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Perceptions of Knowledge Visualization

Explaining Concepts through Meaningful Images

Part of the Advances in Multimedia and Interactive Technologies Series

Anna Ursyn

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Perceptions of Knowledge Visualization:

Explaining Concepts through Meaningful Images

Anna Ursyn
University of Northern Colorado, USA

A volume in the Advances in Multimedia and Interactive Technologies (AMIT) Book Series

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Foreword

I attended a visualization conference some twenty years ago, with little idea of what I was doing there. I am a painter, and I use computer graphics. I must have been looking for connections, but this was a new field to me. I was aware of special effects in movies, and I knew that animators favoured ants because they were easy to render, but like most people, I took information displays for granted—traffic warnings, air traffic charts, weather systems. I did not think of these as being designed, but I could tell they had become "computerised."

Here we were, all gathered together: statisticians, academics, ecologists, physicists, chemists, medics, software engineers, artists; with presentations by librarians, armourers, car designers, market analysts. The visuals were eerily beautiful, rolling and rotating 3D meshes like models of galaxies or neurons in the brain. My attention wandered away from what they were supposed to communicate—the librarian needed to know how many readers borrowed simultaneously both Jane Austen and Hemingway. I was looking at them with delight, like a collector of gorgeous medieval maps who does not care whether they represented something real or imaginary. Then I was alerted to cases where it would be life or death: interactive 3D modelling let medical students explore the interior of the heart. Leonardo—anatomist, inventor, engineer—had made detailed drawings of those same ventricles some five hundred years before.

The past twenty years have seen some amazing science and art projects, wonderful art exhibitions in science museums, but it would be a mistake to blur the distinctions. Information design needs to be objective, clean, and articulate. It has to be tested. A "graphic," such as a desktop icon, logo, or a stop sign, has a job to do. An ambiguous message is no use. Recognition must be instant. An art piece can be vague and linger in the imagination. It may not "represent" anything, but some diagrams—information stripped down to the essentials—have the look of abstract art. The most often-cited visualization masterpiece must be Harry Beck's 1931 London Underground map, itself derived from electrical circuits. It was an inspired invention, seized on by commuters the moment it was tried out in 1933—despite it misrepresenting the actual positions of the subway lines. Mondrian, a London resident in the early forties, took up the theme in the late Boogie-Woogie paintings.

I should here mention something obvious. When stuck with a difficulty, such as being lost in a city, and then realising where we are, we naturally say, "I see." Seeing is synonymous with being aware, realising, recognizing. We draw maps in the sand, plumbing diagrams on envelopes. What we want is information we can act on. Apart from the occasional aesthete, we do not need to savour the image itself. More and more we just look, click, and go.

Sometime in the eighties, I began to draw on the computer. The flickering screen was more like a diagram than "art." I could get a fuzzy "print-out," but it was nowhere near as detailed and smooth as a photograph. You could play with shapes and colours. You could spin them about and rearrange them at will. I knew how squares and circles came to be "generated" by inputting simple directions. Therefore, I am of the generation who can think of putting information into the processor to get an image. Today, we take the information out. Compared with today's laptops, those computers were primitive, slow, bulky. It was a bit of a struggle. We did not have Facebook or Wikipedia. I now use a Cintiq, which means I draw directly on the screen, but one advantage back then was that you sensed the affinity with the logic of the program. You knew how to build forms in the right and simplest manner. I recall walking through a park after a session and looking at the trees and seeing the branching command—go up, divide in two, repeat. Computing gave you this after-image, this glimpse of nature's systems. In fact, representations of the tree were the default 3D modelling demos, and my observation was something of a cliché, but here and there a theoretical conundrum has been resolved in a moment of pattern recognition. One such event took place in 1951 at Kings College, London: Rosalind Franklin looked at a foggy X-ray slide and identified the double helix of DNA. Once "seen," the problem was solved.

Can we expect an interchange between researchers in labs, information modellers and artists, now that they all use Photoshop? Could we find these connections within the field of abstract art? I have long been an abstract artist—not exclusively. I admire Paul Klee's "Thinking Eye" method of improvising, of "taking a line for a walk." In the thirties, anthologies of modern art included photos of bacteria, but we should be wary of the term "abstract" because it implies the artist is attempting to represent something immaterial and distant, to "visualize" an idea perhaps, something less tangible than a bowl of fruit. This is not necessarily the case.

