Visualization as a Knowledge Transfer

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INTRODUCTION

There is growing significance of both visual literacy and knowledge of visualization, where visualization means communication of data, information, and knowledge with graphical representations. Knowledge visualization has become a cross-disciplinary, interactive culture and the element of the utmost importance in science education because of a need to convey the information to students about advances in technologies. Possibly, visualization is the best way of learning, teaching, or sharing the data, information, and knowledge because it amplifies cognition, outperforms text-based sources, and increases our ability to think and communicate. For all these reasons visualization ability should be introduced and trained since kindergarten.

This text presents selected concepts, methods, and tools related to visualization of data, information, and knowledge. It presents some approaches to the concept of visualization and the ways it mediates between the user and the physical world. It overviews visualization tools and applications, and discusses the importance of visualization methods for the current educational strategies.

BACKGROUND

Information is usually presented in numerical, graphic, or diagrammatic form; it may be shown as a sketch, drawing, diagram, plan, outline, image, geometric relationship, map, music and dance notation, object, interactive installation, or a story. Diagrams visualize information in a pictorial yet abstract (rather than illustrative) way: as plots, line-graphs and charts, or the engineers or architects' blueprints. Complicated presentations of data organization and interpretation, for example governmental statistics are easier to comprehend in a graphic than in a numerical form, when they serve as explanatory tools for the data sets. Thus, visualizations change numerical data into graphs, clouds (Chen, 2010), tree visualizations (Shneiderman, 2014; Lima, 2014), network data, time-based, interactive, metaphorical visualization designs, and other formats.

Visualization means the communication of information with graphical representations. At the present time, visualization means using the computer, which transforms data into information, and then visualization converts information into picture forms. Graphic images and symbols convey and express the meaning of abstract data, which lets us comprehend data and make discoveries, decisions, or explanations about patterns or individual items (Shneiderman, 1996). Thus communication through visualization is at the same time pictorial and linguistic. It is socially and culturally conditioned, based on familiar linguistic patterns, as in a 'pie chart' metaphor for market shares, or a 'starry night' metaphor showing data in 3D (Bertschi & Bubenhofer, 2005).

Cognitive way of learning and teaching may involve cooperation with specialists in several disciplines. Computer scientists and artists apply visual way of presentation while working, for example with mathematicians, anthropologists, designers, and architects to conduct computer analysis of facades and architectural details. Professionals performing scientific presentations and researchers in fields of natural sciences, medicine, pharmacology, biology, geology, or chemistry examine and visualize symmetry and patterns in natural and human-made structures. Many artists

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have created masterpieces this way. Visualization serves as an efficient tool that assists practitioners creating communication media-art, installations, animated video or film, architectural projects, designing newspapers and magazines, or working on website design. Users apply visualizations to understand how data analyses and queries relate to each other. From simple charts and data graphics to 3D multi-user virtual reality environments happening in real time with human interaction possible, visualizations let us fly around the organized data, comprehend, and make decisions (Chen, 2010, 2011). Structural modeling of the relationships may involve the use of graphs, trees, or cones; detecting proximity and connectivity; clustering and classification using word search; multi-dimensional-scaling; network analysis; glyphs (single graphical units portraying many variables by adapting their properties) on charts and graphs; virtual structures; applying complex network theory, and network representations (Chen, 2010).

Visualization enhances communication through information display with the use of letters, numerals, art, graphic design, visual storytelling, signs, symbols, and application software. Drawing basic shapes like squares, triangles, and circles connected by lines and arrows, and then inserting simple drawings inside of these shapes creates visualization of our concepts. Graphs, diagrams, or animations can visualize messages as well. Examples of the non-visual creations are multimodal interactive data presentations, sonifications, and haptic/touch interfaces, for example pressure sensitive interfaces. Visualization has also been considered a semiotic process because of the use of signs to present ideas.

There is a wide range of visualization techniques, still growing along with the developments in computing and information technology. Visualizations help explore and understand complex data, communicate, and navigate on the web. Visualization industry uses software and programming solutions, along with the great amount of the cultural, historical, and architectural research. Examples may include a study on the Napoleon's campaign (Tufte, 1983,1992) or a Periodic Table of Visualization Methods (Lengler, & Eppler, 2008). Time-based, 3D, and augmented reality applications serve for the military, intelligence, aviation and air traffic control, medical education, and other purposes.

Metaphorical Language of Visualization

Visual metaphors make a basic structure in visualization because they describe relations among data, organize information in a meaningful way, and combine creative imagery with the analytic rationality of conceptual diagrams. A metaphor indicates one thing as representing another, difficult one, thus making mental models and comparisons. Instead of developing a nomenclature specific for computing, we apply metaphors – names of familiar items and actions for organizing computing-related items and activities: we open a new window or a file with a mouse, put them in a folder, we cut, copy, and paste, place icons on a desktop, use tools and search engines, canvas, mailbox, documents, in-and-out boxes, and a web portal. The desktop metaphor is now fading because cell phones and tablets are replacing PCs as the main gateway to the Internet. We may use graphics or show virtual environments, often shaped by artist's fantasy; the success and quality of any visualization depend on imagination, the retrieval of necessary data, the choice of a metaphor, and the delivery method: whether to apply animation, interconnection, or interaction. Visual metaphors can either be natural objects or phenomena (e. g., mountains, tornados) or artificial, man-made objects (e. g., a bridge, a temple), activities (climbing), or concepts (war, family). Metaphors organize, structure information, and convey an insight through characteristics or associations. Metaphors may convey topics such as theological events or encyclopedias' tables of contents, and serve as classification systems (Lima, 2011).