

# Chapter 13

## Visualization in Learning: Perception, Aesthetics, and Pragmatism

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### ABSTRACT

*Visualization is currently used as a data analysis tool and considered a way of communicating knowledge and ideas in many areas of life such as science, education, medicine, marketing, and advertisement. The chapter contains complex interdisciplinary material and attempts to construct a general framework of visualization roles in learning. The structure of this content is presented on Figure 1 as a kind of mind map. Authors emphasize that visualization mechanisms are designed taking into account analytical and content-related potential, timeliness, online availability, and aesthetics. But classical (tabular) forms still remain dominant in information presentation. A good portion of the discussion is dedicated to the alternative solution – non-linear layout, such as network or fractals. Several visualization maps with specifically designed architecture are demonstrated as important elements of contemporary education. Authors consider the potential and implementation of these tools in e-learning platforms. Parallely, they underline the role of interdisciplinary collaboration in map making processes. Researchers in different fields can apply contemporary trends in visualization including natural shape perception, 3D representation problems, as well as the aspects of neuroaesthetics.*

### INTRODUCTION

Visualization methods are currently used for scientific and scholarly presentations and considered the communication tools in interactive web applications. On the other hand, we must take into

consideration an increasing role of mobile technology in communication processes. Visualization methods in education are still underestimated. In most cases numerical data are presented in a tabular form or by two-dimensional graphs and charts. An extended gap has appeared, between

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classic forms of information presentation and the users (students) who utilize new technologies with a particular emphasis on mobile devices. It could be observed during e-learning processes where an emotional component provided by the direct communication is lost. Introducing special graphic modules strictly related to new achievements in cognitive science should fill this gap.

Usability of visualization mechanisms depends on several factors, namely their analytical and content-related potential, timeliness, online availability and, of course aesthetics. Many information visualization (Infovis) projects available on the Web meet these criteria. They provide their users with instant feedback and data manipulation options and offer social collaboration in visual analysis. Virtual exhibition Places & Spaces<sup>1</sup> is an interdisciplinary portal for researchers concerned in scientific domain mapping and human activity across global history. The visual explorer IBM ManyEyes<sup>2</sup> allows the users to visualize their own raw data and finally share results and interpretations.

In this chapter, the authors try to show that data visualization techniques are being more and more widely applied in the education process. Being not only simple forms of visualization, but also colorful and often interactive maps, they become a perfect teaching tool in the education process. Visualization is not just a methodology that originates from computer graphics and data analysis and is applied in many areas of life (science, education, medicine, marketing, etc.), but it is also an effective and popular way of communicating knowledge and man's ideas. Thus, visualization is becoming more and more important for today's users – students – readers – consumers. This chapter contains complex interdisciplinary material and attempts to construct a general framework of the role of visualization in learning. This diversity of content requires a special (non-linear) form of representation. Instead of a classical table of content, the conceptual map with graphical explanations is included in

Figure 1. The map shows the issues discussed in the chapter and the history of their origin – first that in the authors' brain and then on paper. The sequence, mutual connections, and similarity between specific issues are presented by arrows or close location. Based on visualization study, the various aspects of perception of information structure are discussed, as well as science maps and visual elements used in education. Special attention is given to the creation of new qualities of knowledge structures, and dynamic processes in the *space of the mind* (Duch 1998).

Image perception is here discussed from the user's point of view, including both ergonomics of placed information resources and the aesthetic structure of presented images. In recent years many works on that subject have appeared and a rich collection of results from scientific experiments is already available.

Fractal structures are exceptionally intuitive in perception and reception because they originate from (or resemble) nature. This explains why fractal-like visualizations are perceived better. Visual communication messages should be constructed by following such patterns. This neuroscience-based issue has been solved in nature by fractal structures that are easy to compute in iterative way and reflecting the structural complexity in the form of aesthetic communication. Discussion focuses on visualization methods as a tool for building a bridge between natural perception and educational materials construction. This matter is currently used in scholar presentations and considered to be communication tools in interactive web applications.

## BACKGROUND

### Visualization as a Map

The term 'map' is usually associated with cartography and those are the first maps that we come to know. They describe the world at a two-

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