Traditionally, artists have always begun their studies with drawing. You can get an idea of how teaching methods have evolved over the past hundred years by looking at drawing manuals. Here you find, in embryonic form, some of the concepts that inform today's computer-aided visuals. It is doubly interesting, because much of the explaining is done with drawn illustrations – drawings of hands holding the pencil the correct way, vertiginous lines heading to the vanishing points of perspective. In other words, visualizations of how to visualize. There were fierce arguments about whether children should be disciplined or allowed to express themselves freely, and whether it really was possible to draw what was in front of you without first understanding a good deal about it. Before you drew the chair, you might need to know perspective. Before you drew the model sitting in it you might need to know how the skeleton and muscles fit together. Others argued that this was beside the point: all you needed to do was to look and see what was there, but they did agree on one principle: the trick was not so much in learning to draw as in learning to see.

Today teachers tend to encourage the student's individual creativity, rather than strive for uniformity and accuracy. Drawing, generally, is not seen as an examination subject – except in China. Ideas about drawing, about what else drawing might be, how it might include video and performance for example, are in flux. The precision drawing necessary in aeronautics and architectural fly-throughs is necessarily computer strict. Educators are left speculating how drawing should be taught. Forget about pencil and paper, the still life and the posed model. Have the cameraphone and iPad finger-painting taken their place? Have smart phones made us smarter? Because we speed dial and know all the icons? Whatever the answer, if we want to work in this field—as artists or as information designers—we should probably still be able to draw a table. That would not have been much of an attainment a hundred years ago. Art students then had to copy geometric figures pinned to the classroom wall, copy approved drawings by the masters, draw simple still life objects in correct perspective. They would study plants and animals. They would learn to draw from memory. There are samples of students' memory drawings—bell-towers, fire engines, clocks—whose virtuosity would stun today's tutors, but that previous generation would probably be as shocked by what we can draw with our gadgets.

It would be impossible to provide a comprehensive how to draw book today with the scope of those publications. "Nature" meant botany, animal studies, and landscape scenery. Much of what we know of our universe—from the very small to the very large—we know second or third hand through TV documentaries. Direct observation is not an option.

I recall another lucky encounter at a conference. This time an astronomy conference. I just gasp in awe when I look at a Hubble photo of a tiny fraction of the night sky, clouds of luminous gas, millions of galaxies. I assume I am looking at a photo, where what is "out there" more or less corresponds with what I am looking at. Not so. I am looking at a sophisticated simulation, a visualization. The data for these images is processed and edited; the colour is cosmetic. Asked what would I see were I suspended amidst these unimaginably distant galaxies, my astronomer colleague looked perplexed. Do not take these literally. It would be like looking at a paper map of the Atlantic Ocean and thinking that was the same as the miles of turbulent sea. It is just a way of representing something unknowable, massaged until it looks like something familiar.

Therefore, I would sidestep these questions of whether we need to draw, whether we have become so much better than previous generations at understanding the world around us, better at making serviceable information boards, and better at making art works that embrace the insights of science. For the most part, I am skeptical about progress and technology, but I feel we should do all we can to follow our curiosity and see where it leads. I like the ambition of this remarkable book, and following some of its hints, we can afford a little humility as a species. Yes, we navigate with GPS, we Skype, we shop on the Web, but what of the birds that migrate across continents? Do we dismiss that as blind instinct, or do we respect it as visual thinking? I was intrigued to learn that experiments have shown that pigeons—which do not migrate—have differentiated vision, in that they navigate with the left eye and find food to peck with the right eye. Pigeons "were found to be at least as good as humans at memorising and categorising visual images. At the time, this seemed bizarre because pigeons appeared to be so inept at other tests, but when it was later realised that pigeons rely on visual maps to navigate… it made perfect sense" (Birkhead, 2012, p. 184).

