Art of Visual Thinking for Smart Business Education

Tatiana Gavrilova *
Graduate School of Management, Saint-Petersburg University
Volkovskiy per., 3, 199004, Saint-Petersburg, Russia,

Daniela Carlucci
Laboratorio di Ingegneria Gestionale, DICEM, University of Basilicata
Via Lazazzera, 75100 Matera, Italy

Giovanni Schiuma
Laboratorio di Ingegneria Gestionale, DiMIE, University of Basilicata
Via dell’Ateneo Lucano, 10, 85100 Potenza, Italy

* Corresponding author

Structured Abstract

Purpose – Visual Thinking Techniques (VTT) form a significant part of any course of critical thinking. But wider understanding of their role for smarter education is underestimated [Barab & Plucker, 2002; Knight, Gašević & Richards, 2006]. We argue that the current palette of visual thinking strategies and techniques and their aesthetic impact may heavily influence the cognitive effectiveness of teaching and learning in business education. VTT may help to develop a holistic conceptual enterprise model, strategic marketing plan, project feasibility conception and other complicated multi-faceted business models [Clarke, Flaherty & Yankey, 2006]. In this paper we aim to overcome the limitations of traditional forms of teaching and learning (as case studies, lectures and seminars) and to enrich the repertoire of teaching methods that can be used in the class to broaden the understanding of the sophisticated business knowledge issues.

Design/methodology/approach – The aim of this study is to show how the repertoire of VTT (mind maps, concept maps and ontologies) can be used in business education to represent, to structure and to codify knowledge (both tacit and explicit). We do this by using the knowledge engineering (KE) methods (such as knowledge elicitation [Gavrilova & Andreeva, 2012] and visual knowledge mapping for training and teaching. Such approach merges the cognitive ergonomics issues with didactics. The point is that aesthetic perception helps to clarify and to shape the understanding [Schiuma, 2011]. In this paper we aim to bridge that gap and introduce visual elements and styles from the artistic point of view. Our approach is based on the principles of good shape coined by Max Wertheimer in his Gestalt Learning Theory of Productive Thinking [Wertheimer, 1958].

Originality/value – the paper proposes a new approach to VTT based on wide survey and practical experience of the authors. The paper contributes to a wider use of visual knowledge engineering methodologies and technologies in business education.

Practical implications – The paper contributes to business educational practice by describing a systemic variety of VTT with direct recommendation to their design and feasibility.
Keywords – visual models, cognitive approach, aesthetic influence, knowledge engineering.

Paper type – Academic Research Paper

1 Introduction

During the last decade, Visual Thinking Techniques (VTT) [Ware, 2005] has become one of the key considerations in e-learning methodology and it is heavily associated with knowledge maps. Alongside this, VTT have arguably come to play a central role in courseware content. VTT as knowledge maps (mind maps, concept maps, ontologies) are built on conceptual skeleton of the teaching domain and might serve various purposes such as better understanding, knowledge sharing, collaborative learning, problem solving, seeking advice, or developing competences by learning from peers. Recently, visual modelling perspective has gained interest in the domain of computer-aided learning and cognitive psychology involving the study of the structure and patterns of knowledge. These studies rely heavily on theory and tools from knowledge engineering analysis that has already a longstanding tradition in the knowledge-based systems domain (Mizoguchi & Bordeau, 2007). The tools and techniques developed in this domain can be applied fruitfully in the field of learning structuring and design (Schreiber, 2000; Knight, Gašević & Richards, 2006), SemanticWeb applications (Davies et al., 2002). The ideas of using VTT and visual structuring in educational e-learning were discussed in many works and now are implemented in several software tools. These techniques can be used as the assessment tools also.

2 Teaching and VTT

2.1 Ontologies for teaching

The idea of using visual structuring of information to improve the quality of student’s learning and understanding is not new. This is because visualisation supports different mental processes involved in learning, such as perception, memorization, development (see Figure 1).

![Figure 1: The power of visualization (adapted from Scocco, 2008)]
For more than twenty years concept mapping (Sowa, 1994; Jonassen, 1998) has been used for providing structures and mental models that support the process of teaching and learning. This is because maps as visual tools facilitate the representation and communication, support the identification and the interpretation of information, facilitate consultation and codification, and stimulate mental associations.

As such, the visual representation of general domain concepts facilitates and supports student understanding of both substantive and syntactic knowledge. Many teachers, especially those who teach sciences and engineering courses, operate as a knowledge analysts or knowledge engineers by making visible the skeleton of the studied discipline and showing the domain’s conceptual structure (Kinchin, 2006). Often this structure is called “ontology”.

However, ontology-based approach to knowledge representation in pedagogy is a relatively new development. Ontology is a set of distinctions we make in understanding and viewing the world. There are numerous definitions of this milestone term (Neche et al., 1991; Gruber, 1993; Guarino et al, 1995; Gomez-Peres et al., 2004). Together, these definitions clarify the ontological approach to knowledge structuring while giving enough freedom to open-ended, creative thinking. So, for example, ontological engineering can provide a clear representation of a course structure, main concepts, approaches, terms and their inter-relationships. Many researchers and practitioners argue about distinctions between an ontology and a conceptual model. We suppose that an ontology corresponds to the analyst’s view of the conceptual model, but is not de facto the model itself. There are more than one hundred of the techniques and notations that help to define and to visualize the conceptual models. Ontologies now supposed to be the most universal and sharable forms of such modeling.

2.2 Visual ontology design

Meta-ontology provides more general description dealing with higher level abstractions. Figure 1 illustrates different ontology classifications in the form of the mind map. Mind-mapping (Buzan, 2005) and concept mapping (Novak & Canas, 2006) are now widely used for visualizing of the ontologies at the design stage.

