Polyscopy – a New Paradigm in Design for the Web

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Abstract—*Polyscopy* is offered as a new paradigm in the design for the Web. Polyscopic modeling was first developed as a methodology for designing information, creating information that satisfies certain set of principles and criteria and offers the possibility for entirely new way of informing. Certain tools and techniques from this approach may be applied to devise a methodology for better way of designing for the Web and of using the visual language in order to produce high quality information presentation on the Web.

Index Terms—Information design, visual intelligence, design criteria, information visualization.

I. Introduction

Information design, rather than being a defined point of origin, is a field to which researchers and practitioners converge from variety of disciplines such as graphic design, linguistics, computer science, library science, education, cognitive science etc. Research within the field thus has diversity of angles of looking at the field, methods and techniques. For us, information design is about designing a new way of informing. This new way of informing requires information that is *created* according to certain set of principles and criteria.

The possibility to *design* an *informing* as a whole is a novelty. Information design in this sense is a highly interesting proposal and the reader is referred to [1] for further reading.

Our stance is that *an internally consistent and well functioning informing can indeed be designed!* A prototype methodology called Polyscopic Modeling is the most powerful tool to help in that endeavor. The main point behind the Polyscopic Modeling methodology prototype proposal is that it shows that our '*informing* puzzle' *can* be solved: The *methodology* serves as a prototype design plan for well functioning *informing.*

The application of Polyscopic Modeling may lead to different understanding and handling of key issues such as economic and political power, free choice, values and sustainability.

What we will show in this article is how the *methodological* approach to designing information can serve as foundation for reconstructing the way we design for the Web.

In section two of the article we will give short review of what we call *polyscopy*. In section three we will present the idea behind polyscopic topic maps as a tool for creating a semantic layer on top of the Internet resources, allowing for more efficient access. In section four we look at how the ideas behind polyscopic modeling can help devise criteria for design and for evaluation of all visual representations aimed at publication on the Web.

II. Polyscopy

Polyscopy is a brand name for Polyscopic Modeling methodology [1-13].

A. Polyscopy - a strategy for positive culture change

Polyscopy may also be understood as a strategy for positive cultural change. The reader is referred to [13] for more details; here we mainly outline the context in which we make the above claim. It is included here as it offers abstract and value based aspect of the approach which does get reflected in our treatment of the design theme, though not explicitly. We view our design approach as value-based, value being embodied within the principles and criteria of the methodology.

The essence of *polyscopy* is a certain insight followed by corresponding change of attitude and action.

The insight is that our mind has a tendency to consider a certain *conceptualization* of reality (be it religious, scientific or otherwise) as the reality itself. More precisely, a certain 'aha' or 'eureka' feeling which results when the pieces associated with our conceptualization of a situation fit nicely together is taken as a sure sign that what we have is the unique and accurate description of 'reality'. Modern cognitive science allows us to understand the origins of this tendency.

This tendency becomes transparent when we notice that practically every cultural tradition had a different 'reality picture', which to the people belonging to the tradition appeared as *the* reality.

The tendency of our mind to hold on to a certain 'reality' is the cause behind cultural inertia, closed-mindedness and intercultural misunderstanding. The same tendency is the main obstacle to *culture* and *cultural environmentalism,* because as long as we adhere to our own cultural view and look down upon others, there is no communication, no preservation and no cross-fertilizing of the heritage of traditions. In Polyscopic Modeling this tendency of the mind has been called *pseudo-consciousness* [15].

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The essence of the on-going critique of 'modernity' is that we have once again fallen pray to this age-old tendency of the mind.

Fixed worldviews have always been the way of dividing and controlling people. They are the main source of power of various historical and modern *power structures.*

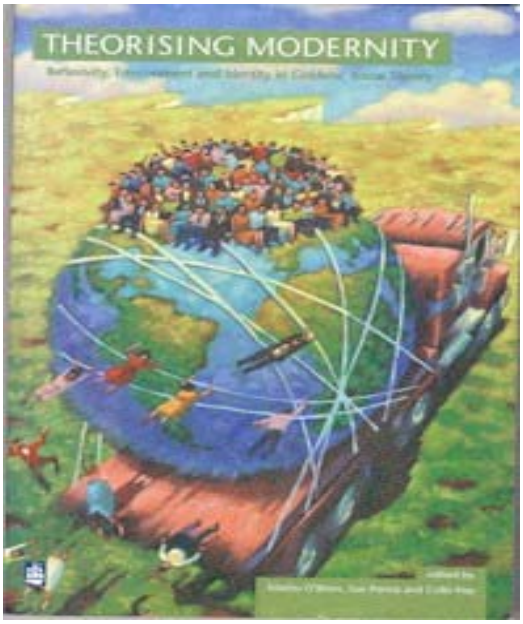

Figure 1. The Cover of the Book "Theorizing Modernity: Inescapability and Attainability in Social Theory" by Peter Wagner