James Faure-Walker
University of the Arts, UK

James Faure-Walker *(born London 1948, St Martin's 1966-70, RCA 1970-72) has been incorporating computer graphics in his painting since 1988. In 1998, he won the "Golden Plotter" at Computerkunst, Gladbeck, Germany. He was one of five English artists commissioned to produce a print for the 2010 South African World Cup. He has eleven works in the collection of the Victoria and Albert Museum, and his work was featured in "Digital Pioneers" there. One-person exhibitions include Galerie Wolf Lieser, Berlin (2003); Galerie der Gegenwart, Wiesbaden, Germany (2000, 2001); Colville Place Gallery, London (1998, 2000); the Whitworth, Manchester (1985). Group exhibitions include "Imaging by Numbers," Block Museum, Illinois, USA (2008); Siggraph, USA (eight times 1995 -2007); John Moores, Liverpool (1982, 2002); DAM Gallery (2003, 2005, 2009), Bloomberg Space, London (2005); Digital Salon, New York (2001); Serpentine Summer Show (1982); Hayward Annual, London (1979). He co-founded Artscribe magazine in 1976, and edited it for eight years. His writings have appeared in Studio International, Modern Painters, Mute, Computer Generated Imaging, Wired, Garageland, and catalogues for the Tate (Patrick Heron), Barbican, Computerkunst, Siggraph. His 2006 book, Painting the Digital River: How an Artist Learned to Love the Computer, Prentice Hall (USA) won a New England Book Award. In 2013, he won the Royal Watercolour Society Award. He is Reader in Painting and the Computer at CCW Graduate School, Chelsea, University of the Arts.*

REFERENCE

Birkhead, T. (2012). *Bird sense: What it's like to be a bird*. London: Bloomsbury. ISBN 978408820131

Preface

A SUMMARY

The focal premise of this book is a conviction that multisensory perception is becoming an important factor in shaping the current lifestyle, technology, and reasoning. This is because a growing number of biologically inspired technological solutions are based on our knowledge about living organisms that communicate in ways not resembling the traits of human senses. This is also because social communication is becoming multisensory, interactive, interdisciplinary, and technology-augmented. Researchers are often solving problems according to social behaviors and the heuristic ways the social societies of insects, fish, or birds solve their difficult situations.

With projects involving readers' cooperation, this book discusses background material that might be useful for computational solutions for knowledge, art, and entertainment. The book offers a discussion of issues related to visualization of scientific concepts, picturing processes and products, as well as the role of computing in advancing visual literacy skills.

The topics introduced above are spread between the two books titled: *Perceptions of Knowledge Visualization: Explaining Concepts through Meaningful Images* and *Computational Solutions for Knowledge, Art, and Entertainment: Information Exchange beyond Text.*

NEEDS AND ISSUES THAT AMOUNTED TO SHAPE THIS BOOK

Multisensory Perception of Science and Physical Manifestations

This book emphasizes a need for increasing interest in multisensory, especially visual, ways of thinking and presenting knowledge. Computer scientists, cognitive scientists, science, and technology-oriented professionals are often communicating this need. The world is enthralled by the multisensory solutions because interactive application software such as apps, installations, and multimedia presentations are pervasive in technology, education, and everyday life. Computer scientists, engineers, and technology experts see and acknowledge the power existing beyond visual explanations with comparative power. However, many are not ready to approach this subject in practical terms. Other people take an attitude that an active approach toward visual thinking and presentation of scientific and computational concepts may be marginally interesting to computer scientists or cognitive scientists. The goal of the book is to connect theory with practice, processes with products, and to give the reader an active, engaging experience, which would enhance perception of the role of computer graphics.

Suggestions on How to Read This Book

The chapters of this book include mini-topics that encourage the reader to explain concepts in a visual and verbal way. They serve as a link between theory and the reader's own practice, and encourage the reader to explain and reveal a visual aspect of a theme under discussion. Reader's visual solutions will link and connect the conceptual with the depicted and include the reader in an active, visual style of processing and outputting information. In contrast to a textbook-like style, this book offers information about basic concepts and facts as inspiration for creating visual solutions coming from examples of applications of knowledge, as well as trends resulting from developments in technologies.

Many figures in this book have QR codes (Quick Response codes) for the URL of the Website containing color pictures. Many figures containing art works comprise the QR codes in order to bridge the offline text with online presentation of art by enabling the reader to access the Webpage and look at art works. "Digital and Traditional Illustration" provides information and a picture about a structure of QR code matrices designed to be detected as a 2-dimensional digital image by a semiconductor image sensor and then digitally analyzed by a programmed processor. A QR code is a matrix barcode consisting of black modules (square dots) arranged in a square pattern on a white background that records information about an item.

