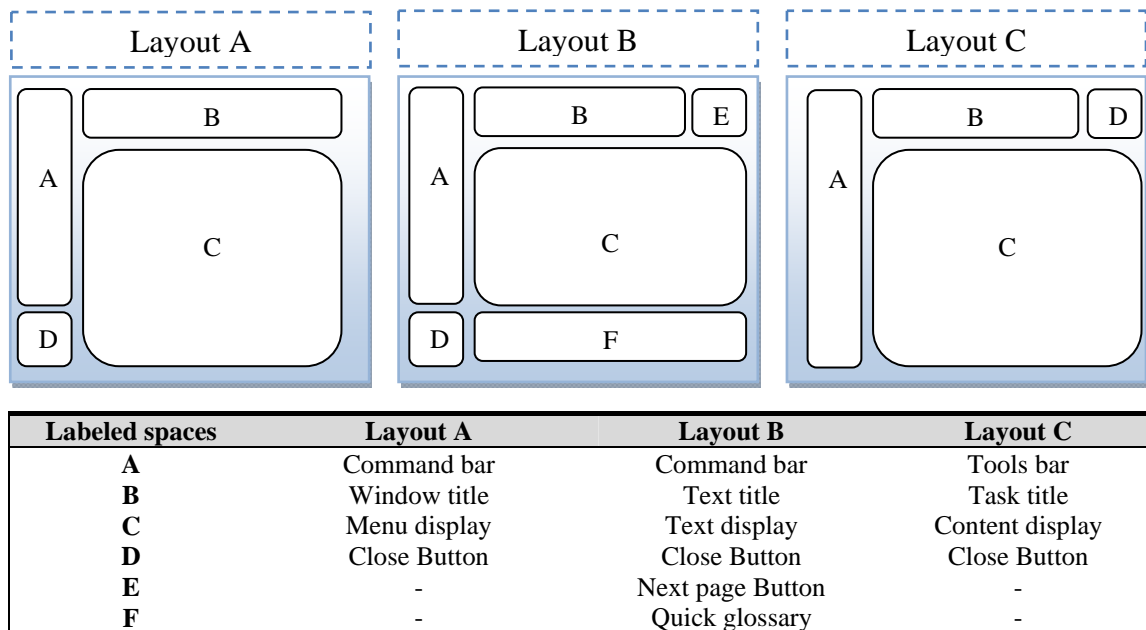
Labeled spaces	Layout A	Layout B	Layout C
A	Command bar	Command bar	Tools bar
B	Window title	Text title	Task title
C	Menu display	Text display	Content display
D	Close Button	Close Button	Close Button
E	-	Next page Button	-
F	-	Quick glossary	-

Figure 4. Layout design

In Layout C, the tools and the content display will vary according the task. The content display can be a map or not, for example, in some cases the subject is a game or an animated strategy to facilitate the learning about some concept. The Figure 5 shows the subjects arrangement for the three Layouts.
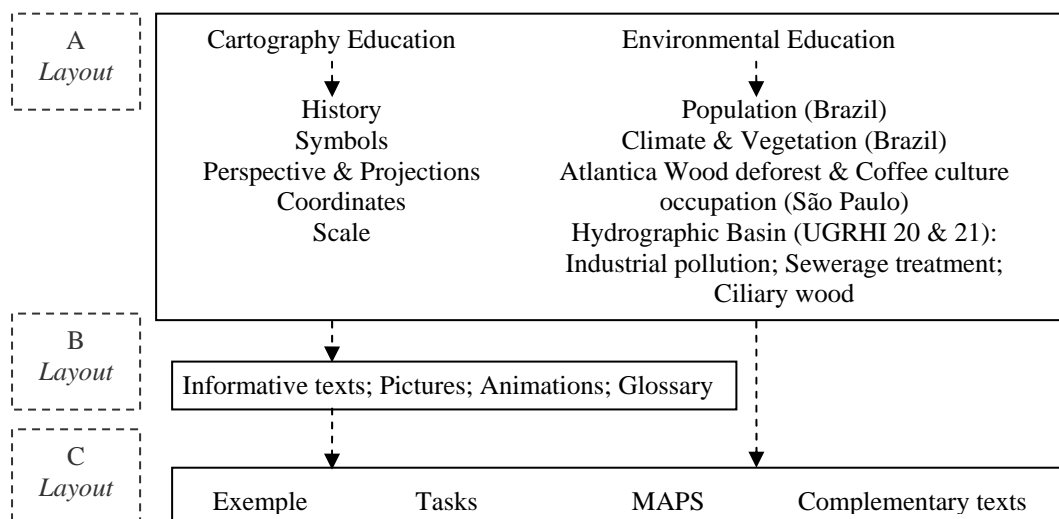

Figure 5. Subjects arrangement schema for ISA

There are two main menus, which are cartographic education menu and environmental education menu. The cartographic education menu items are separated in five lessons and have to be accessed in a serial way. The environmental education menu must be accessed preferentially after the cartographic education menu.