The change of attitude associated with *polyscopy* is to consciously counteract this deceptive tendency of the mind.

The action associated with *polyscopy* is to consciously seek new ways of looking at things, or perhaps a single new way of looking at things, which shows us clearly what we most need to know.

Polyscopy stands for conscious creation and use of new ways of looking at things. It emphasizes the *high-level view* or 'the view from the top of the mountain' as the way of looking we need.

Polyscopy is a prerequisite for *'holistic* thinking', *design* and conscious choice [8]. It is not enough if something looks good and whole from one point of view; something that is *whole* must look *whole* from every angle.

Polyscopy stands for the fact that proper handling of any issue presupposes that the issue is perceived, understood and dealt with within an *appropriate scope*. A car cannot be understood at the level of detail of nuts and screws. We need to think in terms of large building blocks such as the steering and the engine, and in terms of the function. *Polyscopy* allows us to see 'the whole thing' in clear and simple terms.

Like alpinism, *polyscopy* also has its 'fear of heights' that must be overcome. We are unaccustomed to look at issues 'from above', to see them in simple and clear terms and take responsibility.

Polyscopy also stands for 'contextualizing' *information* and action. *Polyscopy* allows us to see the large issues and *contextualize* the smaller ones by understanding them within the context of the larger ones.

The paradox that we are lacking exactly the sort of information we most need may easily be understood as a consequence of historical trends. 'Reductionism' means destroying the *high-level information* by reducing it to *low-level* one, which is considered as more 'real'. The *traditional culture* did not need *polyscopy* because 'the whole thing' evolved spontaneously, and the traditional people only need to perform their traditional roles within it.

B. Polyscopic structuring of information

Polyscopy offers a way to construct reliable or 'scientific' *high-level information*, by using the methods of Polyscopic Modeling.

The methodology offers a multitude of tools and guidelines for practicing *polyscopy*: the notion of *polyscopic information* with multiple *scopes* and *views*, *levels* and *aspects*; the *criteria*, *epistemology*, *approach*, methods (*holons*) etc.

Polyscopic structuring of information is one of the key elements in this methodology. In keeping with the basic principle of programming, polyscopic information is structured in terms of small, manageable modules, each representing a simple *coherent view*, as explained below.

The polyscopic structuring of information is based upon the notion of *scope*, which may be understood as a viewpoint or a way of looking. Multiple scopes are considered as possible and even necessary. The *scopes*, and the associated *views*, can be either *high-level* or *low-level*. The *high-level views*, like the high-level modules in a hierarchically structured program and the view from the top of a mountain, present the large picture. The *low-level views* present the details. As in a structured computer program, the *high-level* modules provide the structure for organizing the *low-level* modules. At the same time, the *high-level* modules

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provide the context and the motivation for the information contained in the *low-level* modules.

Obviously, the polyscopic structuring of information involves more than just reorganizing the existing information. The lacking *high-level information* needs to be created. The missing *low-level information* needs to be created and the existing one needs to be reconfigured. The Polyscopic Modeling methodology provides the principles, criteria and methods that are required for this task.

In addition to *vertical abstraction* whose goal is to create the *high-level information*, the methodology also supports *horizontal abstraction*. Polyscopic information is presented in terms of different *aspects* which intuitively correspond to 'sides' or 'angles of looking'. The *aspects* may reflect different reader categories, ways of looking at the subject etc.

A *high-level view* of polyscopic information is given in terms of the Polyscopic Information Ideogram (Figure 2), where the triangle represents a hierarchy of *scopes*, the circle represents the *high-level information* and the square represents the *low-level information*.