Interdisciplinary Way of Presenting Topics

This book provides a selection of concepts, data, and information belonging to a number of disciplines. This is because most of recent advances in knowledge result from cooperation of specialists in seemingly unrelated domains. Moreover, the progress often moves forward through networking, chatting, using Skype, or simply updating the school-based knowledge. Fields of research become interdisciplinary, interactive, and often integrated. Many themes discussed in this book have been annotated with explanatory notes, some of them being obvious for readers focused on the issues under discussion, and many appearing to be unrelated for those concentrated on other fields of interest.

A question arises about the ways the teaching about art and design could be combined with programming and computing. Both are aimed at enhancing higher-level thinking skills, abstract thinking, creativity, and novelty. Many artists apply programming to create art works or visualizations, and many computing scientists and programmers do the same. The content of these programs becomes a question belonging to the art domain, while inquiries about what can be done to make these programs aesthetic becomes the problem of the usability territory. After pursuing a study of the arts, a programmer may gain a viewpoint about the purpose for programming the individual projects and making sense of it in further phases, and thus achieve a more ontological attitude relative to the essence of being.

While constantly immersed in the mind puzzling natural phenomena, objects, and processes explored by sciences, we gain knowledge and experience, a good deal of it ensuing from our school education. However, educational assessment involves multiple-choice tests as a typical form of testing. In order to prepare ourselves to tests, we have often memorized particular facts, laws, and formulas, each and every one with the test questions in mind. This kind of knowledge interweaves with a whole landscape of knowledge we acquire later. Our knowledge constantly changes along with the developments in technology. At the same time, the school tests are the same for all students, disregarding the diversity of the intelligence types described by Howard Gardner (1993/2011, 1993/2006): visual/spatial intelligence, verbal/linguistic, logical/mathematical, bodily/kinesthetic, musical/rhythmic, interpersonal, intrapersonal, naturalistic, and existential intelligence. We may feel our own visual or verbal preferences in dealing with our tasks. The projects presented in this book are designed to inspect selected themes from a totally different perspective.

A Place for the Arts in the Multimedia-Oriented Social Environment

One may say art is an interpretation of human perception saved accordingly. This book focuses on a visual approach to natural events rather than on their detailed analyses. It encourages the readers to perform some mental activities in a visual way. Many agree that our ways of communication are drifting toward visual media; our efficiency in sharing knowledge and emotions may depend on our adaptability and ability to convey them in an up-to-date way. It may have something in common with Barbara Smaller's wish that was pictured in a June 4, 2012 issue of *The New Yorker* (p. 114): "I'm looking for a career that won't be obsolete before my student loan is paid off." This book attempts to respond to the changing role of art and promotes including the learning of art into the technology-oriented world.

Viewers used to appreciate art they considered beautiful, which often was meant as the lifelike art works that resembled real-life objects. At the present time, due to the pervasive presence of social networking sites, groups of interconnected people exchange information and cooperate applying computing. Their creative activities involve higher-level thinking processes aimed at approaching multisensory, interactive actions. We may notice art-related schools, which were traditionally named the Art and Design departments, now introduce themselves as the Art and Media or the Art and Technology schools, with computing and programming described as a requisite both for the studies and future work.

This Book as a Form of Entertainment

Many agree that mental exercises make the best entertainment. Japanese prize-winning writer, Haruki Murakami (2011, p. 175), assumes that what may be called intellectual curiosity, a desire to obtain knowledge at the universal level, is a natural urge in people. Jean-Baptiste Dubos (1670-1742) wrote that man does nothing but what fulfills his needs; one of them is a need for keeping his own mind busy; otherwise, he becomes bored and unhappy:

The soul hath its wants no less than the body; and one of the greatest wants of man is to have his mind incessantly occupied. The heaviness which quickly attends the inactivity of the mind, is a situation so very disagreeable to man, that he frequently chuses to expose himself to the most painful exercises, rather than be troubled with it. (Dubos, 1717)

With Facebook becoming the most popular social networking site involving about a billion active users, Google being probably the Internet's most visited Website, console gaming becoming a widely used instructional tool, and cinematic effects in motion pictures and games valued as motivational tools, we often consider play as a tool for learning, sharing, and entertainment. Within this template, learning can provide entertainment and amusement.

