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Perspectives on Visual Learning

Learning and Technology in Historical Perspective

Edited by András Benedek and Kristóf Nyíri

Hungarian Academy of Sciences / Budapest University of Technology and Economics

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Volume 2

Hungarian Academy of Sciences
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András Benedek / Kristóf Nyíri (eds.)

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Contents

András Benedek

Preface

The chapters in this volume emerged, after an arduous process of peer-reviewed selection and careful editing, from the talks given at the 8th Budapest Visual Learning Conference (VLC8), held on April 26–28, 2018. The volume is the second one in an envisaged series of three. The title of the first volume, published in March 2019, is *Vision Fulfilled: The Victory of the Pictorial Turn*, while that of the planned third: *Image and Metaphor in the New Century*.

As explained in the Preface to the first volume, VLC8 was preceded by seven earlier conferences, which in their turn were based on the activities of the Budapest Visual Learning Lab (VLL – www.facebook.com/BudapestVisualLearningLab), established at the Department of Technical Education, Budapest University of Technology and Economics, in October 2009, by Kristóf Nyíri and myself. In my introductory chapter to the first volume I have provided a detailed history of the Budapest Visual Learning Lab, as well as a summary of the fundamental transformations education in the Western world has undergone in the past few centuries, and of the challenges educational theory and practice now face. It is these transformations and challenges that form the topic of the present volume.

The volume's first part, VISUAL LEARNING, is made up of five chapters. István Bessenyei's essay "Curriculum Innovation and Visual Learning" brilliantly sets the stage. As Bessenyei stresses: despite today's prevalence of information and communication technology, it is the printed book that remains the core media in schools. There is no room for visual and/or networked learning forms. Bessenyei offers a detailed and indeed profound program of possible classroom educational alternatives. A basic dimension of those alternatives is outlined in Andrea Kárpáti's chapter "Art Education of Youth Subcultures – From Child Art to the Visual Language of Adolescents:

Changing Concepts of Creativity in Art Education". As Kárpáti puts it, the 21th century, characterized by participatory culture, witnesses an increased influence of visual media, and young people acquire a media-influenced visual language from each other, through informal learning, rather than from their school teachers. The chapter provides an overview of the ongoing research on the visual competence of adolescents, calling for a shift of educational focus from "fine" or "high" art towards a wider interpretation of youth culture. The next chapter, "Picture Analysis: Creating a History of Childhood", by Orsolya Endrődy-Nagy, claims that regardless of the era, time, region, ethnicity or gender, Childhood Studies researchers should analyze images and texts in equal measure in their investigations. The chapter offers a summary of important results in Childhood Studies, gained with the help of visual analysis and iconography. Visuality, children and education are the topic also of the following chapter, by Colleen Fitzpatrick. She focusses on what it involves for children to draw and paint. Building on the work of philosopher and art historian Paul Crowther, she emphasizes the essential role of physical gestures in the production of drawings and paintings. Such gestures are not fully present when pictorial expression unfolds in a digital environment. As Fitzpatrick puts it: while figurative paintings date back to around 40,000 years ago, "[c]urrently young people are experiencing a barrage of disembodied digital practices on devices and this calls for a counter-balance". The closing chapter, Gyöngyvér Horváth's "Visual Learning in Storytelling Images: Emotional Narrative", offers a fascinating analysis of how, "[b]eyond their didactic and dogmatic function, narrative pictures effect us on a physical, bodily level", drawing attention to the scientifically established fact that specifically the *mirror neuron system* plays an essential role in the mediation of empathic responses. To quote a striking passage from the chapter: "It is indeed hard to underestimate the significance of moral and intellectual teachings as communicated through pictorial narratives. But narrative images do more. They provide a sense of the past, proclaim official or alternative versions of history, show roles in society, keep personal memories, offer solace, give the hope of salvation, and through our bodies, with a wide range of sensations, they teach us to connect

with others and navigate in the world." And another passage: "Images bring unmediated sensuality. They have an instant, physical effect, and perhaps this is the most fundamental difference between written and visual modes of expression. Storytelling pictures touch us on elementary, visceral level…"

The second part of the present volume, IMAGE AND SYMBOL: AN EARLY HISTORY OF DIAGRAMS, offers detailed historical analyses on a topic that was already introduced in our first volume, in the papers of Neuman and of Moktefi. Diagrams of course display a vast variety, but they are, invariably, syntheses of the visual and the textual. Insights into their nature are so many discoveries about the way the pictorial and the verbal interact. In the volume three chapters are treating this topic. The first one, "The Role of Aristotelian Diagrams in Scientific Communication", by Lorenz Demey, draws attention to an intriguing phenomenon: Aristotelian diagrams today enjoy widespread use, even beyond philosophy and logic, in a number of disciplines, such as for instance linguistics, cognitive science, artificial intelligence. An Aristotelian diagram, to quote the definition Demey begins with, is "a visual representation of a number of formulas or expressions, and certain logical relations holding between them (in particular, contradiction, (sub)contrariety and subalternation)". What might be the attraction of such a diagram for contemporary science? The hypothesis Demey entertains is that Aristotelian diagrams function as specific heuristic tools that enable researchers to find unexpected analogies between at first sight unrelated logical, philosophical and scientific frameworks. – We are coming to the next chapter, Anna Somfai's captivating "Déjà Vu? Visual Thinking in Medieval Manuscripts and Imaging the Unimaginable". Medieval manuscripts are, for Somfai, "an exceptional source for studying visual thinking". She argues that "studying layouts and diagrams allows us a glimpse of the creativity and originality of the medieval mind, with broader contributions to the enquiry into visual thinking throughout the ages". Somfai sketches and explains a number of medieval diagrams, and also reproduces in colour, and comments on, two spectacularly interesting manuscript pages. I cannot summarize the chapter better than by quoting this passage of hers: "The medieval manuscript mise-en-

page with its various visual elements provides a visual thinker with a genuine work surface. The structure of the layout is a personalized page for intellectual output and intake. Constantly using books having been designed this way meant that medieval readers developed a sense for visual structuring, they emulated it and I suggest it became their learning strategy. Diagrammatic thinking was part of the visual vocabulary." Finally, the chapter "Shaping Operations like Images: Operation Diagrams in Ramus's *Algebra* (1560)", by François Loget, discusses the mathematical work of Peter Ramus, a prominent figure of the French Renaissance. Loget focusses on Ramus's so-called operation diagrams, in particular on their iconic dimension, and raises the question whether there are here connections between the history of mathematics on the one hand and the history of book printing on the other. His answer is that, in the case of Ramus, the search for a specific language for mathematics is indeed connected to his exploiting the possibilities of the printing press.

The third part of our volume, LEARNING IN THE DIGITAL AGE, begins with a chapter on 3D technology, augmented and virtual reality. With the assistance of 3D technology, "the physical world", as the author of the chapter, Kinga Biró puts it, "can be expanded with virtual elements (e.g. 3D models, videos and animations) that merge into the real-life environment". One of the introductory passages of the chapter provides an excellent summary of the author's main message: 2D technology "is not simply a tool, but it allows a student to explore, experience or be involved, as if they were actually present in the environment. The educational experiences using the technology will be entertaining, enjoyable and motivating. This technology is a part of the students' lives. In a world where students consume media, virtual reality helps the educators to teach students about new ways of constructing narratives." The following chapter, by István Danka, "Gamification: Old Wine in New Bottles", is perhaps slightly less enthusiastic about the educational value of new entertaining technologies. This is how the chapter begins: "A serious challenge online education has not been able to overcome is motivating learners. A most recent hope for many to solve this problem is gamification, i.e., developing educational techniques that build on an analogy between

educational environments and (video) games. Gamification is attractive because games are especially motivating. Applying their benefits to education can help learners get committed to learning. I shall argue that gamification is an old wine in new bottles because the educational technique it applies is not novel. As a synthesizing framework, gamification can be effective, insofar as the old and new elements it synthesizes can work together effectively. But if gamification is educationally useful, it is useful partly because of the old educational techniques, and their compatibility with technological advantages." The concluding chapter of this part of the present volume, by János Horváth Cz., is "Microcontents: Visual Content Management in a Networked World". Microcontents are compact multimedia products, in terms of text and image typically not extending the size of a small display. As Horváth Cz. points out, the construction rules for an mC vary from community to community, indeed from individual to individual, the main requirements being that a microcontent "has to be created, published, shared and understood very quickly and easily". Horváth Cz. has developed a novel system of microcontent construction and application, presenting his ideas in an essentially Neurath-inspired broad image-theoretical framework.

We are coming to this volume's the last part: TOWARDS A VISUAL FUTURE. The first chapter, by Dóra Horváth, Attila Cosovan, and Zita Komár, with the impressively *dernier cri* title #Visual #Communication #Development (I have refrained here from inserting quotation marks), and the explanatory subtitle "Designcommunication Projects Integrated into the Education of Future Economists", describes an approach, elaborated by the authors, which puts students into designer roles, allowing them visual expression, and a so to speak holistic view. Designcommunication, the authors stress, is compounded of two inseparable notions: design and communication. It creates, as the authors put it, "a real-time connection among classroom learning, research and entrepreneurship". With the following chapter, "The New Body of Medial Images in The Urban Space: Audio-Visual Narratives, Virtual and Augmented Reality", by Rita Lisa Vella and Anna Chiara Sabatino, the reader is returned to a topic earlier introduced by Kinga Biró, albeit here discussed from a very different perspec-

tive. As Vella and Sabatino put it, "our cities are full of commercial screens and electronic devices, and surveillance cameras are always on. The media are reshaping the human experience developing different kinds of visuality and narratives". The chapter aims to "understand and interpret the role of the new medial images in the urban context and, in particular, the contributions of these images to building and sharing specific urban narratives and identities". Finally, the chapter by Theo Hug exploits and discusses the example of a recently established Austrian literary estate archive to demonstrate the radically changing tasks of humanities today. Archiving, the author reminds us, is "one of the oldest activities of humankind. From ancient practices of keeping documents to contemporary forms of archiving, records of administrative, commercial, social or spiritual activities have been generated in various cultural forms throughout history. We find continuities and upheavals, and sometimes most recent forms of preservation and mediation remind us of ancient practices." Of those continuities and upheavals this chapter presents a fascinating picture.

Let me here thank my co-editor, Kristóf Nyíri, for his role in bringing to completion the chapters in this volume. Also, I feel it appropriate to recall on this occasion that Nyíri's earlier publications on our present topic had a not negligible impact in the professional circles I work. To mention just three of those publications: "Open and Distance Learning in an Historical Perspective" (*European Journal of Education*, vol. 32, no. 4, 1997); "Towards a Philosophy of Virtual Education" (in Marilyn Deegan and Harold Short, eds., *DRH 99*, London: King's College, 2000; "Towards a Philosophy of M-Learning" (in M. Milrad et al., eds., *Wireless and Mobile Technologies in Education*, Los Alamitos, CA: IEEE Computer Society, 2002).

In the series *Perspectives on Visual Learning* we do not follow the today dominant convention of indicating, for internet references, the date when authors last accessed the site they quote. Rather, each internet reference has been checked by the editors; all internet references contained in this volume were valid at the time the material was sent to the printers.

March 2019

VISUAL LEARNING

István Bessenyei

Curriculum Innovation and Visual Learning

1. Introduction

The purpose of this chapter is to designate the place and role of visual learning in the hyper-medial plateau network. Referring to Jeanette Böhme's book,[1] the chapter describes the potential topics specific to the application of six possible media plateaus: Iconic Plateau, Phono Plateau, Alpha Plateau, Action Plateau, Numero Plateau and Talk Plateau, and seeks a strategy for finding the place of visual learning within a new hyper-medial school network architecture. The key questions of the study include how to describe the hyper-medial plateau network, and how to manage their connections to several "learning objects", working groups, and output requirements. The study also emphasizes that new networking competences can only be developed if the school learning organization takes time to learn about the properties of the platforms. In addition, organizations must learn how to utilize the relationships between these and how to foster teamwork. The chapter presents examples of the classroom learning potential of the plateaus through family history, foreign languages, and math. Finally, the paper aims to point out the educational policy obstacles that hinder the introduction of innovative learning networks. One of these obstactles include the school's insistence on the monopoly of the book (of the typographic plateau) and the typical characteristics of a strong process- and input-regulated system compared with a more liberal output-steered learning organization system.

[1] Jeanette Böhme, *Schule am Ende der Buchkultur: Medientheoretische Begründungen schulischer Bildungsarchitekturen* [School at the end of book culture: Media theoretic foundations of school educational architectures], Bad Heilbrunn: Klinkhardt, 2006.

Despite the prevalence of information and communication technology, the book remains the core media in schools. Due to the plurality of cognition and communication opportunities, the book culture of schools is under pressure to justify the old learning forms in light of fears about the disintegration of traditional school structures. Thus, the myths of book culture are diligently cultivated in schools. The underrating of the educational significance of ICT (secondary orality[2]) and the inflating of the educational significance of printed educational architectures (as the last central school education monopoly) can be attributed to this. Didactic innovations tailored to the needs of multimedia-socialized students (query-based learning, gaming, knowledge sharing, connectivism, visual learning) are strongly opposed. There is no room for visual learning forms or for the sensual cognition possibilities of the new networked environment. Systems based on unified educational inputs – and those that strive for ideological monopoly – reject output routing based on free choice and variety of content and methods and insist on cognitive linearity. Rather than taking advantage of the derivative communication, tradition-transfer, and learning cultures in a complementary way, schools tend to demonize or block new developments. As a consequence, the school remains a provincial "typographic domain". Most schools in the present system keep the monopoly of the book (of the typographic plateau) in sequential, linear, bureaucratically directed, predominantly input-regulated curricula. "Transmedial socialized nomads" (Böhme) do not find their place in this world, even if they are ideally suited to accept and acquire new abilities. What new organizational structures are needed to involve other media in the learning process? What new abilities (knowledge, skills, competencies, literacies) do we need in detail? What are the educational policy conditions for curriculum innovation?

[2] That is, a new oral culture building on the literacy of the preceding centuries. See esp. Walter J. Ong, *Orality and Literacy: The Technologizing of the Word*, London: Methuen, 1982.

2. The Space of Visual Learning in a Hyper-Medial Plateau Network

What place can visual learning occupy in a learning environment that gives up its one-sided and monopolistic book culture and involves a wider range of networked media in the learning process? Jeanette Böhme suggests a hyper-medial network with the following possible plateaus: Iconic Plateau, Phono Plateau, Alpha Plateau, Action Plateau, Talk Plateau, and Numero Plateau. Böhme describes the nature of the plateaus as follows: The Plateaus are

> algorithmically shaped by a specific grammar, in which specific spatio-temporal relations of cultural orders will be manifested, and synesthetic relations of modes of perception are preferred. Plateaus can be loosely coupled by links, shift into each other, and amplify each other in their potency. However, these interferences shape themselves specifically depending on educational processes, which are not linearly coherent, but spatio-temporally simultaneous and synesthetically variable, thus rhizomatically processed by the plateau structure.[3]

Therefore, the plateaus do not represent a curriculum form, but are spatially and time-widened systems of media-specific communication networks requiring competences that differ significantly from the needs of traditional reading and definition based school curricula. Each plateau represents a dominant communication medium: visual (audio-visual), oral (talk), alphabetic, phono, math, or performance. *The approach also offers the opportunity to focus attention on a topic with a deliberate choice of media in the cross-dimensional range of images, sounds, and texts.*

Figure 1 briefly summarizes the communicative-performative potential of each plateau in (mixed) terms of topics, actions or performances (see also Figures 2–4 and 6–7 below).

[3] Böhme, *op. cit.*, pp. 134 f.

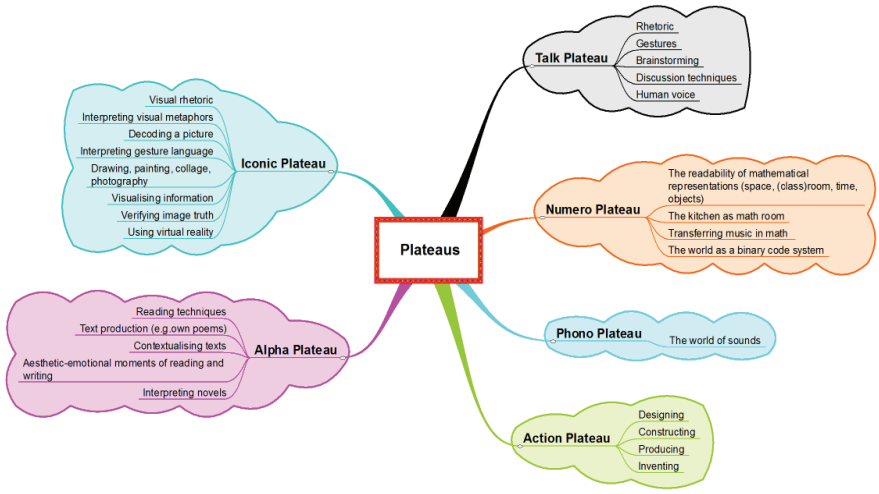

Figure 1: The Plateaus.