INTERACTIVE AND ANIMATED MAPS

Many data sources were used to produce four types of map that are "view-only" map, interactive static map, animated map and interactive animated map. Each map type was exported as a specific file format. The geographic data was edited with CAD and GIS softwares: *MapInfo*, *AutoDesk Map 5* and *ESRI ArcView GIS 3.2*. For the interface and prototype functions, it was used *Macromedia Flash Mx*, *Corel Draw*, *Microsoft Visual Basic 6.0* and *MapObjects 2.1*. The animated maps were created using *Placewable WMF* files that allow to access separately the picture elements (lines, points, hachure etc). In that way it is possible to select a particular feature of a map and convert it into an animated form. The Flash animation tools consist mainly of buttons and film clip. The buttons are composed by four states (mouse off, mouse over, mouse down and activation area) in which are created animations for the action control. The film clip can be defined as an animation inside the animation that can be controlled by a film control. These animated forms were used on maps of Brazil, Sao Paulo state and UGRHI (Hydrological Resources Management Division). Examples of interactive and animates maps are shown as follow.

Brazil interactive and animated map: population per state from 1970 to 2000

The temporal animation was implemented using the census data from 1970, 1980, 1990 and 2000. This information was mapped using two kinds of symbols: bar and proportional circles (Figure 8) that are displayed separately.
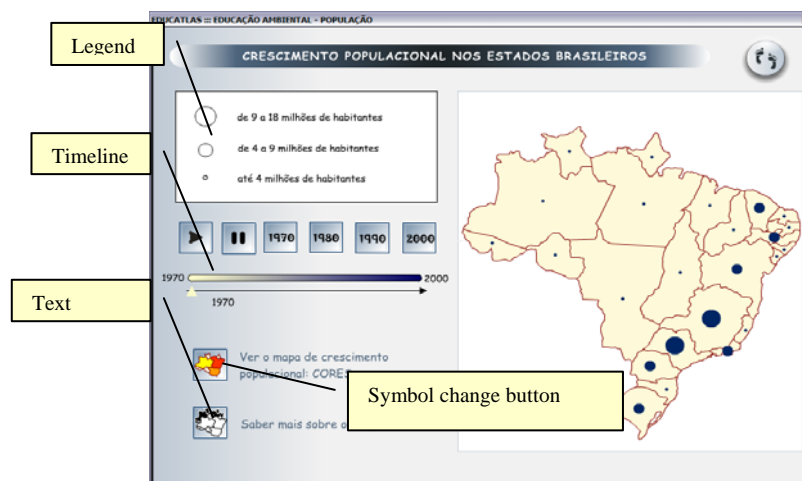

Figure 8. Brazil animated map – population growing from 1970 to 2000

To create a continuous view perception of the population growing in time, it was used the *animation by interpolation* tool of Macromedia Flash. The map can be animated by pressing the play button above the timeline. It's possible to view each static map by clicking on the respective button above timeline. The text button opens a pop-up window with a brief text about the population growing.

Presidente Prudente interactive map: city downtown

The interactive map of Presidente Prudente downtown was created for the symbols task. This task aims to show the importance of the legend for map comprehension. It is presented a map of Presidente Prudente downtown with alphanumeric symbols (Figure 6) that can be replaced by geometric or pictorial ones. The change of symbols is made by clicking in the interactive legend.
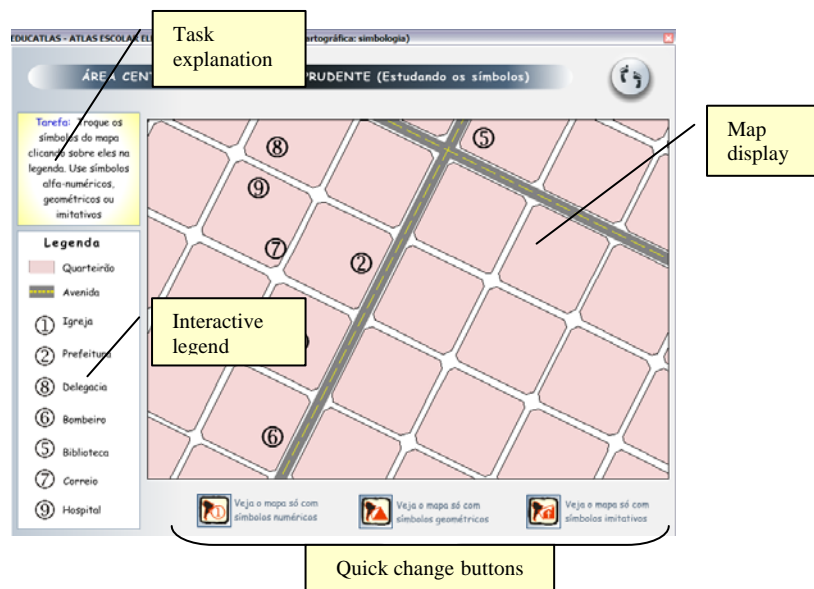

Figure 6. Presidente Prudente interactive map for symbols task.