Dean Simonton (2003, 2004) points out that creativity of scientists is a constrained, stochastic, randomly determined behavior, as the new theories in all sciences are. When we realize that the results of our research are characterized by conjecture and accidental or unpredictable events (Simonton, 2004, p. 41), our curiosity may be enhanced. We cannot predict the results we can only know after computing them. Simonton reminds us of the Albert Einstein's remark:

It is, in fact, nothing short of a miracle that the modern methods of instruction have not yet entirely strangled the holy curiosity of inquiry; for this delicate little plant, aside from stimulation, stands mostly in the need of freedom; without this it goes to wreck and ruin without fall. (Schlipp, 1951, p. 17)

Many would agree our thinking often depends on the tools we use; more areas are available for thought experiments by reason of the developments in technology. Tools may enhance our imagination. Thought activities are often shared, and thus become more entertaining, because almost everything we examine can be visualized. This allows creating technology-based entertainment such as films based on scientific books, worlds populated by avatars and beings existing in the past, the future, or in fictitious environments. Charles Jencks, an architect and writer questioning postulates expressed by the Modern architecture and describing its successors – the Late, Neo, and Post-Modern architecture, wrote:

Whatever the reasons, contemporary science has not yet transformed the cultural landscape not led to a renaissance in thought… In any case, I believe that the ideas of contemporary science do provide the basis for a cultural reawakening and that a new iconography must be made more tangible through art if it is to be assimilated. (Jencks, 2003, p. 20)

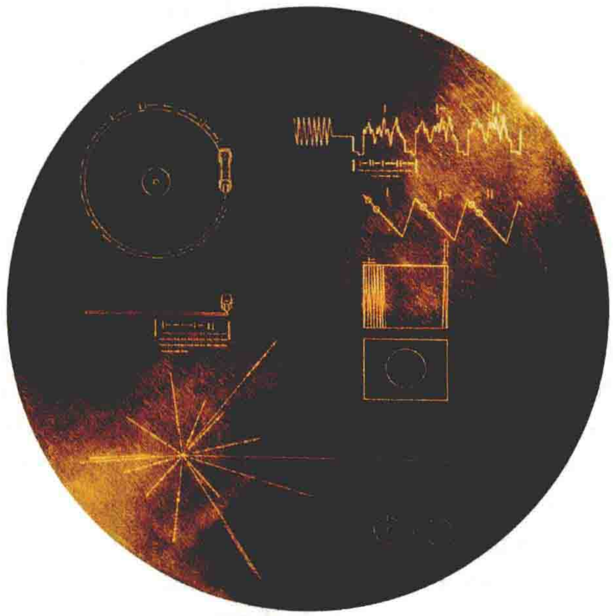
Nathan Yau (Lima, 2011, p. 248) describes the citizen science that is based on social data collection, "Although not everyone who 'analyzes' this data will have a background in the proper techniques, a certain level of data literacy must be developed. Visualization will be essential in making the data more accessible." Yau (2011) emphasizes the engaging quality of interactive, flying data that he finds not only explanatory but also compelling and entertaining. Non-professionals become involved in visualization and analysis when they take on microblogging and engage with social applications like Twitter and Facebook. The task is to add structure and tools that take advantage of these open applications, to see the undiscovered relationships, and to interact with our surrounding.

The Power of Visualization and Visualizing Thoughts

According to the pioneer in the field of data visualization Edward Tufte (1983/2001), vision is the only universal language. Gyorgy Kepes (1906-2001), who published an influential book about design and design education *Language of Vision* (1944/1995, p. 13) wrote, "Visual communication is universal and international; it knows no limits of tongue, vocabulary, or grammar, and it can be perceived by the illiterate as well as by the literate."

The Voyager, which is conveying the data about the heliosphere and the interstellar space, had sent into the deep space a gold-plated copper disk containing visual descriptions as a record of our civilization (Figure 1). A committee chaired by Carl Sagan of Cornell University selected the content of the record for NASA. The spacecraft may approach another planetary system in at least 40,000 years (NASA Jet Propulsion Laboratory, 2012).