Böhme's approach deconstructs traditional frameworks within the school and makes the medial transfer channels multidimensional and flexible. The plateaus have many synergy possibilities. For example, the combination of Alpha and Iconic plateaus leads to the following questions: What are the distinctions between the handwritten and printed word, between alphabetic and pictographic writing systems? What is the relationship between layout and content? How can there be a reflexive connection of media design possibilities?[4]

3. The Competence Approach

Questions, activities, and forms of knowledge (information, knowledge, master knowledge, skill, and literacy) are almost inseparable in a complex pedagogical process. For this reason, it is expedient to use

[4] *Ibid.*, pp. 137 f.

the concept of "competence".[5] This concept circumvents the difficulties of defining the many types of knowledge by curriculum development, and uses the interconnected set of knowledge as a basis.[6] It is no accident that the pragmatic Anglo-Saxon world is spreading; learning requirements and outcomes are defined in integrative, detailed, well-structured categories of competences.

To overcome confusions in definition of knowledge types, Anglo-Saxon school policy has attempted to solve the problem by introducing output regulation instead of input control. This means that, in addition to a well-built quality assurance system, the capabilities to be achieved are defined as competences ("to be able to…") in the form of competence-based catalogs not by strongly defining the obligatory inputs, but rather the well defined outputs.[7] This liberalized the choice possibilities between methods and contents and created the bridge between the definition of cognitive and manual processes.

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[5] Theo Hug analyzed in detail the differences between several competence and literacy approaches, see his "Media Competence and Visual Literacy – Towards Considerations beyond Literacies", *Periodica Polytechnica: Social and Management Sciences*, vol. 20, issue 2 (2012), pp. 115–125.

[6] German brain researcher Ernst Pöppel cuts the Gordian knot of knowledge definitions by maintaining that there are three types of knowledge, namely which we are able to communicate, which we are able to do *and, which we are able to imagine*. See Ernst Pöppel, "Drei Welten des Wissens: Koordinaten einer Wissenswelt" [Three worlds of knowledge: Coordinates of a knowledge world], in Christa Maar – Hans Ulbrich Obrist – Ernst Pöppel (eds.) *Weltwissen Wissenswelt: Das globale Netz von Text und Bild*, Köln: DuMont Verlag, 2000, pp. 21–39.

[7] George Siemens developed a network learning theory called "connectivism". Siemens focused on the social character of knowledge acquisition and included the following competencies, among others, as prerequisites for successful network learning: the ability to synthesize and recognize connections and patterns; the ability to draw distinctions between important and unimportant information; an organization's ability to foster, nurture, and synthesize the impacts of varying views of information; ability to see connections between fields, ideas, and concepts; ability to make common decision processes; ability to co-create knowledge. See "Connectivism: A Learning Theory for the Digital Age", *International Journal of Instructional Technology & Distance Learning*, vol. 2, no. 1 (January 2005), http://www.itdl.org/journal/jan_05/article01.htm.

Jenkins's meta-competence suggestions for the new ability needs of the information society relate primarily to interactions in the digital world. According to Jenkins, the new skills could be the following:

1. Play — the capacity to experiment with one's surroundings as a form of problem-solving
2. Performance — the ability to adopt alternative identities for the purpose of improvisation and discovery
3. Simulation — the ability to interpret and construct dynamic models of real-world processes
4. Appropriation — the ability to meaningfully sample and remix media content
5. Multitasking — the ability to scan one's environment and shift focus as needed to salient details
6. Distributed Cognition — the ability to interact meaningfully with tools that expand mental capacities
7. Collective Intelligence — the ability to pool knowledge and compare notes with others toward a common goal
8. Judgment — the ability to evaluate the reliability and credibility of different information sources, source consciousness
9. Transmedial Navigation — the ability to follow the flow of stories and information across multiple modalities
10. Networking — the ability to search for, synthesize, and disseminate information
11. Negotiation — the ability to travel across diverse communities, discerning and respecting multiple perspectives, and grasping and following alternative norms.[8]

Box 1: Jenkins's Competencies.

This meta-competence list encompasses a much wider spectrum than standard media competence definitions, most of which rely

[8] Henry Jenkins et al., *Confronting the Challenges of Participatory Culture: Media Education for the 21st Century*, Cambridge, MA: MIT Press, 2009, p. xiv.

solely on the handling of virtual tools. When approaching the theme of visual learning, we need to go a step further towards concretizing. Kristóf Nyíri's listing of the main areas of the theory of image provides inspiration for breaking down the visual learning steps into more concrete competences and tasks for the visual learning approach.[9] Nyíri's listing:

- Iconology, the icon theme at the beginning of computer age
- Mental images
- Image meaning, visual similarity, verifying image truth
- The language of advertisements
- Imagery
- Image problem in conceptual metaphor theory
- Visual metaphors
- Visual rhetoric
- The gesture language
- Children's drawing
- Comics
- Film theories
- Visualization of information

Box 2: A List Derived from the Theories of Images.

How can these meta-skills be broken down into more concrete, school-relevant, visual learning competences that include some possible topic areas of the Iconic Plateau? The following expandable list encloses some possible categories of such competences, which can help define the output requirements:

[9] Kristóf Nyíri, "Elfelejtett képelméletek" [Forgotten Theories of the Image], *Visual Learning Lab Papers*, ed. by András Benedek and Kristóf Nyíri, issue 3 (2016/3), pp. 3–55, see https://www.academia.edu/29571702/Forgotten_Theories_of_the_Image_in_Hungarian, this list on p. 4.

The ability of…
• Transferring between textual and visual expression forms
• Interpreting, paraphrasing, classifying visual phenomenon
• Encoding and deciphering imagery
• Collecting and tagging old family photos with similar age images
• Comparing old and new family photos and interpreting the differences and similarities
• Searching suitable illustrations for given topics, choosing tools for illustrations
• Collecting photographs and paintings of professions and activities, no existing today
• Categorizing and tagging the own childhood photos
• Interpreting photos from point of view of hierarchy, power relations, fashion
• Exemplifying with visual information
• Locating the old and new residence of family members on a map, interpreting mobility direction
• Using video blogging
• Selecting appropriate visual methods of presenting data
• Connecting the processes of family or local history with processes of world history, described in the textbook (or looked on a video document)
• Making live story interviews, identifying life story nodes
• Constructing collaborative documents
• Creating comics, cartoons
• Validating analog and digital image sources
• Creating collage to given topics
• Using online graphic tools
• Using images as conceptual tools

Box 3: Special Iconic Plateau Abilities.

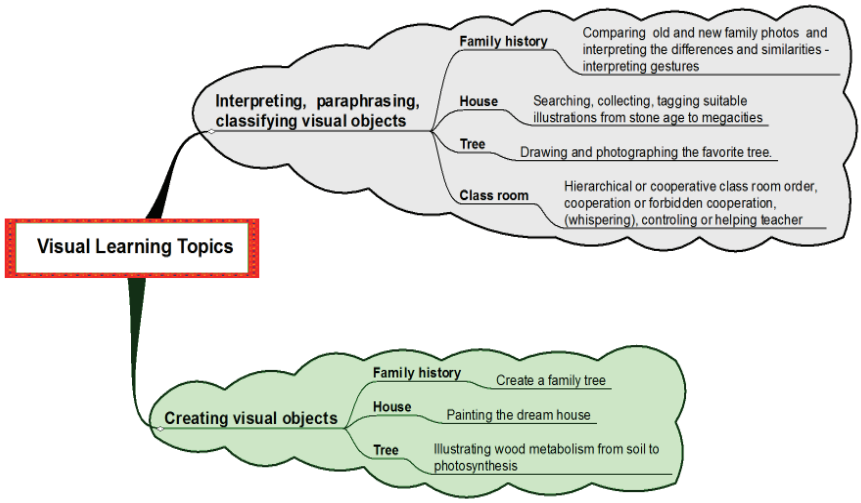


Figure 2: Concrete Examples for Iconic Plateau Competencies.

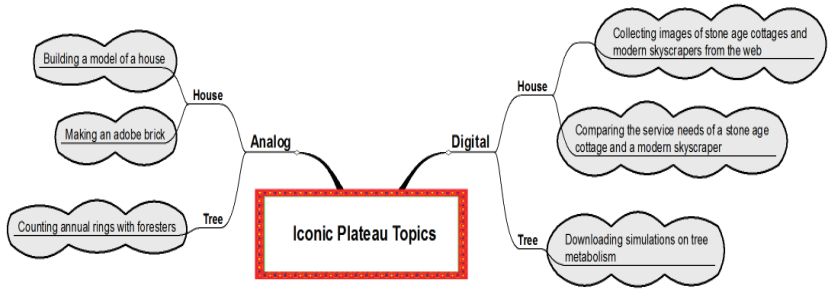


Figure 3: Analog and Digital Visual Learning Topics on Iconic Plateau.

A possible visual learning topic could be, including the Iconic and Talk Plateaus, the interpretation of various class room photos. The abstraction level of interpretations could be ranged from elemen-

tary emotional commentaries to Foucault's approach on observation and punishment as school system function.

- Hierarchical or cooperative room order
- Cooperation or forbidden cooperation
- Differences to own classroom
- Which solution is cheaper? In the short term and in the longer term?
- Which solution is more effective? In the short term and in the longer term?
- Where are the limits of strictness and leniency?

Box 4: Interpreting Classroom Images.

4. Learning Areas in the Hyper-medial Plateau Network

In the world of artificial intelligence and neural networks, machines take on an increasing number of functions from humans, and databases store an increasing amount of retrievable knowledge. For this reason Jack Ma, the chairman of the internet giant Ali Baba, suggested: "Students should above all learn what makes them different from machines: teamwork, art, music." What else is specifically human? Love, empathy, innovative and intuitive thinking, ethical behaviour in the case of the latter learned formally through concrete decision examples. This list also includes "source consciousness", the ability to choose, and the ability to store and organize knowledge. *Of course, these can only be incorporated into the system of school learning if the curricula of mass education and book-text based learning will be reduced significantly.* Instead of commenting on unwieldy book texts based on linearity and sequentiality, students should have much more time to collaborate, to develop the ability to select information, to get to know and exploit the possibilities of the hyper-medial networks. Therefore Böhme suggests that the organizational design of the transmedial network architecture (the possibil-

ities of networking) and the learning sources; the nature, levels and content potential of the media plateaus; the crossover organization between methodological tools and central questions, and team work must also be separate, introductory learning phases.

1. The first important learning area is, therefore, the *organizational design of the transmedial architecture***,** the logistic for synesthetic movement between hypermedia networks, a crossover organization between methodological tools and central questions.
2. A second learning area is *the management of network processes* from the viewpoint of time, personnel and professional questions: the problem of modality, of how groups can be linked to the cognition paths opened by the plateaus.
3. The content of the possible third learning area could be a *formal method training* of variable forms of cultural appropriation, reflexive-hermeneutic penetration of media-specific coding programs, testing of meaningful design potentials in the exploration and processing of topics and problems.[10] Here students can practice the connection between the content (issues) and interfaces.
4. Areas of *source consciousness* could be attached to this content*:* techniques of information validity, web security, mobbing, dependency, personality rights and copyrights, and the use of online-tools.
5. The main goal in this learning area is the *development of team competence* using collective, communicative activities in the thematic work groups. The network manager of the work group can arrange different forms of synergy between thematic groups and plateau contents. The group can select members responsible for different areas: time management, rule management, external connections, presentation management, mediating, tutoring, and promoting of young talents.[11] A spe-

[10] Böhme, *op. cit*., p.137.
[11] *Ibid.*, p. 138.

cial theme in this package could be the *use of several suitable online or analog tools.*

6. *Select, designate, rework, and discuss themes, problem areas, and question complexes in group work,* as in Dewey's school democracy approach. In this topic, the group chooses and discusses socio-cultural relevant issues and problem complexes related to the physical environment or to society. (Can any phenomenon of the physical environment be described in terms of math? What is the path from kitchen math to Einstein, from a Stone Age shanty to a global village or to skyscrapers, from tribal society to globalization?) After discursive identifying of the main issues, the learning group discusses which plateaus can open the best possibilities for the given learning goal. In this way, a three dimensional hyper-medial "neuronal network" that connects thematic groups, themes, and cognitive paths can be formed.

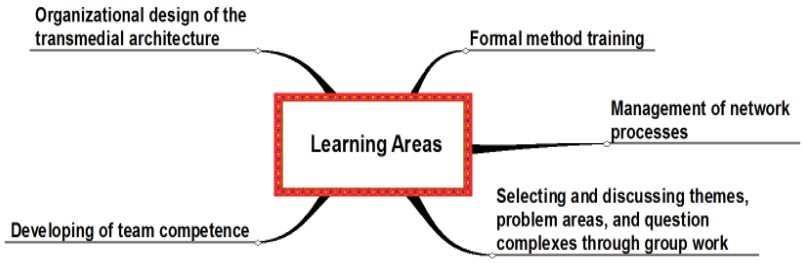


Figure 4: Summary of Learning Areas.

The organization of the whole process can begin by selecting the competences related to the subjects to be discussed in the given period and then by listing the available activities (tasks). But if we choose the query-based method, gathering student questions about a given subject could also be the first step. As a second step, the question groups could be arranged and assigned to such competencies and tasks that can help provide solutions.

5. Classroom Activities

5.1. The Example of Family History

Family history topics can be a good way to initiate the Iconic Plateau in learning (analyzing old family photos), the Talk Plateau (grandmother telling a story), the Alpha Plateau (digitizing grandmother's cookbook, searching for interpretative places in the textbook about family history nodes), and the Phono Plateau (recording stories about family history).

Family history and family research – the preservation and cultivation of a personal cultural heritage and the search for identity – are inceasingly popular. There are institutes for the creation and maintenance of "oral history" archives, and books on the interpretation of oral narratives. Nevertheless, in the formal, often ideologically influenced teaching of history, the family history receives only scanty and inconsistent space.

We could also imagine a curriculum in which family history – perhaps falling back in time – would play a greater role. Stories of living grandparents and parents, changes or continuity in their occupations, diaries, digitally stored histories, customs and feasts, cooking and baking recipes could be used to bring some historical processes closer to student life. (Given that the interpretation of the differences between the story and the history may raise serious questions of theoretical aspects, it is recommended to plan a teacher training curriculum around this issue.)

In a query-based learning environment, the following questions and actions may arise:

- How many years of family history do we know? What happened in the environment, in the city, in the country, in the world?
- What is the difference between grandmother's recipe book and the recipes from internet search results?
- What were the major lifestyle differences?

- What did not exist in our grandparents' age?
- What are the style and content differences between conventional mail and email?
- How is an old diary different from a carefully crafted blog?
- What do old photos reveal about photography rituals and stratification?
- How expansive was territorial mobility?
- Where does you closest relative live?
- What do old family photos say about lifestyle, work, and holidays?
- What were their jobs? Which do not exist today? For example, why did the literacy and typesetter professions and the numerous agricultural activities (threshing machine) disappear?
- What do the old photos reveal about social stratification?

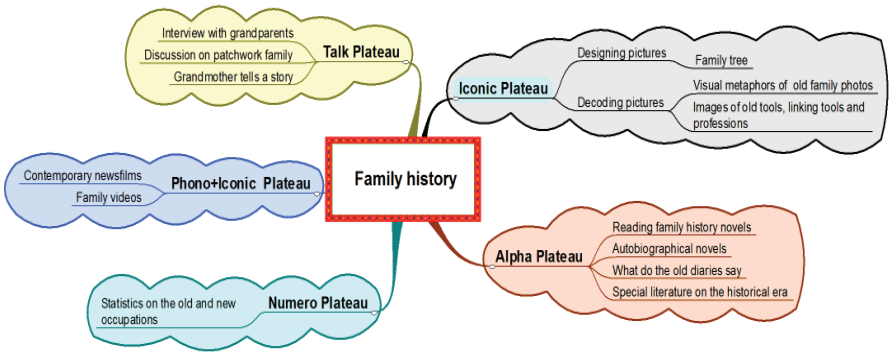
Box 5: Family History Questions.

- Collecting old letters, diaries, and other documents;
- Collecting, digitizing and systematizing family photographs;
- Making a genealogy;
- Voice recording of grandparents, parents, and relatives (live story, storytelling);
- Searching for novels by the great writers, selecting one, referring to it.

Box 6: Family History Activities.

Figure 5 summarizes the potential of plateaus to discuss family history:

Figure 5: Family History as Plateau Synergies:



4.2. The Example of Visualizing Math

To take another example, the Numero Plateau can provide a variety of synergetic forms for visual learning in both mathematics and physics. Jeremiah Ruesch compiled a useful tool list relating to visualizing math:[12]

tape diagrams
area model
number talks
graphs
number lines
animations

[12] Jeremiah Ruesch, "The Power of Visualization in Math", *Edutopia*, Sept. 8, 2017, https://www.edutopia.org/article/power-visualization-math.

splat
dud math
youcubed
geogebra
demos
visual patterns
estimation 180

Box 7: Tools relating to visualizing math.