São Paulo state interactive and animated maps: coffee plantation expansion and deforestation Atlantic forest

The deforestation map was displayed juxtaposed to the coffee plantation expansion map of São Paulo state (Figure 8). The aim is to show the man influence in the environment (causal relationship).

These maps were synchronized according to a timeline from 1886 to 1952, and both are manipulated by the same film control. The play button animates the maps and the year buttons (1886, 1920, 1035 and 1952) allow stop the animation on a particular year. The text buttons show a pop-up window with a brief text about the subject.
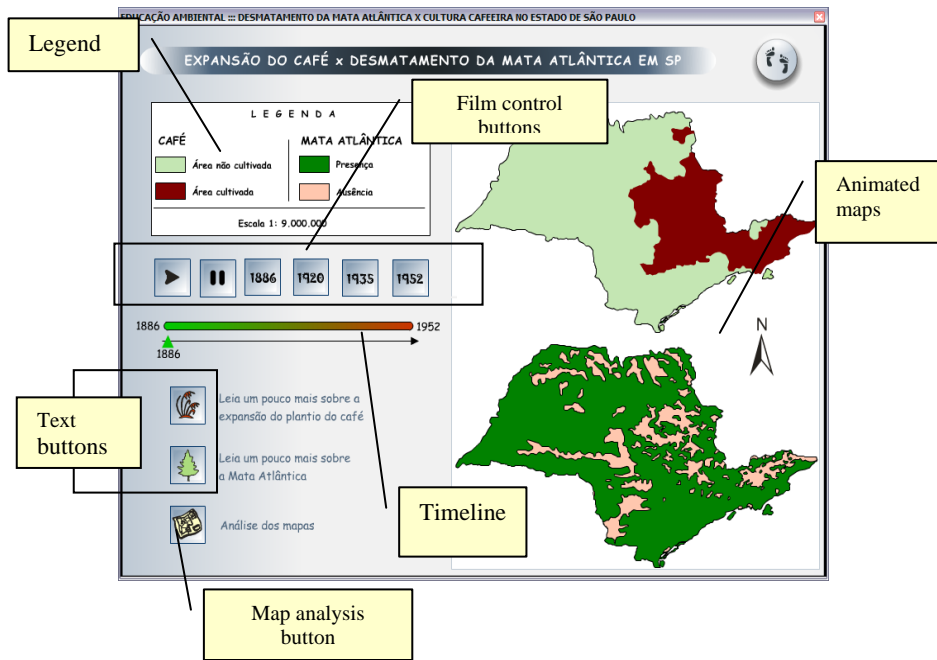
Figure 8. Deforestation and coffe plant expasion maps window

Presidente Prudente interactive map: change of scale

For the scale task was created a set of eight maps, which range from 1:2000 (Presidente Prudente downtown) to 1:40.000.000 (Brazil). They were arranged from the biggest to the smallest scale (Figure 7).
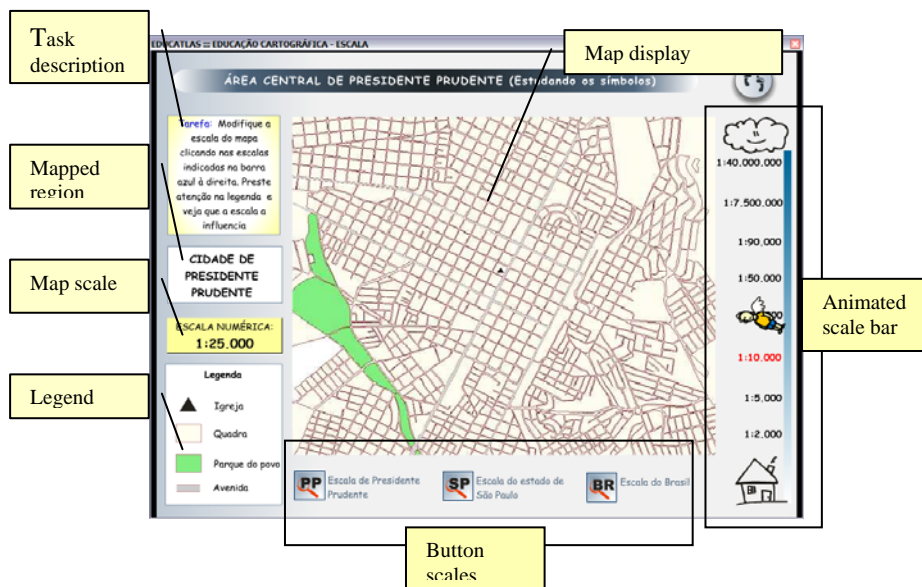