Ontology design also may be used as an assessment procedure where it is used for expressive as opposed to exploratory learning. These are different and complementary modes of learning. Exploratory tools allow learners to investigate models of a given domain which are different from theirs and so examine consequences and conflicts. Expressive tools give the students the opportunity to express their own models about reality and so learn through representing, exploring and reflecting on the consequences of these.
Figure 1. Summarizing the ontology classifications in a mind-map

3 Gestalt psychology and visual Thinking approach

3.1 Gestalt psychology principles

Bearing in mind that teaching ontologies are to be used not only as a knowledge component of the courseware system but also as a mind tool for comprehensiveness and better understanding, we tried to follow the principle of good shape (or beauty) that is not new in basic scientific abstraction and modeling (e.g. physics, chemistry, etc.). It is difficult to give the formal definition of this concept but it features the imprecise sense of harmonious or aesthetically-pleasing proportionality and balance. The most substantial impulse to it was given by the German psychologist Max Wertheimer. His criteria of good Gestalt (image or pattern) (Wertheimer, 1945) we partially transferred to ontological engineering:

- Law of Pragnanz (the law of good shape) – the organization of any structure in the nature or cognition will be as good as the prevailing conditions allow. ‘Good’ here means regular, complete, balanced, and/or symmetrical.
- Law of Parsimony – the simplest example is the best (the Ockham’s razor principle): entities should not be multiplied unnecessarily.
- In the case of building ontological hierarchies, we have to keep in mind that a well balanced hierarchy corresponds to a strong and comprehensible representation of the domain knowledge. We enlist below some tips that we consider useful in formulating the idea of “harmony” (Gavrilova, 2010):
  - Concepts of one level should be linked to their parent concept by one type of relationships, for example, “is-a”, “has part”, etc. This means that concepts of one layer have similar nature and level of granularity.
  - The ontology tree should be balanced, that is, the depth of the paths in the ontological tree should be more or less equal (±2 nodes). This will also
insure that the general layout is symmetrical. Asymmetry means that shorter branch is less investigated or longer one is too detailed (see Figure 2).

- Cross-links should be avoided as much as possible.

Moreover, when building an ontology, which is used for information visualization and browsing, it is important to pay attention to clarity. Minimizing the number of concepts is the best tip according to the Law of Parsimony. The maximal number of branches and the number of levels may follow Miller’s “magical number” (7±2), which is related to the human capacity for processing information (Miller, 1956).

“Beautification” bias works as a strong methodological approach that helps to find the points (nodes) of “growth”, “weak” branches, inconsistence, and excessiveness. But, in fact, specific domain knowledge features may be of higher priority than design principles.

We have produced several simple hints to refine and illuminate the ontology’s design stage.

1. Use different font sizes for different levels.
2. Use different colours to distinguish particular subsets or branches.
3. Use a vertical layout of the tree structure/diagram.
4. If needed, use different shapes for different types of node.

We have already developed more than 20 teaching ontologies and several research ontologies to help the research community to generalize their shared understanding in such the domains as “user modeling”, “ontologies in education” and “project management”.

As we are speaking about the pre-design stage of creating light-weight ontologies (without formalizing into OWL or other language), the usage of any available graphical editors may be helpful. These editors work as powerful assistants. The best results we received when using mind mapping and concept mapping tools.

Figure 2. Well-balanced(A) and ill-balanced(B) ontologies
3.2 Artistic associations for teaching ontologies

We can propose different types of teaching ontologies which substantially can aid effective learning:

- Main concepts ontology (or conceptual structure),
- Historical ontology (genealogy),
- Partonomy of the discipline, where the main relation between learning objects is “has_part”
- Taxonomy of the theories, methods and techniques, etc.

Nowadays the availability of so different ontologies is fairly important. Diagrams, graphics, templates for presenting data, contents etc. can help to grasp the current complex and nuanced world and represent helpful tools to understand, create and experience reality. Showing information and data as blocks, rivers, nets, etc. can open a new and rich visual language through which the external world, included a business, can be more easily interpreted and understood.

Focusing on learning, there is substantial evidence that pictures, graphics and/or visual images play a critical role in learning mechanisms. Numerous studies have demonstrated that students’ engagement and understanding of conceptual information are improved when they are exposed to visual content (e.g. Anglin et al., 2001).

In such a view, the use of aesthetics principles in building of teaching ontologies can be fruitful. Aesthetics is a branch of philosophy associated with art and beauty and is concerned with how individuals perceive objects or make judgments based upon information received as five human sensory inputs. The proportions, scale, colours, images and pictures of an ontology can stimulate human sensory inputs and affect also emotion and feeling. This, in turn, facilitates learning mechanism. In this regard, a recent study on the impact of design and aesthetics on usability, credibility, and learning in online courses (David and Glore, 2010), has demonstrated that both aesthetic quality and content quality are critical. This is because design and aesthetics have a profound impact on how users perceive information, learn, judge credibility and usability.

Therefore aesthetics and design can help to build ontology tools able to make things easier to understand and learn.

4 Conclusions

The aim of this study is to show how visual approach and art can be used in business education to represent knowledge (both tacit and explicit). The point is that aesthetic perception helps to clarify and to shape the understanding [Schiuma, 2011]. In this paper we aim to bridge that gap and introduce visual elements and styles from the artistic point of view. Our approach is based on the principles of good shape coined by Max Wertheimer in his Gestalt Learning Theory of Productive Thinking [Wertheimer, 1958].

Such view puts stress on visually and cognitively tractable models. We discuss how beautiful mind maps, concept maps and ontologies support robust qualitative thinking.
We hope that our approach will have implications for smart teaching and learning in management and other business disciplines.

References