Figure 1. The Golden Record. Image in the public domain.
Available at http://www.jpl.nasa.gov/images/voyager/gold_record-browse.jpg



Projects for the Reader

Themes for particular chapters in this book have been selected with several objectives in mind. First of all, descriptions of natural and technological processes are focused on visual ways of explanation. Second, the readers are invited to look at the underlying physical and natural laws and actively react to the nature- and science-derived facts and processes. Translation into the art and visualization oriented frames of thinking supports current methods of communication going through networked, linked, and shared media. Developments in science, technology, and art created with the use of a computer come in a great part from biology-inspired sources. As Gérard Battail (2009, p. 323) wrote, "Life is an outstanding expert in solving engineering problems." The selected nature- and science-inspired themes are intended to encourage the reader to respond in one's own way, by creating, designing, writing, and programming individual reactions to these themes.

Many of us scan and copy items or use Internet resources, and then apply filters to transform them into line drawings; many do not draw at all. We can see this trend in animations and feature films. Perhaps the meaning of drawing is different in electronic media, where images are interactive, linked, and open-ended. Paul Fishwick (2008, p. 4) defines aesthetic computing as "the application of the theory and practice of art to the field of computing." For him, it is the study of artistic, personalized, formal model structures in computing that go beyond representation and events in technology.

The book tells about a number of nature-inspired projects, applications, and technologies, selected with a focus on visual way of communicating solutions. Readers will find framed spaces for their visual and verbal responses. The spaces left for reader's thought and action are the decisive parts of this book; it is a place for novel, personal interaction in the form of drawing and writing. Combining selected fields of knowledge with practical applications in terms of the visual and verbal expression serves as a tool used to show the way of applying one's visual way of solving particular tasks and to work on one's ability to do this. For these reasons, I see the tables with a space for the reader's input as an inherent part of the book. This serves as a link between theoretical and practical application of visual literacy seen from a new perspective. The central aim of this book should not thus be misunderstood, neither as a research source suggesting new themes for other researchers nor as a collection of exercises for particular groups of people.

The goal of art therapists lies in helping people with problems at the cognitive, motor, emotional, and psychomotor levels, to name just a few. It is not necessary that "patients" fully comprehend this material, with its scope spanning from science, engineering, and computing to art concepts. This book is meant for those thinking at the higher, abstract thinking level, who grew to the point of opening themselves to current venues and experiences. Thus, the main thesis of the book is in proclaiming a need for shifting the readers' thinking and acting towards creating visual explanations and solutions based on a selected knowledge base. Filling out by the reader each framed space adheres to the book's intention.

Projects suggested in this book are meant to support visual way of thinking and developing visual communication with the use of visual semiotics by constructing signs, symbols, icons, iconic objects, analogies, and metaphoric connotations, thus conveying some meaning in a visual way. The text is interlaced with projects to be solved by the reader within the boxes designated to their visual/verbal answer to the project. The empty boxes in the text are for sketches; the reader can sketch or can choose to continue working further on the computer. Projects are open-ended in nature and integrative. The sources for inspiration are contained within the background information provided, rather than in a description of an expected outcome. The reader may go any direction one would choose, look for answers on the Internet, or try to create something totally new. My students' solutions accompany the text, along with the author's visual solutions, which are printed black-and-white here.

Each project challenges you to react to a theme under discussion, add your input or modify the content, visualize the concept, and then complete your visual/verbal answer. Each empty space is a place intended for your planned idea for a project. First, you may want to describe it, to sketch, draw, design a concept map, or draw some key frames. Then you may feel ready for writing a program, designing a software application or an app for mobile devices, use graphic software, and create a picture or a sculpture (for example from wooden blocks or the found objects). Finally, you may want to make a photo or a short video of your project, post it online, thus adding your active, creative, independent solution or interpretation and explaining it to others. Your projects may take form of an artwork, a verse, a story, a concept map, animation, comics or manga, or a smart phone app.