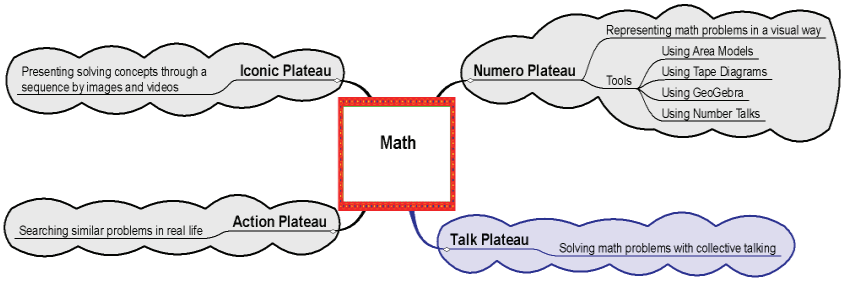


Figure 6: Visualizing Math.

5.3. Examples for Synergies in Learning of Foreign Languages

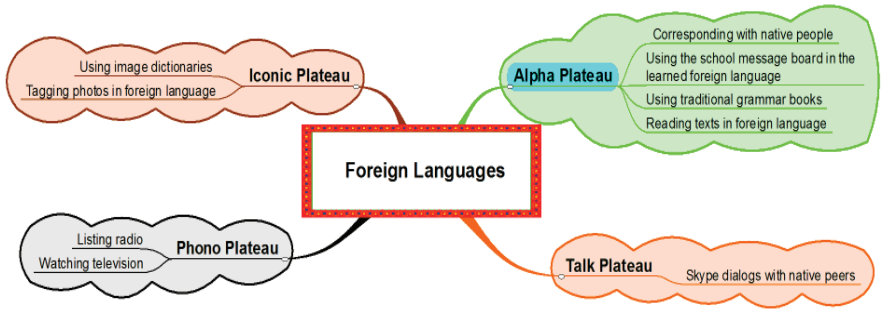


Figure 7: Foreign Languages.

6. Educational Policy Requirements

The multi-faceted involvement of media, the development of teachers' media literacy, the other school architecture of space and time constitute a real "curricular turn" likely to be conceived in a more open school system with output regulation. The following box includes the (ideal-typical) description of the input and output steered systems:

Input and process-controlled systems	Output regulated systems
Regulation	
Authoritarian system	Democratic system
Strong and detailed determination of methods and processes	Freedom in the choosing of processes and methods
Bureaucratically limited procedure models, resources and contents	Offering a wide range of methods, resources and contents
Strong, linear, sequential curricula, based on monopoly of textbooks	Deconstruction of traditional curricula; the correct placement of typographic platforms in the network

Strong top-down determination of contents	Top-down and bottom-up approaches in content creation through negotiation
Centralized establishment of learning objects and textbooks	Decentralized, discursive framing of output requirements
Ideologically determined contents	Controversial contents
Controlling	
Bureaucratic quality control	Quality management, based on methodology competences of teacher; self-evaluation
Outcome control by marks and examinations	Outcome evaluation by self-evaluation and advising
Read, define, and solve control tasks	Definition of problems, collecting sources, peer review
Penalty for deviation from the prescribed point of view	Targeted training for the change of point of view
Learning algorithms	
Linear, for structured-learning algorithms	Situated, context-dependent learning algorithms
Individual knowledge acquisition	Collective knowledge acquisition
Fact-centered concepts	Problem-centered concepts
Coding systems	
Using middle-class language codes, strong printed text-based framing	Using multi-dimensional coding, open framing
Textual centered language	Using new visual language as well (visual codes)
Motivation	
Strict supervision-based system	Curiosity-based system
Focusing on errors; non- motivation	Success-based motivation
Punishment as motivation	Curiosity and appreciation as motivation
No place for spontaneity	Place for spontaneity
Internalized efficiency ethics	Joy in cognition
Education as a system of top-down instructions	Education as a system of horizontal connections

Box 8: Comparing Input-regulated and Output-steered Educational Policy.

The main steps and terms of an “innovative curricular turn” can be summarized as follows: less bureaucratic definition of content, processes and methods; more space and time for self-organizing learning; balanced and versatile use of several media**;** ability to focus on capturing essential content from the sea of images; and of course a "curricular turn" not only in the school organizational architecture, but in teacher training and further training too.

Andrea Kárpáti

Art Education of Youth Subcultures
From Child Art to the Visual Language of Adolescents: Changing Concepts of Creativity in Art Education

1. Setting the Stage

"*Child art*" *as an aesthetic concept* is the invention of the first decades of the 20th century. Children's paintings and drawings arrived at the walls of exhibition spaces around the 1910s, in exhibitions organised by Franz Cižek at the Academy of Applied Arts in Vienna, by Ebenezer Cooke in London, at the Royal Graphic Arts Society, and by László Nagy, at the Art Hall of Budapest. John Dewey equalled child art with high art in his landmark work, *Art as Experience.*[1] "Drawing Studies" (Zeichenunterricht, l'enseignement du dessin) were renamed as Art Education or Education through Art, (künstlerische Erziehung, l'enseignement des arts plastiques). At these shows, technical virtuosity of young creators was praised – a characteristic feature that does not necessarily foretell future artistic excellence as directly as performing skills in music do.[2] None of the exhibitors in Budapest, for example, achieved artistic fame later, unlike the young musician, Yehudi Menuhin, who performed at the opening. In pursuit of talent development, art education curricula of the first half of the 20th century taught a "school art style", in conformity with academic ideals about the arts but in total disconformity

[1] John Dewey, *Art as Experience*, New York: Minton, Balch & Company, 1934.
[2] Mary Stankewitz, "Constructing an International History of Art Education: Periods, Patterns and Principles", *The International Journal of Arts Education*, vol. 7, no. 1 (2009), pp. 4–20.

with the emerging new, non-realistic trends that were to shape the future of art: Cubism, Expressionism and Surrealism.[3]

2. Reading Read

The first empirical studies on graphic skills referred to children's drawings as measures of intellectual maturity or psychomotor ability. Herbert Read[4] and the art education innovation movement he launched in the 1950s changed the discourse from psychological to poetic, through building connections between personality traits and the creative output of children. Read presumed that children assume a certain style of expression – one that will shape their visual language and perception in general far beyond youth. His categories: the *linear* type with a graphic orientation; the *plastic / haptic* who tends to represent bulky volumes through patches of colour, the *imaginative* that is characterised by fantastic images and settings, the *naturalistic*, who in turn will prefer detailed representation of nature, the *realistic*, who expresses characters as seen in life, and the *patterner,* whose creations mainly consist of decorative formal arrangements may be too restrictive, but their introduction was highly important. Focusing on content, rather than formal development, Read called the attention of educators and parents to messages hidden in "artful scribbles". He pioneered a new interpretation of children's visual creations that Howard Gardner[5] established as a new line of research on the emergence and development of visual language – a concept that replaced child art by the beginning of the 21th century.[6]

In the decades following Read's landmark volume commemorated in the name of the largest international association of art edu-

[3] Arthur Efland, "The School Art Style: A Functional Analysis", *Studies in Art Education*, vol. 17, no. 2, (1976), 37–44.
[4] Herbert Read, *Education Through Art*, London: Faber, 1958.
[5] Howard Gardner, *Artful Scribbles*, New York: Basic Books, 1980.
[6] The title of an international collection of papers on assessment in art education shows this change of focus: Andrea Kárpáti and Emil Gaul (eds.), *From Child Art to the Visual Language of Youth*, Bristol: Intellect, 2013.

cators,[7] a disciple of Sigmund Freud, Victor Lowenfeld[8] meticulously described the "*stages of artistic development*" that drew the conceptual map for a fine arts oriented perception of children's artistic styles, sometimes even compared with those of art history. Lowenfeld represents the bridge between the admirers of child art and interpreters of their visual expression. He named the phases of artistic growth in relation to adult perceptions of visual imagery, for example: the Dawn of Realism. He named adolescent artmaking "Gang Age", in reference to the common roots of adolescents' peer group rooted identity and its visual representation. In the seventies, when Brent Wilson (Lowenfeld's successor at the most significant child art study centre in America, the Pennsylvania State University), published his iconoclastic views about the rich and uncharted lands of *visual culture* of the young, the language of vision has already become the dominant mode of expression of the age, and youth seemed to master it first.[9]

3. Participatory Visual Culture

Thus, the 20th century started with the discovery of child art and ended with the celebration of the visual language of adolescents. In the 1960s, the focus of art education practice (and research, consequently), also took a sharp art critical turn, and embraced the contemporary art styles of the age, mainly conceptual and reflecting on contemporary (youth) culture.[10] *The visual language of youth* became the centre of professional discourse, and models of development of graphic skills no longer reflected continuous growth towards realism,

[7] International Society for Education through Art, InSEA, www.insea.org.

[8] Victor Lowenfeld and W. Lambert Brittain, *Creative and Mental Growth*, New York: Macmillan Publishing Company, 1967.

[9] Brent Wilson, "Little Julian's Impure Drawings: Why Children Make Art", *Studies in Art Education,* vol. 17, no. 2 (1976), pp. 45–61.

[10] Andrea Kárpáti and Tünde Simon, "Symbolization in Child Art: Creation and Interpretation of Visual Metaphors", in András Benedek and Kristóf Nyíri (eds.), *The Power of the Image: Emotion, Expression, Explanation*, Frankfurt/M.: Peter Lang, 2014, pp. 143–160.

as this imagery was no longer desirable. Instead, they strived to decipher the sophisticated symbolism and tune in with the strong expressive intentions of visual utterances of all forms – from neat landscape drawings to skateboard decorations.[11]

The 21th century, characterized by *participatory culture*, saw an increased influence of visual media, and young people seem to acquire this media-influenced visual language from each other, through informal learning, and not from their school teachers. This puzzling phenomenon deserves in-depth studies to reveal, if and how art education should interfere with the rich landscape of peer learning in visual arts. Below we will give a brief overview of research on the visual competence of adolescents that calls for a shift of educational focus from "fine" or "high" art towards a wider interpretation of youth culture.

In 2011–13, we studied Visual Culture Learning Communities (VCLCs) where young people engage in art activities 10–20 hours weekly in their free time, without the practical purpose of preparing for a professional career in art or design. Later in this paper, we summarize how these communities function and why their peer-to-peer art training is so popular – in order to support formal education to open up and integrate its values and genres. The research group that first described their activities consisted of members from six countries representing three continents: art educationalists from the University of Cambridge, UK; the Northern Illinois University, U.S.; Aalto University of Arts and Economics, Finland; the Amsterdam Academy of Fine Arts, The Netherlands; Concordia University, Canada; Taihua University, Taiwan, and the Visual Culture Research group of ELTE University, Hungary. Case studies were collected in six cities: Amsterdam, Budapest, Chicago, Helsinki, Montreal and Taipei.[12]

[11] John White, "20th Century Art Education: A Historical Perspective", in Elliot Eisner and Michael Day (eds.), *Handbook of Research and Policy in Art Education*, London: Routledge, 2009, pp. 55–84.

[12] Kerry Freedman, Emiel Hejnen, Mira Kallio-Tavin, Andrea Kárpáti and László Papp, "Visual Culture Networks for Learning: What and How Students Learn in

Our two-year cultural anthropological study focused on individual and group practices in visual culture communities and peer teaching and learning processes. Our results indicate that visual culture groups act as powerful student communities for auto-didactic and peer initiated learning. Art learning occurs in an informal setting, and students frequent these communities *to increase their art knowledge and related life skills* like project planning and management, as well as for *identity building and social networking*. Art education at their schools often fails to offer any of these. Mixed research methodology involved a wide array of tools from cultural anthropology to skills research. We undertook semi-structured individual and focus group interviews, engaged in long sequences of participant observations, and collected video and photo documentation of group processes and creative products for analysis.

We studied groups of 3–30 members, 16–28 years of age, active in one of the following visual culture forms:

- *cosplay*: players create their costumes, props and scenery to recreate characters and stories of popular comics;
- *demoscene*: computer software and applications creating complex multimedia effects through variations and combinations of colour, light and mobile visual patterns;
- *fanart*: digital or traditional graphics based on photos and films, (re)creating real and imaginary scenes from the life and career of famous actors and actresses, musicians and other celebrities (see Figure 1 for an example);
- *manga* and *anime:* copying traditional and contemporary Japanese comics (manga) and creating new visual stories based on their storylines, executed in their style;

Informal Visual Culture Groups", *Studies in Art Education*, vol. 54, no. 2 (2013), pp. 103–115; Andrea Kárpáti, Kerry Freedman, Emiel Hejnen, Mira Kallio-Tavin, and Juan Carlos Castro, "Collaboration in Visual Culture Learning Communities: Towards a Synergy of Individual and Collective Creative Practice", *International Journal of Art & Design Education*, vol. 36, no. 2 (2016), pp. 164–175.

- *skateboarding art:* sophisticated, often symbolic imagery drawn, painted, carved or sewn on skateboards and skateboarders' paraphernalia;
- *street art:* graffiti, flyers, murals and posters with personal or social messages
- *video blog* and *film clip:* short multimedia work with highly expressive, outspoken narration and striking imagery.

Figure 1: Tomasz-Chistowski: Fan art. (Source: Geek & Soundry, https://geekandsundry.com/critical-role-fan-art-gallery-forged-in-fire).

Most VCLCs meet several times a week, with members devoting large amounts of their free time for practicing their art form. Cultural theorists claim that we have entered a new era in which cultural production is no longer the domain of professional experts, but rather it is a shared province in which experts and amateurs build cultural knowledge together, using digital technology to produce, publish, share and remix content.[13] Therefore, benefits of these voluntary groups of adolescent artmaking include education for team work and, ultimately, for democratic citizenship. Our study revealed that members in VCLCs acquire basic collaboration skills that the Program for

[13] Clay Shirky, *Cognitive Surplus: How Technology Makes Consumers into Collaborators*, New York: Penguin, 2010.

International Student Assessment (PISA) has identified as crucial for developing learning motivation and engagement.[14]

In VCLCs, adolescents and young adults use art to experiment with different personas in the process of constructing their (visual) self. *Identity formation*, a key endeavour in adolescence, is being supported, for example, through a shared devotion to an exotic culture (in manga groups); a common desire to express ideas and emotions through sharp multimedia messages (graffiti artists, video bloggers); escaping from the present and travelling though time (cosplayers); or turning their back to the traditional geek image through creating visually pleasing, highly sophisticated but practically useless computer programs (demosceners).

VCLCs are models for positive social interdependence as they work for shared goals in a supportive autodidactic and peer-directed learning environment. Competences are enhanced through just-in-time learning of new skills and through group critiques of ideas and creative products. Successful collaboration in artistic creation fosters group members' self-esteem and helps them achieve life goals that are often unrelated to art. We also revealed tensions and resulting conflicts of being member of a creative community. Here, members learn how to negotiate interests and values, how to arrive at compromises that lead to the flow of knowledge, and innovative solutions to problems they set themselves. By working outside the framework of formal education, these groups show why the arts are crucial for personality development and reveal models of learning that may inspire the practice of art education in schools.

[14] Program for International Student Assessment (PISA), *Collaborative Problem-Solving: PISA Results 2015*. Paris: OECD, 2017.

Figure 2: Preparing a sand animation movie. Jászberény (Hungarian town), Szent István Sport Primary and Secondary School, Grade 5, age: 11 years.

Visual Culture Learning Communities changed art teachers' interpretations of media, modes of rendering, cultural codes and visual heritage to be acquired. These peer learning communities turn social media into creative opportunities and city spaces into art scenes. It is partly due to their massive appeal among the young that "Visual culture" as a school discipline has been introduced in Canada, the U.S., Finland and in Hungary almost at the same time in the late 1980s.[15] At present, one of the major challenges art educators face is the integration of these highly popular youth art genres in curricula, without losing the motivational value of informality and peer bonding.[16] In the last part of this paper, an experiment to "tame" media-based youth art for classroom use will be briefly introduced (see Figure 2 for a Hungarian example of collaborative media creation).

[15] Kerry Freedman, "Adolescents, Identity, and Visual Community: The Formation of Student Communities Based on Popular Visual Culture", *Visual Arts Research*, vol. 32, no. 2 (2006), pp. 26–27.

[16] Julian Sefton-Green and Elizabeth Soep, "Creative Media Cultures: Making and Learning beyond the School", in Liora Bresler (ed.), *International Handbook of Research in Arts Education*, Dordrecht: Springer, 2007, pp. 835–854.

4. Moholy-Nagy Visual Modules

The name of László Moholy-Nagy in the title of our research program refers to an important and, for public education, still unutilized legacy of Hungarian art education: educational theories and practices of the Hungarian masters of the Bauhaus, the iconic German arts and crafts college. The Bauhaus had no codified pedagogy, but in the educational practice of the masters, among them, decisive Hungarians like László Moholy-Nagy, György (Georg) Kepes and Marcel Breuer, certain characteristics can be observed. *Collaborative development, planning and modelling of design ideas* (the origins of Design Thinking, a favourite cognitive strategy today), *experiments with new technology* (compare Figure 3), in parallel with *sophisticated craftsmanship:* scientifically grounded study of materials, technologies and their visual effects and, above all, *social relevance of art and design:* engagement with the problems of their age and identification of socially fair, practical solutions for needs related to the built environment.[17] Based on this rich repository of innovative ideas, the Visual Culture Research Group of the Hungarian Academy of Sciences has developed curricular modules to map four areas of the discipline called "Visual culture" of the Hungarian Core Curriculum:

1) *Multicultural visual communication*: decoding and producing authentic messages;
2) *the art of (social) media*: integration of their values and linguistic features of with traditional imaging;
3) understanding and shaping the *man-made environment*;
4) *contemporary visual arts* as an individual and collective experience: closing the gap between creators and their young audience.