Ideograms [10] are tools for visually capturing ideas. As they often involve visual metaphors, a short textual message usually accompanies the visual presentation. The message of this ideogram is that polyscopic information (represented by the 'i') consists of a concise and holistic *high-level information* (the circle or the point) which is founded upon a detailed and analytical *low-level information* (the square).

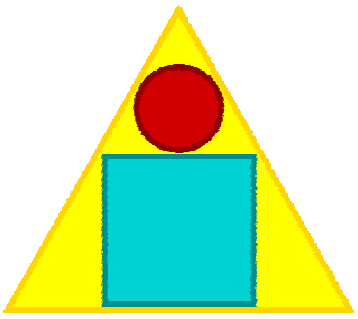

Figure 2: Polyscopic Information Ideogram.

The main principles of polyscopic information structuring may be formulated as follows:

- Information exists on all *levels*. Both *high-level* and *low- level views* must be provided (*vertical abstraction*).
- Information has multiple *aspects*, some of which are subtle or hidden. The most relevant *aspects* must be provided (*horizontal abstraction*).
- Information is a function of the way of looking or *scope*. The *scope* is *coherent* if it represents a single level of detail and angle of looking (or intuitively, if it reflects a single viewpoint on the metaphorical mountain). Each information module must be associated with a single *coherent scope* (*coherence*).
- The knowledge of the *scope* is crucial for proper understanding (intuitively, one must know where on the metaphorical mountain one is standing when looking at a piece of information). Each information module must be associated with a clear and correct representation of the *scope* (*orientation*).
- The *scope* determines the *view* (intuitively, the *scope* is the control knob given to the reader to switch between *views*). The reader must given the capacity to select the *view* by changing the *scope* (*navigation*).

To see the naturalness of the polyscopic presentation, it is useful to think of inspecting a hand-held object. Naturally, one uses the capacity of the hand to turn the object at different angles and take it closer or further from the eye to explore the object. In a similar way, the polyscopic information structuring facilitates the active exploration of the presented subject.

Polyscopic information structuring supports the 'holistic' or 'multiple-perspective' thinking. This way of thinking is especially relevant in the post-industrial era, where it has become increasingly important that both technical, socio-cultural, political and other aspects of an issue be taken into account in decision making [16].

In a similar way, the polyscopic structuring of information also supports active, exploratory learning.

The main design criteria in polyscopy are *perspective*, *nourishment*, *relevance* and *foundation*.

The *perspective* criterion postulates that *information* needs to allow us to 'see through' the whole, to see the whole in correct proportions, with nothing essential left obscure or hidden. The *perspective* roughly corresponds to the intuitive notion of the 'whole truth'. The *perspective* criterion gives role and prominence to *ideograms* and other intuitive, artistic or visual techniques in *informing* .

The *nourishment* criterion reminds us that information has subtle long-term effects, influencing our values, emotions, preferences, habits etc. This criterion gives prominence to *implicit* information.

The *relevance* criterion imposes a priority structure on *information*. We are reminded that *information* has a purpose, and that we must create and choose *information* according to that purpose. Less *relevant information* should not be allowed to take precedence over the more *relevant* one.

The *foundation* criterion postulates that '*information* needs to have a broad and solid *foundation*'. This roughly means that *information* must be reliable, proven or verifiable. Conscious *founding* of *information*, in particular of *high-level information*, can bring substantial benefits to *culture*.

III. Polyscopic Topic Maps

In this section we briefly outline the main ideas behind the Polyscopic Topic Maps information structuring method.

A. Topic Maps

Topic Maps is a method for organizing, retrieving and navigating information. Along with Semantic Web, the Topic Maps method allows for creating a semantic layer on top of Internet resources, which allows for semantic and more efficient access [17].

The main concepts in Topic Maps are topics, associations and occurrences [18]. The associations specify in what way the topics are related with one another. By following an association, the search can move from a topic to the one which bears with it a desired semantic relationship. An example of the kind of access which is facilitated by Topic Maps might involve shifting from the topic 'Giacomo Puccini' to the topic 'Lucca' (the city where Puccini was born) and then to 'Alfredo Catalani' (another composer born in Lucca).

Topic Maps method has been proposed as a remedy for information overload [19].

Topic Maps have proven to be useful in e-learning and active learning [20,21].

B. Insights from the history of computer programming

The following parallel between information overload and early history of computer programming suggests that the Topic Maps method alone is not sufficient to remedy the information overload, and helps us motivate Polyscopic Topic Maps.