Figure 7: Map scale task

This task has as main objective to show the relation between numerical scale and the region mapped. Also, it aims that the children understand that the larger is the geographical area, less details are shown. This task involves the concept of cartographic generalization. The animated scale bar was created to give the idea of zoom in and zoom out the earth surface, using the animated variable named by Peterson (1995) as "distance changing between observer and scene". It was used the static stepped zooming, in which the map image is replaced by another one when the user request to zoom in or out (Brown, 2001).

CONCLUSIONS

The juxtaposed animated map synchronization was used to facilitate the understanding of causal relation between deforestation and the coffee plant migration in the São Paulo state. Bertin (1983)believes that animation can contribute to the teaching, but some studies about this subject have reached no agreement. For instance, Koussoulakou and Kraak (1992) concluded that in the animated maps the user perceives the spatio-temporal phenomenon more easily than in non-animated maps. In other hand, Slocum and Egbert (1993, cited by Slocum et al, 2001) concluded that there is little difference between the use of maps with and without animation. Therefore, it is necessary a more specific study about how and when the animation can contribute to the learning. If multimedia cartography can help the development of children's cognitive skills regard to the comprehension and handling of geographic space, than a school atlas can possible become a more efficient tool for the geography teaching and learning, since the cognitive development stages are taken into account.

BIBLIOGRAPHY

Bertin, J. (1983). *Sémiologie graphique.* (W. J. Madison, Trans.) the University of Winsconsin Press.

Brown, A. e. (2001, n. 1). Cartographic design and production in the internet era. *The Cartographic Journal , 38*, pp. 61-72.

Cartwright, W., Crampton, J., Cartner, G., Miller, S., Mitchell, K., Siekierska, E., et al. (2000, nº 1). Geospatial information visualization: user interface issues. *Cartography and Geographic Information Science , 28*, pp. 45-60.

Castner, H. W. (1987, n.1, spring). Education through mapping. *Cartographica , 24*, pp. 82 - 100.

Crampton, J. W. (2002, n. 29). Interactive types in geographic visualization. *Cartography and Geographic Information Science , 2*, pp. 85-98.

Dent, B. D. (1993). *Cartography: thematic map design.* Wm C.Brown Communications, Inc.

Fairbain, D., Gennady, A., Natalia, A., Buziek, G., & Dykes, J. (2001, n. 01). Representation and its relationship with cartographic visualization. *Cartography and Geographic Information Science , 28*, pp. 13-29.

Koussoulakou, A., & Kraak, M. J. (1992, December). Spatio-temporal maps and cartographic communication. *The Cartographic Journal , 29*, pp. 101-108.

Kraak, M. J. (1999). Cartography and the use of animation. In W. Cartwright, M. Peterson, & G. Gartner, *Multimedia Cartography* (2ª edição ed., pp. 173-180). Springer.

Kraak, M. J., & Omerling, F. (2003). *Cartography visualization of geospatial data.* Prentice Hall.

Lingaard, G., Brown, A., & Bronsther, A. (2005). Interface design challenges in virtual space. In D. R. Taylor, *Cybercartography: theory and practice.* Oxford: Elsevier.

Paula Filho, W. P. (2003). *Engenharia de sotware.* Rio de Janeiro: LTC.

Petchenick, B. B. (1987, n.1, spring). Fundamental considerations about atlases for children. *Cartographica , 24*, pp. 16-23.

Peterson, M. P. (1995). *Interactive and animated cartography.* New Jersey: Prentice-Hall.

Ramos, C. S. (2005). *Visualização cartográfica e cartografia multimídia.* São Paulo: Editora Unesp.

Ribeiro, M. (2003). *Planejamento visual gráfico* (9 ed.). Brasília: LGE Editora.

Robbi, C. (2000). *Sistema para visualização de informações cartográficas para planejamento urbano.* Tese de Doutorado, INPE, Computação aplicada, São José dos Campos.

Slocum, T. A. (1999). *Themathic cartography and visualization.* New Jersey: Prentice-Hall Inc.

Valente, J. A. (1993). *Computadores e conhecimento.* Campinas: Unicamp - NIED.

Valente, J. A. (1999). *O computador na sociedade do conhecimento.* Campinas: Unicamp - NIED.

Ware, C. (2004). *Information visualization: perception for design* (2ª ed.). San Francisco: Elsevier Inc.

Winn, W. (1987, n.1, spring). The state of Canadian children's Atlases from a European perspective. *Cartographica , 24*, pp. 63-81.