[17] For a detailed description of educational models at the Bauhaus, see: Rainer K. Wick, *Bauhaus – Kunstschule der Moderne*, Ostfildern-Ruit: Hatje Cantz Verlag, 2000.

Figure 3: Photograms. Image creation using a traditional Bauhaus art form. Subtle changes of light and shade are revealed through a non-digital imaging technology.

Each module covers approximately 50% of the teaching content of the discipline. The skills structure and the assessment system

is based on the *European Visual Literacy Framework*[18] and recent Hungarian research projects on the description and assessment of visual skills and abilities. Media arts are especially important parts our modules as the discipline called "Film and Media Theory" has been merged with the discipline for art education called Visual Culture in our National Core Curriculum. This merger was introduced in 2015, without piloting or in-service education programs, or even the development of educational materials. Therefore, the pedagogical program developed for Module 2, "The art of (social) media" that builds on and enhances the media-embedded visual language of youth may harmonize informal arts learning of students with formal, school-based learning in the arts.

The *modular structure in curriculum design* is a new concept for developing an art education program. The Moholy-Nagy Visual Modules may be used in conjunction with other art content in the core curriculum, and this way a flexible teaching environment is created that supports local culture, personal interests and educational needs of students. Teachers may use them as a basis for their own programs in the whole or in parts, keeping the theoretical foundations of the modular system.[19]

We believe that traditional values of Hungarian art education curricula like emphasis of manual dexterity and technical proficiency and development of creativity through project tasks should be safeguarded, but not overemphasized. Education through art and teaching

[18] Ernst Wagner and Diederik Schönau (eds), *Gemeinsamer Europäischer Referenzrahmen für Visual Literacy – Prototyp*, Münster – New York: Waxmann Velag, 2016; Diederik Schönau and Andrea Kárpáti, "The Common European Framework of Reference: The Bigger Picture", *International Journal of Art and Design Education*, vol. 15, no. 1 (2019), pp. 3–14.

[19] Acknowledgement: Research presented in this paper was realized with the support of the *Content Pedagogy Research Program of the Hungarian Academy of Sciences*, as part of the "Moholy-Nagy Visual Modules – teaching the visual language of the 21th century" project of the MTA-ELTE Visual Culture Research Group.

visual culture should be realized in synergy. Current content areas like multimedia and intermedia that dominate the art scene today or contemporary, collaborative, often interdisciplinary art genres should be integrated to facilitate the development of a new generation of art lovers and visual language users.

Orsolya Endrődy-Nagy

Picture Analysis: Creating a History of Childhood

1. Opening Remarks

Pictures are autonomous carriers of meaning, but they also function as coded texts; they are capable of conserving information about anything depicted. The study of image-use helps to break the silence regarding child-rearing practices and other educational contexts, such as showing parents' or instructors' attitude towards children. The focus of this paper is to examine recent Childhood Studies' research and share some of the possible analysis methods, focusing on a satiric depiction of a schoolmaster from Pieter Brueghel the Elder. Regardless of the era, time, region, ethnicity or gender, researchers have the right to analyze images and texts in equal measure in their studies. The goal is to give an overview of Childhood Studies researchers' recent work, results gained with the help of visual analysis and iconography. Finally, we hope that this new field will be a well-appreciated subdiscipline of Childhood Studies.

2. Objectives of this Research

The present research enables us to demonstrate the roles of visual sources and their analysis methods, possible limits to their usage during the research process, and the decoding issues. To understand these roles, let us discuss the following problems:

1. How to classify the analyzed documents
2. The limitations of a possible analysis method

As the present paper is dealing with Childhood and Visual Research, we shall mention its interdisciplinary aspects. There could be other related perspectives, narratives, and fields, depending on the

researcher's aims; however, we are focusing on the present research on those two.

Recent research in the history of education has been focusing on images as sources of a deeper analysis of attitudes towards children, which enables us to work with such documents (Grosvenor et al.[1]; Dussel-Priem[2]; Endrődy-Nagy[3], Polenghi[4]). These works are based on photographs and films as possible sources of education and childhood history, but only a few focus on artworks such as paintings or wood-cut prints.

The present researcher agrees with Nyíri[5] that pictures can convey information that cannot be coded in any other way. In this case, we can explore and understand several situations and aspects of everyday life and mentality[6] through analyzing artworks. According to Heywood, we can focus on the following themes in the Cultural History of Childhood:[7]

- Depravity/innocence

[1] Ian Grosvenor – Inés Dussel – Iveta Kestere – Karin Priem – Lisa Rosén Rasmussen – Angelo Van Gorp, "We Seek Revelation with Our Eyes: Engaging with School Cultures through Montage", *Encounters in Theory and History of Education*, 17 (2016), pp. 2–26.

[2] Karin Priem and Inés Dussel, "Special Issue: Images and Films as Objects to Think With: A Reappraisal of Visual Studies in Histories of Education", *Paedagogica Historica* 53 (2017).

[3] Orsolya Endrődy-Nagy, "Images and Iconography in Cross-Cultural Context", in András Benedek and Ágnes Veszelszki (eds.), *Virtual Reality − Real Visuality: Virtual, Visual, Veridical*, Frankfurt/M.: Peter Lang, 2017, pp. 67–78.

[4] Simonetta Polenghi, "Film as a Source for Historical Enquiry in Education. Research Methods and a Case Study: Film Adaptations of Pinocchio and Their Reception in Italy", *Educació i Història* 31 (2018) pp. 89–111.

[5] Kristóf Nyíri, "Gombrich on Image and Time", *Journal of Art Historiography*, 1 (2009) pp. 1–13.

[6] Orsolya Endrődy-Nagy, "Paintings and Illuminated Manuscripts as Sources of the History of Childhood: Conceptions of Childhood in the Renaissance", in András Benedek and Ágnes Veszelszki (eds.), *In the Beginning was the Image: the Omnipresence of Pictures*, Frankfurt/M.: Peter Lang, 2016, pp. 91–103.

[7] Colin Heywood, *A History of Childhood: Children and Childhood in the West from Medieval to Modern Times*, Cambridge: Polity Press, 2001.

- Nature/nurture
- Independence/dependence
- Age/sex

He points out that, according to the Christian doctrine of original sin based on St. Augustine's theories, we need baptism to wash away our diabolical stain. Luther, on the other hand, believes that we are innocent in our first 5 to 6 years. We can say that in the History of Childhood, one of the most important topics is to talk about the polarized opinion of whether children are divine or diabolical. People thought that human nature was determined by class and gender rather than individual circumstances. Nature seemed more important as a theme before the Renaissance, but nature versus nurture shifted during that era. Slaves and servants never achieved full independence, and even children were expected to grow up fast; they needed to help adults more than our children today. According to Philippe Ariès[8], "boys were the first specialized children during the 17th century". They were more certain than we are today about innate differences between males and females. By playing together, it was hoped that "the girl's weakness would be strengthened, and the boy's roughness softened".

3. Iconography as a Research Method

Discussing the analysis methods, we should first mention Erwin Panofsky, who created a manageable, easy-to-use basic iconographical analysis system, used by art historians for decades.

> 1. Pre-iconographical description: In the first step, we try to describe the whole picture in as much detail as possible.
> 2. Iconographical analyses: As a second step, we need to focus on the symbols, and previous similar depictions from the History of Art.

[8] Philippe Ariès, *L'Enfant et la vie familiale sous l'Ancien Régime*, Paris: Plon, 1960.

> 3. Iconographical synthesis: The third step is about deducing the meaning of each element of the picture. In these cases, this method might be difficult to use for those who are not familiar with the iconographic and historic viewpoints.[9]

Steven Addis[10] seemed to invent an analysis system only for Japanese prints; however, it is worth trying it with European woodcuts as well. Originally it helped to categorize Japanese wood-blocks.

Malcolm Colliers'[11] visual anthropologic method, based on intuition, creates a serial analysis system. Its first step lets us write notes about our first impressions and emotions about the image itself. We should write notes on anything that emerges from our mind. It might be useful later, the researcher suggests. The second step is to create categories and lists of our experiments and questions, the third is to structure, measure and compare. Be as specific as possible, suggests Collier. The last step is to focus on the significant elements while creating the conclusion. In the present paper we shall try to use these three different methods on a satirical depiction of 16th century school by Pieter Brueghel the Elder from 1556[12].

4. Ass at School

The picture was created with ink and pen by the genius "Peasant Brueghel", as a complex satirical symbol of school and schoolmaster.

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[9] Erwin Panofsky, *Studies in Iconology: Humanistic Themes in Art of the Renaissance*, New York: Oxford University Press, 1939.

[10] Stephen Addiss, *How to Look at Japanese Art*, New York: Harry N. Abrams, 1996.

[11] Malcolm Collier, "Approaches to Analysis in Visual Anthropology", in Theo Van Leeuwen and Carey Jewitt (eds.), *The Handbook of Visual Analysis*, Los Angeles: Sage, 2004, pp. 35–61.

[12] The painter and printmaker Pieter Brueghel the Elder – also called the "Peasant Brueghel" (lived c. 1525-1530–1569), was one of the most significant artist of Northern Renaissance. As the pioneer of genre paintings, peasant scenes, his works have influence on Dutch Golden Age paintings.

Following Panofsky's iconographical method, we first need to describe in as much detail as possible what we can see in the picture. We then need to find out the meaning of donkeys as a symbol in the Renaissance era. And in the third step, we might create a complex meaning of the picture. Let's look at the picture (Figure 1):

Figure 1: Pieter Brueghel the Elder, Ass at school*, 1556, pen and Indian ink, Staatliche Museen zu Berlin, Germany.*

Pieter Brueghel completed his work in 1556, but these types of school depiction are not unique during the era. We should compare it to the Holbein brothers' (Hans and Ambrosius) pictures – illustrations to Erasmus's *Praise of Folly*, which was very popular. According to Erasmus, a child behaves like an animal if we don't create a human-like person out of it. These artworks are connected to the protestant view of children and the school system as well. Let's look at the Holbein brothers' works (Figure 2, 3, 4):

Figure 2: Ambrosius Holbein, 55th illustration, The donkey and the harp*, ink, Basel, Museum of Fine Art.*

Figure 3: Hans Holbein, 1st illustration, Folly*, on pulp, pen and ink Basel, Museum of Fine Art.*

If we look at the depictions closely and use Collier's method, we might find that, adding these three, we can assemble Brueghel's

picture. These 82 marginal sketches from the Holbein brothers were created in 1509. Most of the sketches are by Hans Holbein (left-hand-

Figure 4: Hans Holbein, The tyrannies of the schoolmaster, pen and ink, Basel, Museum of Fine Art.

ed), and four sketches are from Ambrosius. *Praise of Folly* was rather popular in the beginnings of the Protestant Reformation, since it is a satirical opus about the Catholic Church. Even Pope Leo X. found it amusing. These kinds of drolleries[13] were also popular during the Renaissance[14].

Another work about a donkey was a farce by Nigel de Longchamp (Nigel Wireker): *Speculum stultorum* (The Mirror of Fools),

[13] Stefanie Buck, *Hans Holbein,* Cologne: Könemann, 1999.
[14] Christian Müller – Stephan Kemperdick – Maryan W. Ainsworth, *Hans Holbein the Younger: The Basel Years, 1515–1532*, Munich: Prestel, 2006.

which was written in 1490 and was very popular.[15] This farce was composed against monks.[16]

The core element and symbol in these works is probably the donkey. In analyzing textual and visual artworks, we might find the following meanings of "donkey": *subservience, humbleness, conversion, stupidity, stubbornness, slowness, laziness, voluptuousness, worldliness*.

The only question we face in this case is, who is the donkey? What is the meaning of the symbol regarding this specific picture?

In the Brueghel picture the most intelligent person is the donkey. It is reading and it wears glasses; all the students are rolling around and looking with empty faces. The schoolmaster is hitting one of them and seems unable to control anything or anybody. Brueghel is probably suggesting that the schoolmaster and the donkey are far from interchangeable. If we think about the biblical meanings of the donkey, it is always in charge of transporting people such as the Virgin Mary. It is a witness to change, but on the other hand, it doesn't see the change, so it supports and inspires change while transporting Mary to Bethlehem. Concluding the analysis, we might suggest the donkey (ass) as the core element of the analyzed picture. On the other hand, the complex meaning of the picture lets us believe that Brueghel urged school reforms with this work.

5. Discussion

On the problems in the school system during the Renaissance, we can find satirical pictures. It seems that schoolmasters in the Low countries of Europe suffered from naughty, playful and nosy children dur-

[15] It is about Burnel, the ass, a runaway donkey, who is in search of a longer tail. While searching he consults a doctor in Salerno, attends Paris university for 7 years but remains stupid and in the end, he meets again his master Bernard, who recaptures him.

[16] Alexander Bagley, "Bruegel's 'The Ass at School': A Study in the Iconics of Education", *Paedagogica Historica*, vol. 24, issue 2 (1984), pp. 357–378.

ing the 16th century. We analyzed one of these works using Panofsky's, Addis's and Collier's methods. Due to the limitations of the methods, we should consider using more than one method for a complex analysis in order to understand deeper meanings in a specific depiction.

Colleen Fitzpatrick

Crowther on Drawing and Painting: Implications for Education

1. Introduction

"Man is a mind with a body, a being who can only get to the truth of things because its body is, as it were, embedded in those things."[1]

Merleau-Ponty quotes Paulhan as writing in 1948 that in an age devoted to technical measurement and consumed by quantity the painter is quietly celebrating in a space more attuned to the heart than the intellect – the marriage and reconciliation of man and the world.[2] Quantity and measurement have only increased since then. In an era of innumerable sound bites, drawing and painting are acts of embodiment, products of physical gesture which are qualitative that provide unique opportunities for growth in educational settings.

According to Crowther, the intrinsic significance of drawing and painting lies in the relation between gesture and outcome because they are records of movement that testify to creative moments. The present chapter explores the significance of these ideas in relation to education.

We will begin by elucidating key concepts in Crowther's theory, including embodiment, gesture and style. We will discuss the unique aesthetic space created through pictorial means, including imagination, which has a transformative effect.

[1] Maurice Merleau-Ponty, *The World of Perception* (1948), transl. by Oliver Davis, London and New York: Routledge, 2004, p. 43.
[2] *Ibid*., p. 42.

2. Gesture and Style

From the outset, Crowther articulates that drawing and painting are products of gesture. As created images, in contrast to electronic images, they are autographic. Because they are created through the body they express something which digital imagery does not, i.e. personal style. This is why they are able to "tell us basic truths about how we inhere in the world as embodied beings with spiritual awareness".[3]

Artistic style discloses the artist's mode of being-in-the-world, this happens via gesture being preserved in the finished work. Individuals inhabit the world differently and we expand our own consciousness by engaging with others. Styles vary because we all experience the world differently: "What we see is not simply a function of what we take from the world but what we make of it."[4]

Consider this statement from the artist, Alberto Giacometti: "All the art of the past rises up before me, the art of all ages and all civilizations, everything becomes simultaneous, as if space had replaced time. Memories of works of art blend with affective memories, with my work, with my whole life."[5]

This describes the constituents of a painting which emerge through an artist's "style". Giacometti has unwittingly described how he arrived at his particular style, which is a culmination of influences, life experience and emotional reactions to both.

Merleau-Ponty wrote: "It is by lending his body to the world that the artist changes the world into paintings."[6] Crowther developed this notion: "The 'unique' factor … arises from the fact that our perception is selective and stylized on the basis of the experiential per-

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[3] Paul Crowther, *What Drawing and Painting Really Mean: The Phenomenology of Image and Gesture*, London and New York: Routledge, 2017, p. 3.

[4] Elliot W. Eisner, *The Arts and the Creation of Mind,* New Haven and London: Yale University Press, 2002, p. xii.

[5] Quoted by Jed Perl, *New Art City – Manhattan at Mid-Century*, New York: Knopf Doubleday Publishing Group, 2009, p. 233.

[6] Merleau-Ponty, "Eye and Mind", in Galen A. Johnson (ed.), *The Merleau-Ponty Aesthetics Reader: Philosophy and Painting*, transl. by Michael B. Smith, Evanston, IL: Northwestern University Press, 1993, pp. 121–149, this passage on p. 123.

spectives that arise from embodiment and from our own personal history. We may all perceive the same physical objects, but we characterize them in different ways..."[7]

Crowther argues that images are indexical insofar as the physical traces of gesture marked on the surface exemplify key aspects of how embodied subjects inhabit space.[8] Images are separated off from their usual practical concerns. This is indicative of the "disinterested" nature of aesthetic appreciation. "Disinterestedness" in this context refers to the way that these deliberate activities are not consumed in acting as a means to the realization of something else.