In the early 1950s the budding software industry found itself in a crisis. Ambitious software projects were undertaken which resulted in thousands of lines of 'spaghetti code' (called so because of their complex, spaghetti-like control structure) which nobody could understand or debug. The solution was found by developing high-level programming languages such as Fortran and Cobol, and programming methodologies such as structured programming and object orientation [22], which provide methods for creating and structuring easily comprehensible programs.

The conditions around information are now similar. The new information technologies have allowed us to produce unprecedented large quantities of information [23]. When we now structure information by using the techniques which were developed for much smaller quantities, chaos results [23,24].

Indeed, the initial version of the World Wide Web has provided hypertext as a tool for modular structuring and hyperlinks as an equivalent to program control. But we presently have no underlying metaphor or principle which would help us structure information into modules in a meaningful and comprehensive way. Furthermore, from the point of view of our parallel, the hyperlinks are the gotos (in the sense that they allow for arbitrary jumps from one context to another), and so are the Topic Maps associations. The consequence is that the Internet information is currently structured in a spaghetti-like manner, similar to early computer programs.

What is needed is a collection of structuring principles and techniques, analogous to the ones introduced by early programming methodologies. Those are provided by the Polyscopic Modeling information design methodology.

C. Making the Topic Maps polyscopic

The Topic Maps provide a natural platform for polyscopic structuring of information. The instance/type and the subclass/superclass constructs allow for *vertical abstraction* and for implementing the *levels.* The scoping constructs allow for *horizontal abstraction* and for implementing the *aspects.*

On the other hand, the Polyscopic Modeling methodology provides principles for structuring the Topic Maps in a polyscopic way. To use again our parallel, the Topic Maps are in the role of a low-level programming language. The goal of Polyscopic Topic Maps research is to create standard structuring constructs analogous to the do-while loop and the if-then-else statement. While a systematic account of this research would at this point be premature, for the purpose of our educational model a simple Polyscopic Topic Map prototype is sufficient. In this prototype, the hierarchy of *levels* is implemented by providing the *taxonomy*, which is a hierarchical organization of the main concepts involved (Figure 2). The Polyscopic

Information Ideogram serves for navigating between *levels.* The *aspects* reflect the user interests and profiles, ways of looking at the material covered and the kinds of information that is being presented.

We would like to mention here an example of this approach that is just being put in practice. The example has to do with designing the course in Information Design via flexible and exploratory learning [34]

To see that Topic Maps are useful in the context of flexible and experiential learning, it is sufficient to draw the parallel with geographic maps, whose usefulness when experiencing and learning new environments is well established. If the student should be allowed to depart from habitual learning paths and explore new terrains by following his own needs and interests, what could be more natural than to provide a good, reliable map as support for such journey? Such map can also allow the student to present the trajectory and the results of her explorations, and the instructor to organize a customized exam.

The question remains, why should the Topic Maps for flexible and exploratory learning be polyscopic? There are several ways to answers this question. One of them follows directly from our parallel: The geographical maps *are* polyscopic. They have *levels* (of detail or granularity), each serving a different purpose. They also have *aspects*: physical, political, climatologically and others. For very similar reasons, the guidelines for flexible and exploratory learning also need to be presented polyscopically. The *high-level view*, like the coarse-scale map or the view from the top of the mountain provides an overview and allows the student to choose the general direction. The *low-level views* provide more concrete guidelines in terms of *learning resources.* The *aspects* serve a similar end as in the geographical maps, namely for distinguishing between various usages and different kinds of information presented.

Another reason for using Polyscopic Topic Maps is that this allows us to take care of the prerequisites. While learning no longer follows a linear path, which would naturally allow for presenting the material in the order required, it now follows a path in the graph beginning from the root, which can still have the same property. It is natural to present the foundations and general insights as *high-level views*, and of the material for more in-depth study as *low-level view*. When the *learning resources* are placed in a hierarchical *taxonomy*, as it is in the ID class Topic Map, then the students can easily orient themselves by first learning the parent nodes and then the *low-level* ones. This further supports learning at the right level of generality, which has proven to be efficient.

Polyscopic Topic Maps support good thinking and learning habits. The *levels* allow us distinguish what is fundamental from what is ephemeral, the large picture from the detail. The *aspects* allow us to control the complexity by distinguishing between different angles of looking (technical, humanistic, philosophical etc.) while still keeping them together.