The purpose behind these activities lies in their explanative and motivational power to enhance one's visual, graphical, and visualization literacy (both of the readers and of those who would look at their projects). Our environment and its changes influence our thinking and our acting, which we do mostly with the use of computing. For this reason, the following text tells about the connectivity between our daily life, knowledge, art, and entertainment. In a quest for things that last longer, people work on making materials indestructible and designing intelligent applications. This connectivity becomes even stronger because of the changes we experience when our knowledge about the world we live in becomes bio-inspired, nano-oriented, and progressively shared because:

1. The impact of biology-inspired knowledge, technology, and art is growing.
2. The focus on nanotechnology drives the advances in many domains and brings changes in materials, technologies, and applications, influencing each other.

3. The Web-based networking results in changing the way we now solve our problems (with the immediate help coming from often unidentified sources), entertain (we can enjoy gaming with people from far away), and develop in social media, new media art, or networked art (existing in real time and/or in virtual spaces).
4. Programming became accessible and easier due to the visual way of instruction such as processing, with free online instruction (such as HTML, free courses, Apple Developers' kits, SDK – Software Development Kits, etc.), so the art creating often fuses with the manufacture, while the designing of games becomes an art medium.

In a quest for objects that would last longer, people work on making materials indestructible and designing intelligent applications. Projects interweaving the text are intended to associate knowledge with practical applications, facilitate the integration of particular facets of science that have been routinely segregated into special fields, and to follow the current advances in various areas. Our thinking may probably change not only with the technical progress but also with the experienced reality changing along with the advancements in technology and everyday life. Projects are aimed to hopefully engage the readers in practicing visual communication and visual organization of data and knowledge, with a focus on the meaning, not exclusively on data or numbers. When working on these projects, you may hesitate to look at or copy the ready examples, because copying may influence a person who copies and may have an impact on one's personal visual statement. As a summary, the projects offered in this book will most likely prompt inspiration to find progressive solutions based on the informed way of thinking.

As a conclusive remark, with the advent of pervasive computing, with computer-mediated way of thinking and living at many fronts, one might ponder about a need for a talent search and support for all talents that could further advance our ways of living. Three issues come to mind:

1. A need for a free access to the Internet for everyone, disregarding all differences and levels, so every idea-driven and motivated individual could explore, learn, produce, and share knowledge and achievements. This issue seems to face similar obstacles as a free access to water.
2. A need for solving the image- and video-related copyright problems, so every author could freely illustrate one's writings with visual examples, rather than provide complex, lengthy, and often short-living links. For that, an international agreement would be needed to address profit-based issues.
3. In regard to mining and supporting talents, training and education of children should be focused on recognizing and supporting the innate abilities of children. This would allow starting a holistic training of young minds by providing knowledge visualization early, that means from kindergarten (Figure 2). Knowledge visualization has a power to introduce an outline of major ideas and connections between science, mathematics, and programming.

Figure 2 conveys an opinion that before a child learns typical attitudes, misconceptions, and classifications, we can introduce a big picture as inspiration to finding their own interest, focus, and future path. Ongoing developments in computer graphics and visualization techniques may make us to reconsider the needs of education. With a shortage of programmers combined with usual fear of mathematics, programming, and science, one may consider knowledge visualization as a tool for showing the world at the time when attitudes are open and children' brains are curious.

Figure 2. Anna Ursyn, "Visualize Knowledge in Kindergarten" (© 2013, A. Ursyn. Used with permission)

With the use of visualization techniques, themes related to science, nature, math, art, and how they mutually influence each other might be presented to young children as a big holistic spectrum of knowledge. We may instill abstract thinking in young children by supporting an understanding of the surrounding world, which would allow making connections. On the basis of openness to a wider picture, they may have a chance to shape their own, individual focus on what stirs their curiosity, in relation to other levels of knowledge. To enhance instruction with knowledge visualization component, early childhood specialists and departments would need to welcome knowledge visualization specialists on the board.

THE BOOK CONTENT

Section 1: Perceiving

Chapter 1: "Articulation and Translation of Meaning"

This chapter is about concepts of articulation and translation as the ways of exploring meaning. Articulation is discussed as units combined into complete structures and thus meaningfully expressed. The text includes examples of double and triple articulation of signs in languages, programs, and several other fields. Translation—another common thread interweaving distinctive processes and events—may include translation from nature to art (with the use of technology), as well as many forms of visual, verbal, and numeral translation. Two-way translation is discussed, from nature to idea and production (technical solutions) and from products to human perception and creation.