Chapter 1
Teaching and Learning Science as a Visual Experience

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ABSTRACT
This chapter brings about concepts about implementing a framework for teaching and learning across the disciplines by introducing topics and activities pertaining to science, computing, and graphic arts as a unified cognitive and visual learning experience. First, theoretical framework is presented, to support designing integrative projects for cognitive learning. This part provides basic information about brain and mind, feelings and emotions, cognitive thinking, intelligence and cognitive styles, along with some basics about technologies used for studying cognitive activity. Then follows short introduction to ways to communicate knowledge, visual thinking, visual literacy, and knowledge visualization concepts and methods. Next, concerns about science education draw attention to a need of including into curriculum new developments in science and information about currently emerging disciplines. The goal is to enhance technological literacy of students, activate their interest, motivation, abstract thinking, and elicit a wish to achieve their aims.

INTRODUCTION
The ways of cognitive thinking and learning are changing along with the advancements in instructional technologies, but the notions of creativity, talent, problem solving, aesthetics, and beauty retain their value. Education is often perceived less valued now, when ready solutions are available online, countless students are learning using YouTube, and we may observe the lowering interest in studying at the universities. However, due to the access to information people untrained for example in musicology, computer science, or mechanical engineering may work and produce collectively. Materials and learning projects encourage the use of senses and enhance a feeling of trust in one’s own abilities while creating visual solutions.

Advances in technologies provide science education with tools for applying knowledge visualization and enhancing visual literacy. The developments in new materials, the resulting developments in

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ubiquitous computing, wearable apps, and the use of new materials in architecture and design, all offer captivating educational implications and possibilities. Projects combining science, technology, and art offer a response to the economical and social demands for the arts-based development training, which became used in corporations. The art theorist and perceptual psychologist Rudolf Arnheim posed that some of the objectives attributed to art are means of making visual thinking possible (Arnheim, 1969/2004, p. 254). Visual approach to learning facilitates the comprehending of the core concepts in programming for art, web, and everyday applications. There is a trend to include the arts in business supporting teambuilding, communication, and leadership. Tools for enhancing visual literacy and thus supporting learning about science may comprise toys, games, puzzle, apps, models (often involving 3D printing), animations, simulations (automatic pilot, control tower), and augmented reality environments, among other solutions.

THE FRAMEWORK

Brain, Mind, and Cognition

The process of learning depends on our attempts made by a conscious and curious mind, which has nonphysical nature hinging on the functioning and physiology of a brain. The brain makes a mind using neurons, which are the specialized cells, the basic brain structures for their activity. Neurons, mostly located in the central nervous system send signals to other neurons, muscles, different cells, and the outside world. Signals going outside and toward the brain are transmitted and transformed through synapses, the specialized areas at the ends of the neuronal extensions called axons. There are more than 100 billions of individual nerve cells (Kandel & Schwartz, 2012) and trillions of the synaptic contacts in the brain (Damasio, 2012). Large neural networks act as neural circuits consisting of smaller circuits. Patterns of the large networks’ activity change briefly according to signals going from the body, the external world, and from the patterns of other circuits in the brain. Our environmental space may mean different things for different people (Figure 1). It can be pragmatic (related to where we live), perceptual (showing what we experience), existential (introducing social and cultural issues), cognitive, (based on thinking), and logical (abstract) space.

As a neuroscientist and psychologist David Marr put it, the mind has access to systems of internal representations: “mental states are characterized by asserting what the internal representations currently specify, and mental processes by how such internal representations are obtained and how they interact” (Marr, 1982/2010, p. 6). The brain forms maps, which are concrete or abstract images (visual, auditory, visceral, tactile, etc.) that represent patterns resulting from objects and events. Cognitive mapping means mental transformations, to arrange information in everyday spatial environment. This is not a map but a metaphor, a process rather than product, by making routes, network and metrical descriptions of relative positions. They may become subject of conscious experience (Cavanna & Nanni, 2014). Imagery is the image-making function of the mind. Maps can reflect the physiological condition of the body tissues and organs (interoceptive maps that provide feelings such as pain, hunger, temperature, itch, or visceral sensation; Craig, 2003), state of the organism’s skeletal muscles, tendons, and joints (proprioceptive maps) and the environment external to the organism detected by senses (exteroceptive maps). As for external signals, our perception relies on imagery, which makes that sensations (sounds, shapes, colors and motions) convey meaning. For example, the rustle of leaves means danger for a small animal (Brody,