The Polyscopic Topic Maps are particularly suitable for multi-disciplinarity, inter-disciplinarity and trans-disciplinarity learning and research. They allow for overcoming the separation between the humanistic and the technical aspects of an issue, which needs to be encouraged. Note: a website exemplifying this project will be provided in the final version of this paper.

IV. POLYSCOPIC WEB DESIGN

A. Visual language and visual intelligence

Robert Horn begins his "Visual Language" [horn] book as follows:

> *A larger synthesis of how people communicate is occurring. A wide variety of visual and verbal representation systems are coming together. … Visual language is emerging as any other language does – by people creating it and speaking it. Already, visual language is growing and spreading in ways that artificial international languages like Esperanto, which was invented by a single person, have never done. It is being borne of people's need, worldwide, to deal with complex ideas that are difficult to express in words alone. … The primary goal of this book is to investigate the properties of visual language that make it a language as opposed to another in the multitude of communication methodologies.*

Rapid increase in use of visual language is clearly associated with the growth of the Web, both in terms of the number of users as well as the complexity and diversity of tasks that can be managed by and through the Web. As we have pointed out in our earlier work [27-29], our culture is becoming increasingly visual and there is a need to develop our skills in speaking and writing in visual language. Web is one huge area of application that has given a burst of creativity, but, of course, the use of visual language is not limited to the Web. Visual language is the main tool of the media and multimedia, film, advertising and graphic design,

engineering and architecture, art etc. While the visual language in these more traditionally visual disciplines may be more advanced than what we are seeing on the Web, it certainly finds its presence on it (we can watch movies, co-design buildings, visit art galleries and much more on the Net). However, surfing the Web is still often far from a relaxed, pleasant experience that results in successful retrieval of the information that we need. It seems also to be quite difficult when we find ourselves in the position to, without previous training in visual arts or graphic design, want to publish something on the Web. Whether we are creating a business site, educational site, entertainment or simply a private site, visual language is hard to speak. This is true in spite of clip art, fantastic tools such as Flash and Dreamweaver, guidance on the Web on just how to do this job. Part of the problem might be that in our early education, we did not learn much about visual and spatial reasoning, visual problem solving, visual perception, influence of images on our mind and emotions etc. And now, when we have impetus to use the visual language, we find it difficult. Sometimes, even when we are satisfied with our visual language skills, we find out that we have not communicated clearly, perhaps because our fancy design has blurred our message, as animated stars are falling down our page, smiling happily.

The plausible solution for better design for the Web that we offer here is to combine polyscopy (for structuring and designing information that we want to conway) and visual intelligence (presenting it in a good way). The term visual intelligence is employed here, as defined by Barry [26], as

> *"the quality of mind developed to the point of critical perceptual awareness in visual communication. It implies not only the skilled use of visual reasoning to read and to communicate, but also a holistic integration of skilled verbal and visual reasoning, from understanding of how the elements that compose meaning in images can be manipulated to distort reality, to the utilization of the visual in abstract thought".*

In our earlier work [27-29], we were concerned with problems of addressing and advancing visual intelligence, in particular visual and spatial reasoning. The three central concepts proposed in earlier work (cited above) were visual immediacy, visual impetus and visual impedance.

Visual immediacy is defined as the characteristic that facilitates production of the kind of visual presentations that enables the interpreting party to perceive/recognize and cognitively process information embedded in the presentation (or parts of it) 'at a glance'. Visual immediacy is a *cognitive quality* that is often implied in references to a presentation's intuitiveness and directness. The term is chosen to reflect not only the *visual* nature of this presentation characteristic, but also to emphasize its comparatively faster (and sometimes apparently *immediate*) cognitive processing, which also is an indicator of visual reasoning facilitation.

Visual impetus is defined as a visual impulse, an incentive or stimulus whose aim is to increase activity and curiosity related to the contextual aspect of the design. One can evaluate visual impetus by asking questions related to how the first impression of the page "feels", and whether it hinders or stimulates further interest. Visual impetus is thus related to the aesthetic aspects of a visual presentation, and is a perceptive quality as well as a cognitive one.