3. Imagination

The aesthetic space which is created through drawing and painting emerges due to a number of factors working in concert. A key element here is imagination. Pictorial space generates visual possibility alongside the opportunity to "see-with", i.e. to experience another person's style of being through engagement with the artwork: "to follow the perceptual and imaginative cues that the artwork contains but to absorb it on our own terms".[9] Imagination provides an atmosphere of alternative possibilities.

Pictorial art is the mental image made publicly accessible; the expression of imagination in physical terms. The power of image-making through drawing and painting is that it not only realizes the artist's imagination autographically, it does so through the generation of space.[10] These aspects of aesthetic space encompass the notion of consciousness of self and other. Crowther explains how seeing a picture discloses things and how this happens through an aesthetic empathy: "A mode of identification with the artist's way of seeing and representing visual possibilities of space-occupancy. For us as social beings, the ways in which other people find meaning in the

[7] Crowther, *Drawing and Painting*, p. 9.
[8] *Ibid*., p. 11.
[9] *Ibid*., p. 97.
[10] *Ibid*., p. 95.

world is something fascinating. … in the case of pictorial art … the selection of content and the style in which it is rendered allow us to share the artist's vision to some degree at the level of space itself."[11]

In seeing how a picture discloses things we are not only imaginatively absorbed by the artist's style; we learn things about our own possibilities/limitations.[12] Being spatial means that we exist alongside other things, most importantly other human beings. Encountering others as well as other things involves an awareness of ourselves doing the encountering and as such facilitates self-consciousness. Aesthetic empathy is an integral part of "seeing-with". Pictorial space is the autographic vision of its creator which can be appropriated and experienced by others. This generates an empathy with the vision of another and also stimulates imagination.

The ability to imagine oneself in someone else's shoes is an essential component to empathy. Often when individuals cannot empathize with the plight of others it is because they have little imagination and therefore no capacity to do so, even if they are not unsympathetic or dispassionate. Some people may see refugees dying on boats and cannot imagine what it is like to be in their situation, others can imagine it vividly. The latter will most certainly empathize more. In turn empathy is inextricably and reciprocally linked to self-consciousness.

All artworks have their own unique aspects; drawing and painting are arts of spatial realization, as opposed to music, dance or theatre, which are sequential. Drawing and painting have an open unity which means that they are immediately available to vision based on their frontal, planar presentation.[13] This allows an extra level of freedom at the level of attentive exploration. The artist's style along with changes of scale and projection within a timeless plane all contribute to the way in which reality is transformed.[14]

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[11] Paul Crowther, *How Pictures Complete Us: The Beautiful, the Divine and the Sublime*, Stanford, CA: Stanford University Press 2016, p. 5.
[12] Crowther*, Drawing and Painting,* p. 101.
[13] *Ibid*., p. 97.
[14] *Ibid*., p. 74.

Pictorial expressions change how the world appears by adapting it to the artists sense of aesthetic space. They are not imitations of reality but the artist's vision of the world. According to Crowther they can realize a dream of perfectibility because our admiration of the work's ideality involves acknowledging it *as* something that has transcended its material origins – origins which are acknowledged in the very awareness that it is a painting.[15]

Because the image is set aside for contemplation, it focuses and concentrates our reflective awareness. It offers a distance so that visible details can be enjoyed in a way that they often would not be in quotidian life. Pictorial art gives the viewer permission to reflect on the visible world in a mindful way which is enriching and expansive.[16] The artist's vision made perceptually accessible to an audience makes no demands; entering into the aesthetic experience means participating in a space which is not beset by pressures or judgements.

4. Education

Drawing and painting involve not just fine motor skills but gross motor skills, as well as sense perception and imagination, all working in conjunction with one another. Painting involves sweeping arm and hand movements, changes in posture, repositioning of the head, legs, and whole body. Anyone who has ever painted knows that it is a full body experience. Unlike language, drawings and paintings are *made* and this necessitates particular conditions. Speaking is something the body does without assistance. To draw or paint requires the use of instruments, pigment and an impressionable medium that allows itself to be marked by a bodily organ. It is in the making of them that important features of our relation to Being are revealed in ways unavailable to language.[17]

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[15] *Ibid*., p. 59.
[16] See Colleen Fitzpatrick, "Painting, Mindfulness and Crowther's Aesthetics", *Contemporary Aesthetics*, vol. 15, no. 1 (2017).
[17] Crowther, *Drawing and Painting*, p. 47.

We are at a crucial time in history with regards to education. Children spend large periods of time in school sitting at desks. Physical education is introduced to counteract this, however, structured sporting activities do not encompass the exploration which constitutes art. Learning to draw entails motor dexterity as well as body awareness, creativity, imagination and self-consciousness. Developing the imagination not only increases empathic capacities but also aids future planning and organizational skills as well as communication skills.

Our initial contact with the world is dependent upon our biologically evolved sensory system.[18] Merleau-Ponty has emphasized how paintings make the world visible. The senses are our first avenues to consciousness. Art is a social practice; bringing us into awareness of the surrounding world. As Eisner quotes Suzanne Langer: " 'Seeing' … is not a passive process", it is itself "a process of formulation; our understanding of the visible world begins in the eyes."[19]

Crowther asserts that pictorial art offers a unique perspective upon the spatial unity and connectedness of things and highlights how visual art in this way eternalizes the moment through spatial being and invites us to attend to it again and again. Although a photograph can eternalize a moment, the creation of pictorial art offers something different; the media itself, whether oil, acrylic, watercolour, crayon or charcoal, act as a horizon of being. They open up a range of possibilities in virtual terms – each medium creates its own universe. "However unlike the universe we occupy physically, aesthetic space emanates from the artist's volition" – a universe created freely which thereby is itself an image of freedom.[20]

Technological means of creation can follow the same trajectories as human gesture. However, in drawing and painting the gesture involves personal and spatial exploration, and is related to the gestures which came before and after it. The computer-directed im-

[18] *The Arts and the Creation of Mind* (cf. note 4 above), p. 1.
[19] *Ibid*., p. 2.
[20] Crowther, *Drawing and Painting,* p. 73.

age lacks this, following a different order of creativity; everything hangs on the software design. There is little room for deliberation, choice, or hesitancy and it is not informed by an ever-changing experiential whole in the way that the gestures of a human being are: "Real creativity in drawing and painting centers not only on what the final visual outcome is but also the physical and experiential means by which it is realized."[21]

This does not suggest a hierarchy. Designing and using software have their own aesthetic, but it is different from drawing and painting.

The intrinsically rewarding aspect of drawing and painting cannot be overemphasized because it is not only pleasurable but also has sequential effects in the world of education as well as the world at large. Aesthetic experience, both creation and appreciation, involves a release from the confines of time. The *disinterested* aspect allows the participant to free him/herself from the usual stresses and practical concerns of ordinary life. Making pictures is temporal but it also involves a release from the confines of time as a flow. One is absorbed in the temporal rhythms of Being and at the same time removed from them.[22]

Crowther makes the excellent point that although the emergence of space, the universe and self-consciousness are essentially enigmatic, arts of spatialization make the universe intelligible at the very ontological level that is fundamental to us. Although we know we will never be able to explain these things, aesthetic space frees us from the grips of these enigmas and allows us to creatively explore the space between them – the artist explores the different aspects of the amenability that exist between space and self-consciousness.[23]

The painter extracts what *seems to be invisible* by going out into the world and not just looking but participating. Klee referred to

[21] *Ibid*., p. 73.
[22] *Ibid*., p. 77.
[23] *Ibid*., p. 101.

this when he said that the trees were talking to him.[24] He was a participant in their world. This exchange between painter and world, body and world is highlighted by Cézanne who said that nature is on the inside.[25]

Finally, it should be noted that current educational systems are largely *goal-oriented* whereas *self-directed* learning is vital. Process-oriented teaching fosters self-directed lifelong learning. The importance of experiences in the social and cultural context cannot be overstated.[26]

Even if a child is "taught" to draw, how they do it is their own and therefore "self-directed" because style emerges as an expression of the personal relation between self and environment. The teaching process should encourage children to look more intensely, engage with the world and articulate what they find through pictorial expression.

Consider sports and computer-directed learning: expected and predicted outcomes are the norm. There is nothing wrong with this as *part* of an educational system, but most of the curriculum in educational settings is structured with tests that teach students that there is a right way and a wrong way to do everything based on external input and feedback. Conversely, the open unity, planar aspect and embodied nature of drawing and painting allow for personal and universal exploration. Painting is not just a personal expression but bears witness to the author's participation in the world.

[24] See Galen A. Johnson, "Ontology and Painting: 'Eye and Mind' ", in Johnson (ed.), *The Merleau-Ponty Aesthetics Reader* (cf. note 6 above), pp. 35–55, with the reference to Klee on p. 47.
[25] See *ibid.*
[26] Sanneke Bolhuis, "Towards Process-Oriented Teaching for Self-Directed Learning: A Multidimensional Perspective", *Learning and Instruction*, vol. 13, issue 3 (2003), pp. 327–347.

5. Conclusion

We live in an age where we are all learning new ways to express ourselves through technology and children are at the forefront of this. Drawing and painting still provide an arena of possibility which increases our engagement with existence and the world of others. Self-consciousness and imagination, which cultivates empathy and communication skills are key elements. In addition, an intrinsically rewarding release from the usual temporal flow accompanies these activities. Increased body awareness, perspectives and refuge from the usual pressures of goal-oriented activities which beset education settings are an integral part of drawing and painting.

Electronic technology has a role to play in creativity, but unless computers acquire selfhood, they will always follow a different order of creativity from that of humans, however they can be used to extend the scope of human activity. Selfhood is something that grows over time and cannot be programmed into a computer. This is bound up with finite embodied beings who live and die in communities and whose unity of self-consciousness involves a personal narrative. We engage with things over and above their practical use in terms of survival. Being in time involves more than physical endurance.[27]

Creating pictorial space with full body participation involves a personal and universal explorative journey through physical gesture which other activities do not. Whereas sport stimulates body awareness, writing hones motor dexterity, and digitally produced work can be creative, the visual arts of which we speak uniquely combine these with the added feature of experiential exploration.

Children should be encouraged to feel the world directly and to play with materials and tools that are not laden with connotations of right and wrong. In an age obsessed with instant gratification, discussion of drawing and painting has never been more timely. The space to imagine through physical gesture provides a balance to the goal-oriented nature of much education and the excessive screen time that children engage in.

[27] Crowther, *Drawing and Painting*, pp. 132 f.

Currently young people are experiencing a barrage of disembodied digital practices on devices and this calls for a counter-balance. Figurative paintings date back to around 40,000 years ago. All these practices ensure our need to communicate can engage with the fundamentals of existence. Unlike the world of gadgets, which can be destroyed in an instant by the wrong virus, human beings will always be able to recommence the creation of aesthetic space through drawing and painting. Crowther articulates this when he writes: "[I]n the midst of global consumerism and its trivialities there is still the possibility of authentic expression."[28] That keeps us close to the conditions of space-occupancy and embodiment.

[28] *Ibid*., p. 156.

Gyöngyvér Horváth

Visual Learning in Storytelling Images: Emotional Narrative

1. Introduction

Since I began to look for art in museums and galleries I had a truthful companion: my own body. Each time I see a powerful work of art, it makes my body shiver. I remember when my admiration turned into physical response seeing flesh in Rubens, eroticism in Caravaggio, tactility in Bernini, compassion in Netherlandish painting, or an astonishing level of suffering in Spanish Baroque art. These sensations and emotions, presented by figures within the storyworld of historical, mythological or religious narratives, help us to empathize with the characters and events in the story.

Art theory has addressed the emotional capacity of images since antiquity. Painters were advised to show a wide range of emotions, because it makes art more effective and enjoyable. Leon Battista Alberti thought that there is a law of nature behind our empathy, Leonardo da Vinci suggested painters should study human anatomy to capture the proper movement for the proper emotion. But what does anatomy have to do with emotions? And what is exactly this law of nature?

Beyond their didactic and dogmatic function, narrative pictures effect us on a physical, bodily level. Given that empathic responses are mediated by the mirror neuron system, science claims that the human body is indeed a reliable detector of powerful artistic expression. Pope Gregory's analogy, that pictures serve the illiterate just the way writings the literate, has dominated the study of narrative images for long. This statement has been refined or disproved

by many,[1] however, the idea of simplicity attached to visual narration is difficult to leave behind. It is indeed hard to underestimate the significance of moral and intellectual teachings as communicated through pictorial narratives. But narrative images do more. They provide a sense of the past, proclaim official or alternative versions of history, show roles in society, keep personal memories, offer solace, give the hope of salvation, and through our bodies, with a wide range of sensations, they teach us to connect with others and navigate in the world. Learning about the emotional aspects of visual narratives in art theory, as I argue, is supported by contemporary psychology and neuroscience.

2. Emotional Narrative in Art Theory

Art theory regarded viewer's engagement, and emotional or psychological responses from the audience as positive feedbacks. Artists were encouraged to make their work more effective by depicting various feelings and emotions and raising empathy.

Ancient rhetorical writings used the term *enargeia* when a historical action was so clearly and vividly described that it allowed the audience to reanimate the event and feel as they would be participants. This dynamic visual effect was brought from the mind of the orator before the listeners' eyes. Quintilianus wrote that "enargeia ... by which we seem to show what happened rather than to tell it; and this gives rise to the same emotion as if we were present at the event itself."[2] *Enargeia* was a property looked for not only for epic poetry and speech, but history-writing, oratory and painting.[3]

For Leon Battista Alberti, who incorporated many ideas of the ancient rhetoricians into his writings, good artworks evoke passion,

[1] For a detailed study see Lawrence G. Duggan, "Was Art Really the 'Book of the Illiterate'?", *Word & Image*, vol. 5, no. 3 (1989), pp. 227–251.
[2] Quoted by Paolo Alei, " 'As if we were present at the event itself': The Representation of Violence in Raphael and Titian's Heroic Painting", *Artibus et Historiae*, vol. 32, no. 64 (2011), pp. 221–242, the quoted passage on p. 224.
[3] *Ibid.*, pp. 221 f.

raise emotions, and have a positive impact on the viewer. His treatise, *Della Pittura*, was the first to theorize the genre of narrative painting in the Renaissance. Besides the well-known description of the method of linear perspective, he defined the principles for representing various stories in compositions, and creating an *istoria*, a narrative scenario. Alberti regarded the movements of the characters as pictorial elements that are able to convey not just actions, or show reactions, but express states of mind and thus enhance empathy. "A 'historia' will move spectators when the men painted in the picture outwardly demonstrate their own feelings as clearly as possible. Nature provides – and there is nothing to be found more rapacious of her like than she – that we mourn with the mourners, laugh with those who laugh, and grieve with the grief-stricken."[4] Human feelings and emotions, as he told, were the "movements of the heart".[5]

It was Leonardo da Vinci who developed further Alberti's ideas: he also regarded mental attitudes and states of mind as true expressions of the inner self, in which the viewer's empathy is grounded: "A picture or rather the figures therein should be represented in such a way that the spectator may easily recognize the purpose in their minds by their attitudes."[6] Both Alberti and Leonardo thought that in narrative painting movements bear the sense of life and the variety of emotions foster learning and empathy. The wide range of emotions they mentioned, some identified by psychology as primary emotions such as joy, love, anger, sadness and fear, and some more extreme, like danger, shame, gratitude, grief, pain, desire, compassion or solicitude, provide a visual encyclopedia of emotions.[7] Advantage in studies of anatomy lies not only in drawing realistic body structures, but being more effective in representing pos-

[4] Leon Battista Alberti, *On Painting*, translated by Cecil Grayson, introduction by Martin Kemp, London: Penguin Classics, 1991, II. 41, p. 76.
[5] *Ibid.*, II. 42, p. 77.
[6] Leonardo da Vinci, *Notebooks*, edited and introduction by Thereza Wells, preface by Martin Kemp, Oxford and New York: Oxford University Press, 2008, p. 169.
[7] Alberti, *op. cit.*, II. 41–43, pp. 76–79; Leonardo, *op. cit.*, p. 168.

tures and facial expressions in humans that carry a suitable emotion for the story. Leonardo's talent in capturing emotions through gestures was unique, as Thereza Wells formulated, "Leonardo was taking the devotional subject and giving it an emotional narrative".[8]

3. Emotional Narrative in Painting

Alberti's theory was born in Florence in the early 1430s as a reaction to a new type of painting brought to life by Masaccio and Brunelleschi. Medieval art, at its best, had produced complex narrative structures, such as the Bayeux tapestry or the stained glass windows of Chartres, in which individual characters were identifiable but rather schematic, and the gestures were denotative. Grand mural decorations for storytelling purposes were still commissioned in Renaissance Italy, but the era of humanism put more emphasis on individual narrative scenes in which the characters were presented as being conscious of their feelings and intentions. Illustrating the epic poetry of Homer, Virgil or Ovid came into fashion, and this also brought a more detailed and vivid storytelling.

