Meaning Construction in Data Visualization

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Abstract:

As a past president of the International Visual Literacy Association, a scholar in visual literacy research, and a professor who has been teaching visual information science since 1999, the author will present her research and teaching experience on the process of meaning construction in data visualization.

Tools, software, and technology have been advancing so rapidly to allow information professionals to process and visualize data in many ways desired. Visualization techniques allow a designer to use visual presentations in such as maps, graphs, visual charts, bars along with visual elements of labels, color, line, contrast, distance, space, fonts, and size to create an appropriate visual representation, a visual hierarchy, and a visual highway through data.

In this digital data age, the users are the center of data visualization to meet their information needs. This research and presentation will address and share with the library and information professionals the importance and process of meaning construction in data visualization. It is a critical study to analyze how meaning is construction in data visualization to provide insights for the information profession in data visualization for design purposes to understand the users better and serve them well in the global digital data age.

Keywords: Meaning, visual literacy, data visualization

In this rich data world, tools, software, and technology have been advancing so rapidly to allow information professionals to process and visualize data in many ways desired. Visualization techniques allow a designer to use visual presentations in maps, graphs, visual charts, bars along with visual elements of labels, color, line, contrast, distance, space, fonts, and size to create an appropriate interactive visual representation, a visual hierarchy, and a visual highway through data. Technology has also made it possible to present/represent/visualize data automatically, interactively, and possibly with artificial intelligence. Data visualization offers a graphic representation of data, but also offers viewers opportunities for interpretations of socially construction meanings of data. This paradigm shift from text information to data visualization calls for attention of research. Visual literacy provides theories and research methods for examination.

Visual literacy "refers to a group of vision competencies a human being can develop by seeing and at the same time having and integrating other sensory experiences. The development of these competencies is fundamental to normal human learning. When developed, they enable a visually literate person to discriminate and interpret the visual actions, objects, and/or symbols, natural or man-made, that (are encountered) in (the) environment. Through the creative use of these competencies, (we are) able to communicate with others. Through the appreciative use of these competencies (we are) able to comprehend and enjoy the masterworks of visual communication." (John Debes, 1969b, 27).
    "Visual literacy is the ability to understand (read) and use (write) images and to think and learn in terms of images." (More, 1994).
    "Visual literacy refers to the learned ability to interpret visual messages accurately and to create such messages. A visually literate person can identify, analyze, interpret, evaluate, and produce excellent visual messages." (More, 1994)

Social Construction of Meaning

In his 1936 essay of *The Work of Art in the Age of Mechanical Reproduction* Walter Benjamin described a phenomena that occurred in the late twentieth century. He stated that the "aura" of an art had been lost because of the mass production of the industrial society. The technology advances has witness the loss further in the digital age. The aura of a cultural product has been lost in cyberspace, computer networks, and digital world. Advances in data visualization have been brought about by the global advances in digital communication networks, instant information accessibility and availability, and new technologies, which have made visual text without boundaries. Text-based information is relatively static and can be described in words most of the time with clarity. For example, an index in the back of the book serves such a purpose to point the reader from the index page to the right page and information that a reader is locating. Data visualization or visualized data become a visual text. A visual text invites readers/viewers to interact with the visual text to construct meaning. Images, data visualization, a visual text is the result of a behavior with intent and it is not neutral. Meanings are socially constructed. The visual text encoding and decoding process explore the relationships between and among subject positions of readers/viewers/users/patrons, text/visual text, and historical moments of viewing and investigates how the visual text positions readers/viewers/users/patrons in the social change and meaning construction. It answers such a question as "What meanings do readers/viewers/users/patrons of different age, gender, ethnicity, social, cultural, political, economic, and other background construct in reaction to the visual text?" The data visualization work is never finished because meaning is socially and constantly being constructed. It becomes a postmodern experience. Seeing/reading/viewing a visual does not

automatically ensure that one will learn from it. Students need to be taught to learn the critical thinking skills toward decoding of visuals. Visual literacy studies educate data scientists to gain learning experiences and skills. Data science world has been confronted and challenged by the constant creation of meaning in data visualization, visual intertextuality, and a spectrum of information seeking behavior and services in the data visualization world.

From Text to Data Visualization

In data visualization when textual information is moving toward visual text form, new definitions are needed for the social construction of meaning.