Visual impedance is the hindrance or (often unintended) negative implicature in a visual design that causes the receiver to be less receptive to the visual representation itself, or causes deviance or deterioration in the message communicated trough the visual representation. In relation to reasoning, impedance can be manifested as slower cognition. An interesting experiment has been conducted and described in the works of Knauff et al. [30,31]. They show that with, for example visuospatial relations, if the content yields information relevant to an inference, then reasoning proceeds smoothly. But, if the content yields visual images that are irrelevant to an inference, as is the case with visual relations (such as for example left and right), then reasoning of sighted persons is impeded and takes reliably longer. People who are blind from birth are immune to such impedance effects, since they are not accustomed to using visual imagery. There is much evidence indicating that overcrowded websites with flashing texts and animations have high level of visual impedance.

Further, we need some standard visual language vocabulary:

- ***visual metaphor*** - *representation of a new system by means of visual attributes corresponding to a different system, familiar to the user, which behaves in a similar way.*
- ***visual analogy*** - *representation of a new system by means of visual attributes corresponding to a similar system, familiar to the user.*
- ***visual association*** - *representation of a familiar system by means of visual attributes corresponding to*

a different system, in order to make the user associate the two systems.

- ***visual abduction*** *occurs when hypotheses are instantly derived from a stored series of previous similar experiences. It covers a mental procedure that tapers into a non-inferential one, and falls into the category of perception [32]. This is similar to what Turner [33] calls "parables" and proposes as explanatory of reasoning.*

B. Polyscopy and visual language design characteristics

The polyscopic modeling ideogram from Figure 2 may be used here to connect the discussion on the structuring of information with its visual properties.

The circle now represent the high level information, but what about its presentation?

There is, of course, no single answer to this question, but the idea is to present the high level information simply, clearly, as holistically as possible, using images, ideograms, visual metaphors, associations, abductions etc. Visual immediacy and/or visual impetus should be designed into presentation in a conscious manner. For example, metaphors frequently posses visual impetus, but no visual immediacy when the image is seen for the first time. However, recall of the metaphor is immediate upon consequent viewing. For example, the following

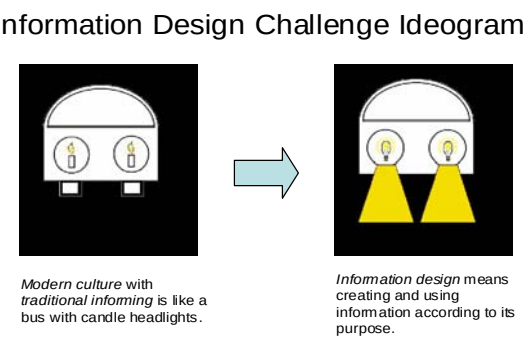

Figure 4. Information Design Challenge

visual metaphor might cause curiosity, but without reading the text, it would not have any meaning at the first glance. In terms of characteristics, the representation has some level of visual impetus and law level of visual immediacy. In contrast, Figure 1, uses visual association and has larger level of immediacy. Depending on the predicted usage of the site, one can design in such a way that desired characteristic is present to a larger degree.

Basic guidelines for design are thus: the text and images work together to communicate the message according to the polyscopic principles. High level information needs to be designed with large level of visual immediacy and/or impetus. The low level information should be designed in such a way that there is as little visual impedance as possible. In learning environments, polyscopic topic maps are en excellent choice for structuring information, and with some creativity and consciously designing into their presentation visual immediacy and impetus, they may be truly a fantastic learning device, combining quality of information with artistic visual expression [34].

V. CONCLUDING REMARKS

While polyscopy is a tool for design of information in general, combined with polyscopic topic maps it becomes a fantastic tool for Web based learning. Polyscopic Topic Maps support good thinking and learning habits. The *levels* allow us to distinguish what is fundamental from what is ephemeral, the large picture from the detail. The *aspects* allow us to control the complexity by distinguishing between different angles of looking (technical, humanistic, philosophical etc.) while still keeping them together. They are also particularly suitable for multi-disciplinarity, inter-disciplinarity and trans-disciplinarity learning and research. They allow for overcoming the separation between the humanistic and the technical aspects of an issue, which needs to be encouraged.

Polyscopic approach, combined with visual intelligence promise to deliver really sound approach to large portion of Web design needs (see for example [35]). The work on understanding visual intelligence, and in particular visual and spatial reasoning, is still in its young age, but definitely worth pursuing.

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