Alberti's sentence, that we mourn with the mourners and grieve with the grievers is reflected in Piero di Cosimo's composition, *Satyr mourning over a Nymph* (about 1495, Figure 1), that depicts both physical and emotional pain: a wounded body, and sadness over the death of a loved one. The theme comes from the Ovidian story of Cephalus and Procris, and shows the culmination of a series of misunderstood situations between two lovers, similar to what happens in the Shakespearean drama of Romeo and Juliet. The original audience must have known the story. Piero di Cosimo's spalliera, a panel for a furniture, probably decorated a wealthy Florentine family's home, and was calling attention to the fragility of love and life.

[8] Leonardo, *op. cit.*, introduction by Wells, p. xxvii.

Figure 1: Piero di Cosimo, A Satyr mourning over a Nymph*, about 1495, oil on poplar, 65.4 x 184.2 cm. London, The National Gallery.*
© The National Gallery, London.

The message was still strong when Piero's works arrived in British collections around the mid-19th century – so strong, actually, that the turbulence they caused in the Londonian artworld deserved a new term, centaurophilia.[9] The sadness of the painting is palpable; Piero's extraordinary vision is kept today on permanent display in the National Gallery where visitors feel sympathy toward the work even though very few of them have ever heard of the Ovidian verse.

Northern art developed a special type of devotional image that purposefully counted on the emotional participation of the viewer. The so called *Andachtsbilder* were small pictures used for private contemplation; they often drew their subject from the suffering of Christ or Virgin Mary. These images moved people to tears. Based on personal accounts, James Elkins described the process of this intensive empathic response: "You would look at such an image steadily, sometimes for hours or days on end, burrowing deeper and deeper into the mind of the Savior or the Virgin. Finally you would come to feel what they had felt, and you would see the world, at least in some

[9] Caroline Elam, "Piero di Cosimo and Centaurophilia in Edwardian London", *The Burlington Magazine*, vol. 151, no. 1278 (2009), pp. 607–615.

small part, through their eyes. At that point their tears would be your tears."[10]

Matthias Grünewald's *Isenheim Altarpiece* (1512–16, Figure 2)[11] follows the tradition of the *Andachtsbild* and is undoubtedly the most striking depiction of a distorted body in the history of Western painting. The central panel of the winged altarpiece represents Christ

Figure 2: Matthias Grünewald, The Small Crucifixion*, about 1511–1520, oil on panel, 61.3x46 cm. Washington, Samuel H. Kress Collection. © The National Gallery of Art, Washington.*

[10] James Elkins, *Pictures & Tears: A History of People Who Have Cried in Front of Paintings*, New York and London: Routledge, 2001, p. 128.
[11] A small version of the main panel is reproduced here.

on the Cross with his closest companions in grief: the fainting Mary supported by Saint John the Evangelist, the kneeling Mary Magdalen, and Saint John the Baptist. The Crucifixion is a frequent topic in Christian religious painting; however, Christ's agony had never been more shocking: there are wounds all over the surface of his body, nails stabbing through his skin, and the greenish colour shows an already deteriorating flesh.

It was intended for a special audience, the ill treated in the hospital of the Antonite monks in the monastery of Isenheim. Their disease had no cure at a time. We know that the altarpiece played a vital role in the daily life of the community, and was incorporated into their treatment plan. Probably it helped the ordinary sick people to place their own personal life story into a bigger perspective, to have something common with Christ who provided companionship and gave solace in hard times. Andrée Hayum, who reconstructed the original cultural context of Grünewald's work, suggested that seeing the altarpiece patients not only realized their own finite existence but could open up to the great mysteries of Christian faith, like transubstantiation, redemption and salvation: "Disease must have been experienced as a composite testing ground of true faith that would have required of these viewers a leap even greater than for the normal worshipper."[12]

Nothing seems deeper than our emphatic reaction to other's suffering, however, the philosophical scepticism of Emil Cioran, who considers life, including his existence as accidental, questions the true effectiveness of religious compassion for modern individuals:

> Nobody is comforted in his sufferings by the thought that we are all mortals, nor does anybody who suffers really find comfort in the past or present suffering of others. Because in this organically insufficient and fragmentary world, the individual is set to live fully, wishing to make of his own existence an absolute. Each subjective existence is absolute to itself. For this

[12] Andrée Hayum, "The Meaning and Function of the Isenheim Altarpiece: The Hospital Context Revisited", *The Art Bulletin*, vol. 59, no. 4 (1977), pp. 501–517, the quoted passage on p. 507.

> reason each man lives as if he were the center of the universe or the center of history. Then how could his suffering fail to be absolute? I cannot understand another's suffering in order to diminish my own. Comparisons in such cases are irrelevant, because suffering is an interior state, in which nothing external can help.[13]

4. Emotional Narrative in Narratology and Cognitive Science

Images describing physically or emotionally painful stories might not ease suffering, but – and both observation-based art theory and experiment-based science agree on this question – they indeed trigger the human body. Empathic responses are rather unconscious physical reactions. An 18th century art treatise described this phenomenon fairly accurately: "But there is, to be sure, a sympathy for physical pain. When we see that someone is about to receive a blow on his arm or shin, we naturally start and draw back our own arm or leg, and if the blow actually falls, we too feel it in some measure and are hurt by it as well as the sufferer."[14]

In research on narratives, the consensus is that perceiving stories is not only an intellectual or spiritual but a physical activity, since the entire human body is involved. We might think about simple things: a stiff neck from reading, tired eyes from watching a movie, laughing at jokes, the feeling of being lost in a novel, walking in a museum in search for an artwork, or standing in front of a painting and trying to make sense of it. Then there are more abstract mental activities that we learn from stories and utilize in everyday problem-solving activities of which five were identified by the narratologist David Herman: structuring our experiences by organizing

[13] Emil M. Cioran, *On the Heights of Despair*, London: Quartet Books, 1995, p. 11.

[14] Adam Smith is quoted by Lessing in Gotthold Ephraim Lessing, *Laocoön: An Essay on the Limits of Painting and Poetry*, translation and introduction by Edward McCormick, Baltimore and London: The Johns Hopkins University Press, 1984, p. 28.

them into certain manageable sections, creating causal and chronological relations between events, managing problems by finding typical patterns in events, finding templates in the narrative in order to mentally model situations, or certain cognitive processes used in construction and revision of stories.[15] Since engagement with stories relies on our memory system and activates sensory and cognitive abilities, Lars-Christer Hydén calls storytelling an embodied activity, a "*bodily* communicative event".[16] Suzanne Keen proposed a transdisciplinary approach for what she called a narrative empathy theory. Based on novel reading she distinguished between character identification and situational empathy, which would be relevant to images as well.[17]

Certain experiments in neuropsychology and cognitive sciences are getting us closer to explaining the underlying mechanisms of narrative empathy and the perception of pain. For example, the mirror neuron system in humans might be a key to understanding what exactly happens in the body and the brain when one sees events and emotions in narrative images. The results seem to confirm what art theory has said since Alberti and Leonardo. Two decades ago, researchers discovered a specialized group of neurons in macaques, and later in humans, that mirror actions and behaviour of others. It means that these neurons discharge not only when one carries out a certain action, but when this action is only observed and performed by someone else. Mirror neuron activity is detected in some brain

[15] David Herman, "How Stories Make Us Smarter: Narrative Theory and Cognitive Semiotics", *Recherches en communication*, no. 19 (2003), pp. 133–154.

[16] Lars-Christer Hydén, "Towards an Embodied Theory of Narrative and Storytelling", in Matti Hyvärinen, Mari Hatavara and Lars-Christer Hydén (eds), *The Travelling Concepts of Narrative*, Amsterdam and Philadelphia: John Benjamins Publishing Company, 2013, pp. 227–244, the quoted passage on pp. 235–237.

[17] Suzanne Keen, "A Theory of Narrative Empathy", *Narrative*, vol. 14, no. 3 (2006), pp. 207–236.

areas and can be tested by visual imaging technologies, such as fMRI.[18]

Mirroring mechanisms are responsible for immediate and automatic responses given upon seeing other's emotional state; they have greater importance in visual learning and action recognition. There are differences among humans: some of us are more sympathetic, others resonate to a lesser extent, but neuroscience suggests that our body produces fast empathic reactions and does it unintentionally. An experiment about the perception of pain used a series of photographs of painful situations from everyday life, like cutting a finger. The study demonstrates that seeing pain in others activated some of those areas in the brain that otherwise play a significant role in processing one's own actual pain.[19] Another experiment examined brain reactions related to facial expressions of pain in self and others and came to similar conclusions of overlapping neural activations.[20] It seems that some areas of our brain are not capable of distinguishing between the pain we receive and the pain we see.

In recent decades, art history has began to confront the materiality of the body and this has led to interesting transdisciplinary approaches. Some scholars recognized quickly the relevance of the mirror neuron system in the visual perception of art. David Freedberg and John Onians think that art is not just a historical, cultural or social construction, but it is influenced by biological factors as well, simply because we humans, who produce and perceive it, are first of all biological beings. Findings of science, therefore, should be taken into consideration in examination of art, especially brain science re-

[18] Giovanni Buccino, Ferdinand Binkofski, and Lucia Riggio, "The Mirror Neuron System and Action Recognition", *Brain and Language*, vol. 89 (2004), pp. 370–376.

[19] Philip L. Jackson, Andrew N. Meltzoff, and Jean Deceity, "How Do We Perceive the Pain of Others? A Window into the Neural Processes Involved in Empathy", *NeuroImage*, vol. 24 (2005), pp. 771–779.

[20] Francesca Benuzzi, Fausta Lui, et al., "Pain Mirrors: Neural Correlates of Observing Self or Others' Facial Expressions of Pain", *Frontiers in Psychology*, vol. 9, article 1825 (2018), pp. 1–12.

search related to mental activities triggered by visual impulses.[21] There is a point from which these recent investigations look so important that some already call it a neuroscientific turn in art history.[22] The areas where these approaches would certainly be fruitful include artists' experiences and intentions, viewers' engagement, and the nature of art in general.

5. Conclusion

Images bring unmediated sensuality. They have an instant, physical effect, and perhaps this is the most fundamental difference between written and visual modes of expression. Storytelling pictures touch us on elementary, visceral level, and it is beyond any literary content. One does not necessarily need to comprehend every small detail of a depicted episode to establish emotional connections and learn about feelings.

The environment that once surrounded Piero di Cosimo's *Mourning Satyr* and Grünewald's *Crucifixion* has radically changed: from home to a museum, from private to public. However, changes in the cultural milieu do not make these works less attractive or less comprehensible. Their popularity is due to their emotional power. What the theorists of the Renaissance said about spontaneous matching feelings is still relevant to us today: we definitely learn about others while we watch them. The activation of the mirror neuron system

[21] See for example David Freedberg, "Empathy, Motion and Emotion", in Klaus Herding and Antje Krause Wahl (eds.), *Wie sich Gefühle Ausdruck verschaffen: Emotionen in Nahsicht*, Berlin: Driesen, 2007, pp. 17–51; David Freedberg and Vittorio Gallese, "Motion, Emotion and Empathy in Esthetic Experience", *Trends in Cognitive Sciences*, vol. 11, no. 5 (2007), pp. 197–203; John Onians, *Neuroarthistory: From Aristotle and Pliny to Baxandall and Zeki*, New Haven and London: The Yale University Press, 2007. Emotional responses to pain in the art of Caravaggio and Artemisia Gentileschi was discussed by Kajsa Berg, *Caravaggio and a Neuroarthistory of Engagement*, PhD thesis, Norwich, University of East Anglia, 2009.

[22] Kate Mondloch, "Wave of the Future? Reconsidering the Neuroscientific Turn in Art History", *Leonardo*, vol. 49, no. 1 (2006), pp 25–31, especially pp. 25–27.

creates the link between the image and the viewer. Alberti's law of nature might include the neural mechanisms behind empathy.

Old masters like Leonardo studied anatomy to create strong empathetic experiences. Maybe contemporary artists should learn more about the mirroring system to win back that affectionate relationship viewers once had toward images.

IMAGE AND SYMBOL:
AN EARLY HISTORY OF DIAGRAMS

Lorenz Demey

The Role of Aristotelian Diagrams in Scientific Communication

1. Aristotelian Diagrams and Logical Geometry

An *Aristotelian diagram* is a visual representation of a number of formulas or expressions, and certain logical relations holding between them (in particular, contradiction, (sub)contrariety and subalternation). Without a doubt, the oldest and most widely used Aristotelian diagram is the so-called *square of opposition* for the categorical statements from syllogistics. The relations of contradiction and contrariety were systematically studied for the first time in the logical works of Aristotle, while the first actual square diagrams are due to the late ancient authors Apuleius and Boethius. Throughout history, distinguished philosophers and logicians such as William of Ockham, John Buridan, Gottlob Frege and Roderick Chisholm have used squares of opposition (as well as larger, more complex Aristotelian diagrams) in order to explain and illustrate their theorizing. Because of the ubiquity of the relations that they visualize, Aristotelian diagrams are nowadays also frequently used in other disciplines that are concerned with logical reasoning, such as linguistics, cognitive science and artificial intelligence.[1]

This widespread usage of Aristotelian diagrams has recently led to the development of the framework of *logical geometry*. Rather than using Aristotelian diagrams as a mere tool to explain some given idea or theory, logical geometry shows that these diagrams can be fruitfully studied as objects of independent interest, with respect to both their abstract-logical properties and their visual-geometric fea-

[1] Cf. the papers mentioned in notes 2 and 3 below for a plethora of concrete examples of the widespread (historical and contemporary) usage of Aristotelian diagrams.

tures.[2] This theoretical work has also led to the discovery of new applications of Aristotelian diagrams (often in logic, but also in more unexpected fields, such as philosophy of religion), and to interesting new case studies on historical authors (e.g. John Buridan).[3]

The aim of this short paper is not to present any new technical results or to develop a new application or case study, but rather to ask a more fundamental question: *why are Aristotelian diagrams used so frequently to begin with?* Or more generally: what is the role of Aristotelian diagrams in the scientific communication of logicians, philosophers, linguists, computer scientists, etc.? Despite their apparent simplicity, these questions go directly to the philosophical foundations of logical geometry. After all, the widespread usage of Aristotelian diagrams constitutes one of the main motivations for systematically developing this framework. A potential danger is that an un-

[2] For the abstract-logical investigations, cf. Lorenz Demey and Hans Smessaert, "Combinatorial Bitstring Semantics for Arbitrary Logical Fragments", *Journal of Philosophical Logic* 47 (2018), pp. 325–363; Lorenz Demey, "Computing the Maximal Boolean Complexity of Families of Aristotelian Diagrams", *Journal of Logic and Computation* 28 (2018), pp. 1323–1339; Hans Smessaert and Lorenz Demey, "Logical Geometries and Information in the Square of Oppositions", *Journal of Logic, Language and Information* 23 (2014), pp. 527–565. For the visual-geometrical topics, cf. Lorenz Demey and Hans Smessaert, "Geometric and Cognitive Differences between Aristotelian Diagrams for the Boolean Algebra B_4", *Annals of Mathematics and Artificial Intelligence* 83 (2018), pp. 185–208; Demey–Smessaert, "Logical and Geometrical Distance in Polyhedral Aristotelian Diagrams in Knowledge Representation", *Symmetry* vol. 9, issue 10 (2017), article no. 204; Demey–Smessaert, "The Interaction between Logic and Geometry in Aristotelian Diagrams", in Mateja Jamnik, Yuri Uesaka and Stephanie Elzer Schwartz (eds.), *Diagrammatic Representation and Reasoning*, LNAI 9781, 2016, Berlin: Springer, pp. 67–82. For further discussion in the context of logic diagrams in general, cf. Jens Lemanski, "Means or End? On the Valuation of Logic Diagrams", *Logic-Philosophical Studies* 14 (2016), pp. 98–122.

[3] Lorenz Demey, "Aristotelian Diagrams for Semantic and Syntactic Consequence", *Synthese*, forthcoming; Demey, "Using Syllogistics to Teach Metalogic", *Metaphilosophy* 48 (2017), pp. 575–590; Demey, "A Hexagon of Opposition for the Theism/Atheism Debate", *Philosophia*, forthcoming; Demey, "Boolean Considerations on John Buridan's Octagons of Opposition", *History and Philosophy of Logic*, forthcoming.

bridgeable abyss might arise between the purely mathematical investigation of (the logical and geometrical properties of) Aristotelian diagrams on the one hand, and their concrete applications on the other.[4] To some extent, these worries can be alleviated by pointing to the variety of new applications and historical case studies that have been made possible by the recent theoretical advances, which illustrate the tight connection between the theoretical and application-oriented sides of logical geometry. Nevertheless, the widespread usage of Aristotelian diagrams is not simply to be taken for granted, but rather calls for a substantial philosophical explanation. The issue becomes all the more pressing if one realizes that the most common (albeit often implicit) conception of Aristotelian diagrams cannot adequately account for all aspects of their widespread usage.