Author/designer is defined as the creator of a visual text, the visualized data as a visual text.

Text or visual text has two meanings. The first meaning is the physical text or visual text one is working with. Such a text is a communication created by the author/designer, carrying socially and culturally encoded messages which may be understood and interpreted in various ways by readers/users of different communities. The encoded messages can be decoded or interpreted by the members who share the same membership in the same community. The second meaning is consideration of the socially constructed meanings by the reader/user and the community of readers/users as a text or discourse. The data visualization is a visual text. See Intertextuality.

Reading is defined as the process of creating meaning while interacting with a text/visual text. Visual texts, data visualization, contain socially and culturally encoded symbols and signs, which remain dormant until they are received by the reader/user/viewer. It is the reader/user/viewer who creates his/her meaning.

Historical Reading refers to each reading of a text/visual text produces meaning at different historical period of time.

Reader is the defined as the person who interacts with the text or visual text, data visualization.

Community of readers/users/patrons could be a group of people who share similar cultural, social, economic, professional, geographic, and other positions. For example, Community of readers/users who are familiar with the same culture is able to read the text and share with the members from the same community.

Subject has two meanings. The first meaning is that a citizen is subject to the state or law. So he/she is a subject to social forces. Therefore, subjectivity is the product of social relations. The second meaning is subject as of a sentence. It brings out the importance of the language. Since the subject of a sentence determines the implication of the text and it represents the subjectivity of the speaker, people sharing similar subject positions have the potential to agree upon meanings, likewise, their interpretations may be diverse. People are subject to and positioned by the free flow of information periodized in various structures, forms, formats, and mediated by technology. Messages and information transmitted through these modes of information positon and situate the subject differently.

In data visualization, the subject can be the information professional who assists patrons/users or the patrons and users themselves. They are all positioned and situated by the visualized data.

Intertextuality suggests that certain meanings of one text are created only by the existence of related texts (De Vaney, 1987). Brenda Marshall (1992) defines that "intertextuality is precisely a momentary compendium of everything that has come before and is now. Intertextuality calls attention to prior texts in the sense that it acknowledges that no text can have meaning without those prior texts, it is space where 'meanings' intersect" (p. 128).

In data visualization, intertexuality refers to certain meanings or interpretations of one data visualization are created only by the existence of other visualized data as visual texts.

Visual intertexuality suggests that certain meanings of one visual text, i.e., data visualization, are constructed by the availability or accessibility of related visual texts. Meanings are constructed out of a visual text in conjunction with the socially situated viewers. Viewers create meanings when they interact with the visual texts through visual intertexuality. (Ma, 2013)

Encoding means precisely that --selecting the codes which assign meanings to events, placing events in a referential context which attribute meaning to them (fictional codes perform this work too; it is not limited to the codes of "actuality" and naturalism). (Hall, 1973).

In data visualization, encoding refers to the design of data visualization process where meanings are assigned. Encoding means to assign codes and meanings to data visualization.

Decoding is defined as meaning is decoded by the receiver. For a visual text, one needs to be taught and guided to learn how to decode visuals correctly. One aspect of visual literacy is the skill of interpreting and creating meaning from the stimuli that surround them.

In data visualization, decoding is defined as interpretation and meaning construction data visualization.

Codes are syntax patterns that are created by the conventions of production which are repeated daily. The syntax patterns or codes are culturally constructed. They need to be examined for paradigmatic meanings.

In data visualization, such codes are frequently appear in the design process.

For analysis, there are examples to illustrate the theories of visual literacy on the design, interpretation, and meaning construction of data visualization.
The Winners of the World Data Visualization Prize
https://informationisbeautiful.net/2019/winners-of-the-world-data-visualization-prize/
The 25 Best Data Visualizations of 2018
https://visme.co/blog/best-data-visualizations/#AEvJcTTJg16ms5Tm.99
(Accessed on July 21, 2019).

Conclusions

Data visualization invites data scientists, LIS educators, researchers, information professionals, LIS students, and users/viewers to consider visual literacy as a mandatory training to understand, design, and interpret visualized data in meaningful ways. Teaching and researching the encoding and decoding process, social construction of meaning, research methodologies to study visual literacy require timely attention and effort by the data science field. Will artificial intelligence will be appropriated for data visualization? Will artificial intelligence provide social meaning construction data visualization information across the globe to meet needs of the mankind in this world?

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