2. The Received View

Although Aristotelian diagrams are used very frequently, authors rarely pause to comment explicitly on their decision to include such a diagram in their writings, or to explain why/how they expect the diagram to be useful. Nevertheless, it is quite clear that there is an underlying common view on the role of Aristotelian diagrams. This view holds that Aristotelian diagrams mainly function as *pedagogical devices*. Because of their visual nature, they have a high mnemonic value, which can be helpful for introducing novice students to the abstract discipline of logic. This view is probably based on the fact that many Aristotelian diagrams can be found in logic textbooks (especially in the scholastic tradition, but also in contemporary times). Furthermore, examination of historical student notebooks shows that

[4] A similar danger exists for the mathematical study of Euler and Venn diagrams; cf. Amirouche Moktefi and A. W. F. Edwards, "One More Class: Martin Gardner and Logic Diagrams", in Mark Burstein (ed.), *A Bouquet for the Gardener: Martin Gardner Remembered*, New York: The Lewis Carroll Society of North America, 2011, pp. 160–174.

students actively drew their own Aristotelian diagrams in order to master the logical subject matter.[5]

This view on the role of Aristotelian diagrams is usually left implicit, especially by authors who actively put these diagrams to use in their logical work. However, in more historical or methodological contexts, we sometimes do find explicit expressions of this received view. For example, a historical overview of graph drawing states that "[s]quares of opposition were pedagogical tools used in the teaching of logic… They were designed to facilitate the recall of knowledge that students already had." Similarly, in his methodological reflection on the square of opposition, Dale Jacquette writes that "[t]he square provides a memory device … and as such can be thought of largely as a crutch for students to lean on when they are first learning syllogistic logic".[6]

The view that Aristotelian diagrams are primarily pedagogical devices has two important consequences. First of all, it entails that the use(fulness) of these diagrams is mainly due to the practical circumstance that novice students are typically less-than-ideally prepared for abstract logical thinking, and will thus benefit significantly from the mnemonic aids provided by the diagrams.[7] Under "ideal" circumstances, however, the use(fulness) of Aristotelian diagrams

[5] Christophe Geudens and Jan Papy, "The Teaching of Logic at Leuven University (1425–1797): Perpetually Peripatetic? A First Survey of a Research Project on Student Notebooks and their European Context", *Neulateinisches Jahrbuch: Journal of Neo-Latin Language and Literature* 17 (2015), pp. 360–378.

[6] Eriola Kruja, Joe Marks, Ann Blair and Richard Waters, "A Short Note on the History of Graph Drawing", in P. Mutzel, M. Jünger and S. Leipert (eds.), *Graph Drawing 2001*, LNCS 2265, Berlin: Springer, 2002, pp. 272–286, the quoted passage on pp. 274–276; Dale Jacquette, "Thinking Outside the Square of Opposition Box", in Jean-Yves Béziau and Dale Jacquette (eds.), *Around and Beyond the Square of Opposition*, Berlin: Springer, 2012, pp. 73–92, the quoted passage on p. 80.

[7] In this context, we should also point out the pejorative term used for another famous logic diagram, viz. the *pons asinorum* or "bridge of asses", which was called like that because it primarily "helped dull-witted students"; cf. Martin Gardner, *Logic Machines and Diagrams*, New York: McGraw Hill, 1958, the quoted passage on p. 30.

would vanish almost completely: if one were teaching logic to an audience that consists exclusively of highly gifted students, then the mnemonic aids would be superfluous, and the diagrams could be dispensed with altogether. Secondly, this view holds that Aristotelian diagrams can help students to reproduce knowledge that was previously acquired, but they cannot produce any genuinely *new* knowledge.

The received view is correct in emphasizing the pedagogical value of Aristotelian diagrams. However, it cannot adequately account for the heterogeneous usage of these diagrams. After all, in the contemporary scientific landscape, Aristotelian diagrams are not only found in textbooks, but also, and most frequently, in *research-level* monographs and journal papers. This observation is hard to square with some of the basic tenets of the received view. In particular, the appearance of Aristotelian diagrams in research-level publications does not fit well with the idea that these diagrams are primarily targeted at novice (or even "dull-witted") students, nor with the idea that these diagrams do not produce any new knowledge. Unlike textbooks, research-level publications are written by scientists for their fellow scientists, and with the explicit aim of contributing to the production of new knowledge.

3. Two Alternative Views

A first alternative to the received view emphasizes the potential *cognitive advantages* offered by the multimodal (visual and symbolic/textual) nature of Aristotelian diagrams. An Aristotelian diagram is taken to provide a "visual summary" of the logical system or lexical field under investigation. This can be compared to the way in which a 2D graph functions as a "visual summary" (e.g. in a regression analysis) of the underlying raw numerical data and calculations. The graph contains exactly the same information as the corresponding spreadsheet with raw numerical data; however, because of its visual nature, the graph is much easier to work with, and thus facil-

itates producing new insights (e.g. discovering general trends in the data).

Just like with the received view, we find a strong emphasis on the cognitive advantages of Aristotelian diagrams. The crucial difference, however, is that these cognitive advantages are no longer restricted to pedagogical contexts, but can also occur in research contexts. For example, some researchers explicitly indicate that Aristotelian diagrams are "very useful to understand in a direct, quick and synthetic way basic notions of modern logic, corresponding to the notion of *Übersichtlichkeit* [surveyability] that Wittgenstein was fond of", or that they constitute "a powerful tool to express all properties of rough sets and fuzzy rough sets with respect to negation in a synthetic way".[8] The main problem, however, is that some Aristotelian diagrams (e.g. 3D polyhedra) have a high degree of visual complexity, and thus do not seem to offer many cognitive advantages. Applications of such visually complex diagrams (which effectively occur in the literature) cannot be accounted for in cognitive terms.

The second alternative view emphasizes the rich and respectable tradition of Aristotelian diagrams within the broader history of logic. The tradition of using these diagrams thus gets endowed with a certain degree of (implicit) *normativity*: because logicians have been using Aristotelian diagrams for a very long time, it is "normal" or "expected" that we continue to use them today. For example, in a paper on artificial intelligence (i.e. *not* on the history of logic), we find side-remarks such as: "The study on oppositions starts in ancient Greece and has its main result is the Square of Opposition by Aristotle."[9] Once the tradition of using Aristotelian diagrams is in place, this view can explain why it continues; however, the main problem is

[8] Jean-Yves Beziau, "The Metalogical Hexagon of Opposition", *Argumentos* 5 (2013), pp. 111–122, the quoted passage on p. 118; Davide Ciucci, Didier Dubois and Henri Prade, "Structures of Opposition in Fuzzy Rough Sets", *Fundamenta Informaticae* 142 (2015), 1–19, the quoted passage on p. 17.

[9] Davide Ciucci, "Orthopairs and Granular Computing", *Granular Computing* 1 (2016), pp. 159–170, the quoted passage on p. 167.

that this view cannot explain how the tradition came into existence in the first place.

4. The Heuristic Role of Aristotelian Diagrams

Both the received view and the two alternatives outlined above face serious problems. I would therefore like to put forward a new explanation for the widespread usage of Aristotelian diagrams. Note that what follows is merely a sketch of this new account; many details still need to be filled in, which will be done in future work. The key idea is that Aristotelian diagrams owe their popularity to the fact that they function as powerful *heuristic tools*. They enable researchers to draw unexpected analogies between seemingly unrelated logical, philosophical and scientific frameworks. Once such a "bridge" between two disciplines has been established, it can also be used to introduce new concepts, by transferring them from one discipline into the other. Aristotelian diagrams are situated at precisely the right level of abstraction to play this heuristic role. On the one hand, they are not too specific, which would otherwise impede the search for genuinely surprising cross-disciplinary analogies. On the other hand, they are not too general either, which would otherwise render the resulting analogies devoid of any substance: if the level of abstraction gets too high, everything will become analogous to everything else. Using ideas from logical geometry (in particular, the notion of *Aristotelian isomorphism*), the idea that Aristotelian diagrams occupy a heuristic "sweet spot" can be made mathematically precise.

Many authors who make use of Aristotelian diagrams, explicitly point to their heuristic potential. For example, the medieval logician John Buridan was able "to exhibit a strong analogy between modal, oblique and nonnormal propositions in his three octagons".[10] Furthermore, in artificial intelligence research, Aristotelian diagrams

[10] Stephen Read, "John Buridan's Theory of Consequence and his Octagons of Opposition", in Jean-Yves Béziau and Dale Jacquette (eds.), *Around and Beyond the Square of Opposition* (cf. note 6 above), pp. 93–110, the quoted passage on p. 109.

have explicitly been called "a new bridge" between different knowledge representation formalisms,[11] and they have also led to the introduction of new concepts: "With respect to the four logic expressions of the square of opposition, we can identify four subsets of attributes. … While [one subset] is well studied, the other [three subsets have] received much less attention".[12]

By enabling us to discover unexpected analogies, Aristotelian diagrams clearly contribute to the production of *new* knowledge. In particular, these diagrams are not mere mnemonic devices that facilitate the recall of pre-existing knowledge. This squares well with the observation that most contemporary applications of Aristotelian diagrams are found in research-level writings from a wide variety of disciplines. Finally, it should be noted that the heuristic view on Aristotelian diagrams is by no means incompatible with the other views described in this paper. For example, historically speaking, it seems plausible that (i) Aristotelian diagrams were initially used almost exclusively as mnemonic devices in teaching contexts, but (ii) over time, they gradually shifted toward the role of heuristic devices in research contexts.

5. Concluding Remarks

In this paper I have sketched several explanations for the widespread usage of Aristotelian diagrams, with a particular focus on the view that these diagrams primarily perform a heuristic role. It bears emphasizing that I have *not* argued for the absolute indispensability of Aristotelian diagrams. One might observe that ultimately, everything that can be done by means of an Aristotelian diagram, can also be done *without* such a diagram. I agree with this observation, but I think

[11] Davide Ciucci, Henri Prade and Didier Dubois, "The Structure of Oppositions in Rough Set Theory and Formal Concept Analysis – Toward a New Bridge between the Two Settings", in C. Beierle and C. Meghini (eds.), *FoIKS 2014*, LNCS 8637, Berlin: Springer, 2014, pp. 154–173.

[12] Yiyu Yao, "Duality in Rough Set Theory Based on the Square of Opposition", *Fundamenta Informaticae* 127 (2013), pp. 49–64, the quoted passage on p. 59.

it is not problematic for any of the views discussed above. In order to explain this, I will finish this paper by drawing an analogy with Feynman diagrams from physics. Already in 1948, Freeman Dyson proved the formalism of Feynman diagrams to be mathematically equivalent to a more conventional, non-diagrammatic formalism.[13] Hence, everything that can be done by means of a Feynman diagram, can also be done *without* such a diagram, at least in principle. However, in many cases, the non-diagrammatic equivalent will be hugely more complex than the original Feynman diagram, to the extent that it becomes utterly infeasible for humans to work with those non-diagrammatic equivalents. For example, the Nobel Prize winner Frank Wilczek recently declared that "[t]he calculations that eventually got me a Nobel Prize in 2004 would have been literally unthinkable without Feynman diagrams".[14] Even though Feynman diagrams are not indispensable *in principle*, they certainly seem to be so *in practice*. In future work, I will argue that something similar can also be said about Aristotelian diagrams.[15]

[13] David Kaiser, *Drawing Theories Apart: The Dispersion of Feynman Diagrams in Postwar Physics*, Chicago, IL: University of Chicago Press, 2005, especially pp. 74–75.

[14] Frank Wilczek, "How Feynman Diagrams Almost Saved Space", *Quanta Magazine*, 2016, https://www.quantamagazine.org/20160705-feynman-diagrams-nature-of-empty-space.

[15] I would like to thank Hans Smessaert, Margaux Smets and, especially, Péter Neuman for their interesting feedback on an earlier version of this paper.

Anna Somfai

Déjà Vu? Visual Thinking in Medieval Manuscripts and Imaging the Unimaginable

1. Introduction

Medieval manuscripts are studied for various reasons, such as their unpublished texts, illuminations, physical structure, reception history or history of their ownership. My main interest lies in that I consider them an exceptional source for studying visual thinking.

In this chapter I shall study manuscript layouts and specific diagrams in order to argue for the medieval readiness to explore, learn, and teach philosophical and scientific concepts by designing specific layouts and creating and re-imaging diagrams. I shall examine the architecture of the manuscript folio, or mise-en-page, the nature of diagrammatic thinking and the way in which these reflect the minds of the medieval visual thinkers who designed and used the pages. I shall argue that studying layouts and diagrams allows us a glimpse of the creativity and originality of the medieval mind, with broader contributions to the enquiry into visual thinking throughout the ages.

2. Manuscript Layouts

Medieval manuscripts were handmade and handwritten, copied from previous copies (exemplars)[1]. My interest lies in the fact that with each instance of copying there was an opening for introducing a new mise-en-page with contemporary audience in mind and for making an

[1] For a general background on medieval manuscripts see R. Clemens and T. Graham, *Introduction to Manuscript Studies*, Ithaca and London: Cornell University Press, 2007.

effort to literally shape the texts and images more reader-friendly.[2] I propose, therefore, two assumptions at the outset. Firstly, the design tells us what was considered at the time the best way to create and transmit knowledge, that is to say, the conventions and demands of the period. Secondly, each individual manuscript mirrors the mind and cognitive processes of its creator and in a broader sense the cognitive processes with which he credits his audience. The medieval mise-en-page can be approached from different points of view. Below I give mine and highlight the cognitive aspects I attribute to the layout and on which my conclusions are based.

The page layout of a manuscript was designed by the scribe, a process that involved both mental and physical work. Parchment, a costly material to acquire, could not be wasted. The planning of the volume had to reckon with the body of texts, whether images were included, marginal gloss was to be added, headers, initials, paragraph marks were to be introduced. The page was ruled accordingly for text and the spatial distribution of the images and various other visual elements of the folio were planned and physically marked up before texts and images were entered.

The text itself is punctured with space, making it a visual image where lines are a spatial mirror of thinking and speech, with pauses, emphases, or the continuity of a flow. Word separation, a visual device we take now for granted, developed over time during the early Middle Ages. Scriptura continua, the late ancient convention, matched oral habits: one speaks continuously, without an audible break, and our brain is accustomed to divide what we hear into units we can comprehend. This comprehension hinges on the familiarity with the language. When texts were read out loud, writing kept being spoken and thus words were not separated. With the emergence of

[2] Equally telling and interesting are the errors and variations introduced by the same process in both texts and images.

silent reading and Latin becoming a second langue for readers of vernacular native languages, the need for visual division arose.[3]

Word separation was the first in a series of devices that facilitated easier reading and comprehension. The introduction of punctuation marks and paragraph symbols, often drawn in alternating red and blue ink, provided further units within the text, marking thought segments. The hierarchy of initials, including large, illuminated initials, smaller initials in colour, yet smaller initials in alternating red and blue, serves to guide the reader's eyes through the various sections in the text. The different types of initial, marking the beginning of books, chapters, sections, and sentences, allowed the eyes to jump from unit to unit, facilitating skimming. Large, illuminated initials with scenes depicted in them often highlighted a particular reading of the text offering an alternative to the textual analysis, acting as a pause to induce pondering on meaning. (See Figures 1 and 2.)

Different scripts were used during the course of the Middle Ages, ranging from ones using only capital letters, through lowercase scripts to cursive of great speed.[4] Some of the early, formal scripts were used later for inscribing titles or specific words, much like our different fonts and styles, such as bold or italic. Using red ink, highlighting words with colours and encircling sections drew the eyes to specific parts of the texts. Many of these devices are memory aids and facilitate the recollection and reuse of the material. As various visual devices are added, folios become more and more image-like and for a visual thinker like I am, they become more legible.

Manuscripts were used for centuries by generations of readers and often contain layers of visual and textual gloss that act as a first layer of interpretation with which the later readers could engage, sometimes adding their own comments. Within the folios of a manuscript a reception history of the text shapes up. It is also for a reader

[3] For the specific question of the practice of silent reading and word separation see P. Saenger, *Space Between Words: The Origins of Silent Reading*, Stanford, CA: Stanford University Press, 1997.

[4] For a survey of script history with samples see M. P. Brown, *A Guide to Western Historical Scripts from Antiquity to 1600*, London: The British Library, 1990.

today a source of intellectual stimulation, much like discussing a text with a contemporary interlocutor. Interlinear notes visually coincide

Figure 1: Getty, MS Ludwig XIV 2, fol. 63r, France 1170–1180.[5]

Figure 2: Getty MS 34, fol. 181v, Italy ca. 1389–1404.[6]

with the main text's body, attracting the reader's eyes almost unconsciously while reading, containing notes for immediate use, such as synonyms. Marginal notes needed specific attention thus increasingly *signe-de-renvoi*, linking symbols, were added connecting the gloss to the relevant portion of the main text, much like our footnote system but more conveniently placed. Brief marginal references aided skim-reading as they offered pointers while more substantial notes were

[5] Digital image courtesy of the Getty's Open Content Program.
[6] Digital image courtesy of the Getty's Open Content Program.

valuable in themselves. Pointing hands in the margin, often amounting to elaborate images, were alternatives to simple nota signs drawing the attention to specific points in the text, acting also as memory aids.

The various devices marked up the text which in turn was mapped up by the eyes of the reader before embarking on close reading. The flexibility of the design challenged the brain and kept it alert. It is a design that reckoned with visual thinking.

Sitting down to read a manuscript today is every bit as personal an experience as it was in the Middle Ages. One can see one's own cognitive habits sharply coming into focus when preferring one layout or visual element over another. The university textbook of the 13th century with its two columns of main text and two and three columns of gloss at either margin respectively and longer quotations from commentaries in the bottom of the folio, facilitated the reading of difficult, newly introduced texts. Figure 1 presents, on a subjective reading, a folio with balance in the use of devices of division, while looking at the folio in Figure 2 one might struggle with visual noise. All these devices, depending on individual preference, can be a way into deeper reading or can induce annoyance as today's library book marked up by a previous reader.

3. Visual Thinking

Visual thinking is a mode of thinking that involves visual imagination and its output takes the form of diagrams, images, doodles, or other visual structures. It is also a way of perceiving information through these channels.[7] The output of visual thinking entails the use of a visual vocabulary accessible to the thinker and, depending on the purpose, the projected readership. The medieval manuscript mise-en-page with its various visual elements provides a visual thinker with a genuine work surface. The structure of the layout is a personalized page for intellectual output and intake. Constantly using books hav-

[7] For an epistemological approach see M. Giaquinto, *Visual Thinking in Mathematics: An Epistemological Study*, Oxford: Oxford University Press, 2007.

ing been designed this way meant that medieval readers developed a sense for visual structuring, they emulated it and I suggest it became their learning strategy. Diagrammatic thinking was part of the visual vocabulary.

4. Diagrams and Visual Thinking

4.1. Diagrams

The diagrams and diagrammatic images I study provide a visual tool, alternative to words and mathematical equations, for exploring and explaining philosophical and scientific concepts. They also mirror the cognitive process that engages with them. Medieval readers used the folios of their manuscripts and even pieces of scrap parchment or paper to visualize their thoughts or the concepts and arguments they studied. Diagrams were used for visually expressing, combining, summarising and verifying concepts and textual analyses. They were visually manipulated, decomposed and reassembled and were often borrowed and recycled in new contexts, in new texts bringing with them some of their original connotations, strengthening associative thinking.

Diagrams were copied together with their texts as they were transmitted through the centuries. They were placed within the body of the text or in its margins or sometimes assembled on folios at the end of a text or a volume. By standard diagrams I denote those that were originally part of the text, described or otherwise referred to. Similarly were placed the diagrams newly created by readers of the manuscripts for further clarification of the text or an existing diagram. The standard diagrams, diagram variants, newly created diagrams, and sketches of visual thought fragments that appear in the margin of manuscripts mark the path of visual thinking.

Medieval diagrams range from simple lettered geometric diagrams inherited from Greek mathematics through basic visual structures containing lines, numbers, and words to complex images featuring human or animal figures or colourful patterns with relationship

among their distinct visual parts.[8] Some visualization involved steps marked by individual diagrams corresponding to stages described in a text. Some were produced by way of combining different diagrams or elements of diagrams already in existence within the body of the text or in its margins. The process of reflection, association, edition, and re-edition made the visual analysis of concepts an aid as well as an alternative to textual and logical thinking. Re-cycling images is an associative process which transcends linear logic, thus facilitates means of understanding alternative to linear composition, and therein lies its potential for originality.

4.2. Case Studies[9]

In what follows I use diagrams from Calcidius' *Commentary* (4th century) to his Latin translation of Plato's *Timaeus* with some of their medieval variants as case studies for medieval visual thinking. Without going into the intricacies of the complicated text of the *Timaeus* and its later interpretations, I shall focus on concepts. Calcidius' *Commentary* contains 25 diagrams, some borrowed from Greek sources, others created by him. These fall into the disciplines of arithmetic, geometry, music and astronomy, intended by Calcidius as a path to philosophy. The first three disciplines are used for introducing the concepts of geometric proportion and musical harmony to support the creation narrative of the *Timaeus*, the set of astronomical diagrams completes the picture and incorporates some conceptual ele-

[8] For a survey of scientific diagrams see J. E. Murdoch, *Album of Science: Antiquity and the Middle Ages*, New York: Charles Scribner's Sons, 1984. For a study of pictorial images in philosophical manuscripts see C. R. Sherman, *Imaging Aristotle: Verbal and Visual Representations in Fourteenth-Century France*, Berkeley, Los Angeles, Oxford: University of California Press, 1995.

[9] For a more detailed analysis see Anna Somfai, "The Brussels gloss: a tenth-century reading of the geometrical and arithmetical passages of Calcidius's *Commentary* (ca. 400 AD) to Plato's *Timaeus*", in the volume Scientia in margine: *Études sur les marginalia dans les manuscrits scientifiques du moyen âge à la renaissance*, ed. by D. Jacquart and Ch. Burnett, Geneva: Librairie Droz, 2005, pp. 139–169.

ments. In geometric proportion two extremes are connected through a mean term. In Platonic cosmology geometric proportion serves as an unbreakable bondage in the mathematical fabric of the Universe's body and soul joining extremes through means while musical intervals serve as the spatial components of their harmony, providing the loci for planetary circles.

4.2.1. Arithmetical Geometry/Geometrical Arithmetic

Diagram 1 is described as an arithmetical proof (*probatio arithmetica*)[10] of geometric proportion: the mean between 6 (2x3) and 24 (4x6) is 12 (3x4) (Figure 3). While giving units geometrical shapes was customary in ancient Greek mathematical texts and their late ancient Latin translations, in Calcidius' *Commentary* a geometrical dia-

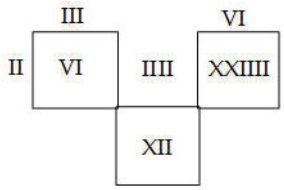


Figure 3: Standard version of Diagram 1.[11]

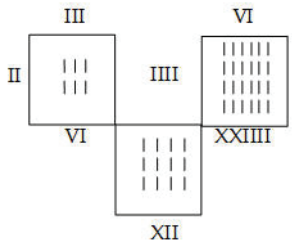


Figure 4: Variant of Diagram 1 in Brussels, BR MS 9625-9626, fol. 10r.

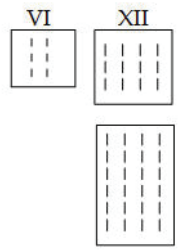


Figure 5: Variant of Diagram 1 in Paris, BN MS Lat. 10195, fol. 84vb.

gram is described. His arithmetic is geometrical in nature. There is an impression as if the mean square would be waiting for being inserted between the first and the third squares. A variant from the 10th century placed the Roman numbers outside the squares and filled the inside of the squares with units (Figure 4). This alteration makes the

[10] Calcidius, *Commentary* 9; 62,1. *Timaeus a Calcidio translatus commentarioque instructus*, ed. J. H. Waszink, London & Leiden: Brill, 1962 (repr. 1975, *Plato Latinus* IV, ed. R. Klibansky).
[11] The drawings in this chapter are my own.

numerical value more visual. An additional diagram was created in the 11th century (Figure 5). Its author decomposed the standard diagram into three separate quadrangles where each represented visually the comparative size of its numerical value. There is a shift to using the units as means and exhibiting more the arithmetical character. The quadrilaterals are separated, expressing less the physical connection and the facing rows and columns highlight the concept of mean arithmetically. The middle quadrilateral shares 3 (rows) with the first one and 4 (columns) with the third one.

4.2.2. Geometry, Conceptualizing the Mean, Decomposing Diagrams

Diagram 3 (Figure 6) uses equilateral triangles for presenting the concept of mean, by stating that between two triangles a third is insert-

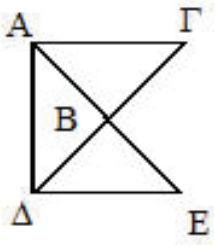


Figure 6: Diagram 3 standard version.

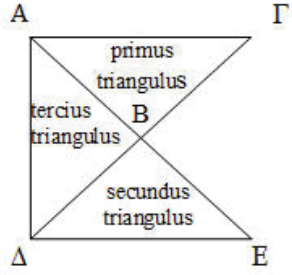


Figure 7: Variant of Diagram 3 in Brussels, BR MS 9625-9626, fol. 10r and Paris, BN MSS Lat. 6280, fol. 9r and Lat. 6281, fol. 24v.

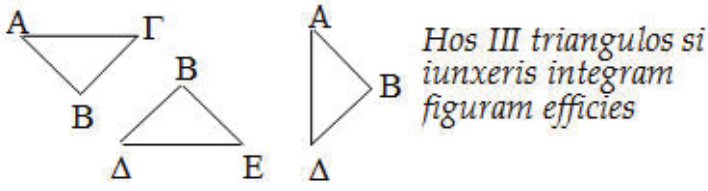


Figure 8: Additional diagram next to the standard version of Diagram 3 in Valenciennes, BM MS 293, fol. 19r.

ed.[12] In the 10th century a variant appeared with an intra-diagrammatic text that specifies the order of the triangles, giving the middle one as the "third triangle" (Figure 7). This only works if one thinks of "third" as being chronologically the last one to be added. An additional diagram was drawn next to Diagram 3 in a 10th-century hand in a 9th-century manuscript (Figure 8). Its creator took the chronological process one step further. He decomposed the diagram into the three triangles presenting them in a linear order going not simply clockwise or anticlockwise but with the middle one put in the third place, emphasizing that it connects the two other triangles and added an explanatory text: "If you join these three triangles, you make a complete figure".

4.2.3. Imagination, Combination and Visual Thinking in Depicting Harmony

The lambda diagram[13] (Figure 9), so called due to its shape which resembles a Greek lambda, was created by Crantor (2nd century) to visualize Plato's mathematical system of the harmonious intervals of

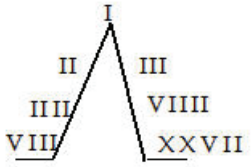


Figure 9: Standard version of Diagram 7.

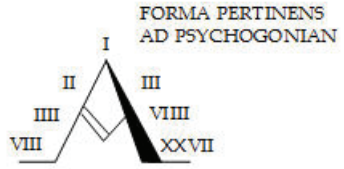


Figure 10: Standard Diagram 7 with imaginative addition in Valenciennes, BM MS 293, fol. 28r.

the soul. It introduces one at its apex and the numbers on each side progress according to geometric proportion. The musical intervals appear through a combination of the numbers on the two sides (e.g.

[12] Calcidius, *Commentary*, 12; 64,1-3.
[13] *Ibid*., 32; 81,20-25.

3:2 is a fifth). The intervals create the mathematical basis for the music of spheres. The diagram was used and further developed by Calcidius.

4.2.3.1. Lambda Variant

In the earliest, 9th-century manuscript an imaginative annotator with three hardly visible strokes transformed the lambda into a capital "A", standing for "*Anima*", or soul (Figure 10). This is no mere sign of visual wit but a testimony to his grasp of the diagram's meaning and his ability to bring together the mathematics of intervals and the concept of the soul.

4.2.3.2. New Diagram: Visual Combination of Mathematics and Astronomy

A new, additional diagram emerged in the margins near the lambda during the 11th–12th century combining two existing diagrams (Figure 11). It superimposed the lambda on a circular diagram of the plan-

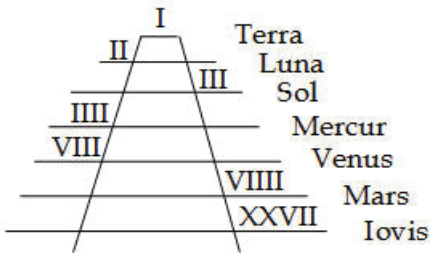


Figure 11: New diagram combining Diagrams 7 and 22 in Valenciennes, BM MS 293, fol. 28r and Brussels, BR MS 9625-9626, fol. 17r.

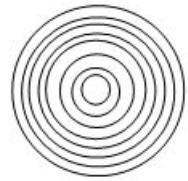


Figure 12: Diagram 22 standard version (schematic drawing without the names of the planets and numerals for intervals added within the circles as in the manuscripts).

etary system which is located in the remote astronomical section of Calcidius' *Commentary* (Figure 12). The new diagram maps the mathematical structure of the soul on the planetary system succeeding greatly in creating a visual depiction of the two coinciding spatially, which is a key concept of the dialogue and one that cannot easily be depicted in diagrammatic form.

At a time when textual gloss was at scarce, these diagrams managed to bring together separate parts of the texts in a visually and epistemologically meaningful manner, testifying to the readers' comprehension of concepts. These diagrams were the result of visual thinking, thought in progress. Later additions and changes represent further thinking by different readers, leading to an ongoing interpretative visual dialogue.

5. Conclusion

The physical and mental production of medieval manuscripts lent itself to the practice of visual thinking. The design of the mise-en-page, the introduction of the various visual devices within and around the texts, the diagrammatic thinking and the visual and textual dialogue of generations of readers make medieval manuscripts a work surface and a thought surface producing an interactive communication surface. The open-endedness of the medieval production and organisation of knowledge afforded by the use of the folio space is an appealing concept. Engaging with manuscripts now makes one part of the intellectual landscape that extends from antiquity to our time.

François Loget

Shaping Operations like Images: Operation Diagrams in Ramus's *Algebra* (1560)

1. Introduction

Peter Ramus is a prominent figure of the French Renaissance. If he has sometimes been presented as a forerunner of Descartes,[1] he is more generally considered as a logician and educational specialist. A prolific author, he published many textbooks dealing with most of the disciplines taught at the University of Paris. Among these, some are devoted to mathematics, a discipline Ramus endeavoured to promote at the University of Paris and that he taught occasionally.[2] His short treatise of Algebra, printed in 1560, was probably designed for a teaching purpose and intended for students.

This treatise isn't original as for its content, as it mostly recollects and rearranges the material of Johann Scheybl's *Algebrae com-*

[1] See André Robinet, *Aux sources de l'esprit cartésien: L'axe La Ramée-Descartes : De la* Dialectique *de 1555 aux* Regulae, Paris: Vrin, 1996. André Robinet's thesis is not unanimously accepted however. The literature concerning Ramus is huge and it would be impossible to mention here even a list of the classical studies concerning the many aspects of his works. Three reviews of these were offered by the end of the 20th Century by Peter Sharratt: "The Present State of Studies on Ramus", *Studi francesi* 47–48 (1972), pp. 201–213; "Recent Work on Peter Ramus (1970-1986)", *Rhetorica*, vol. 5, no. 1 (1987), pp. 7–58; "Ramus 2000", *Rhetorica*, vol. 18, no. 4 (2000), pp. 399–455. A review of more recent works will be published by Dominique Couzinet in 2019 in the *Revue des sciences philosophiques et théologiques* in the forthcoming proceedings of a conference held in Paris in July 2018 (subject to acceptance).

[2] The only extensive study – and still relevant – on Ramus's mathematics is Jakob J. Verdonk's *Petrus Ramus en de Wiskunde*, Assen: Van Gorcum, 1966. Recent works by Robert Goulding brought new light on topics dealing with Ramus's mathematics (cf. *Defending Hypatia: Ramus, Savile, and the Renaissance Rediscovery of Mathematical History*, Dordrecht: Springer, 2012).

pendiosa facilisque descriptio.[3] But it is to some extent innovative as for the mathematical notations and, more generally, the algebraic language Ramus uses. Despite the fact that his treatise is based on Scheybl's, Ramus uses neither the "cossist" symbols, nor the shortened forms of algebraic terms used in Scheybl's book for the powers and the radical symbol, but simply roman lower-case letters. Furthermore, algebraic operations are displayed in an original and systematic way, in a form I will call "operation diagrams". These diagrams appear as one original aspect of Ramus's mathematical writing compared to his contemporaries.

As an historian of mathematics, I studied Ramus's mathematical treatises during the past years and I recently focused on his *Algebra*. For the present paper, I exploit an article of mine recently published in French.[4] In this paper, I focus on Ramus's operation diagrams to study his contribution to the (so-called) "Symbolic Revolution". The matter is also to show the connections between history of mathematics and history of the book, by raising the question whether the "symbolic revolution" has something to do with the development of the printing press (or not). And my answer is that, *in the case of Ramus at least*, the search for a specific language for mathematics is connected to his uses of the printing press.

Here, I will focus on the "iconic dimension" of operation diagrams. I will first explain on a single example what is an operation

[3] Scheybl's treatise is a basic Algebra. It was first published in Basel in 1550, along with the first six books of Euclid's *Elements*. It was then published separately in Paris: Johann Scheybl, *Algebræ compendiosa facilisque descriptio qua depromuntur magna arithmetices miracula*, Paris: Cavellat, 1551. For a comparison between Scheybl's and Ramus's treatises, see François Loget, "Genèse et destin de l'*Algebra* de Pierre de la Ramée: Science et enseignement de l'algèbre en France dans la deuxième moitié du XVI^{e} siècle", *Journal de la Renaissance* 6/2008, pp. 125–160.

[4] François Loget, "Avant la 'langue des calculs': L'écriture des operations dans l'*Algebra* de Pierre de La Ramée", *Philosophia Scientiae*, vol. 22, no. 2 (2018), pp. 81–109. For a general presentation of Ramus's Algebra, see Jakob Verdonk, *op. cit.*, pp. 209–224; see also François Loget, "De l'algèbre comme art à l'algèbre pour l'enseignement", *Revue de Synthèse*, vol. 132, no. 4 (2011), pp. 495–527.

diagram. Then, I will consider some features of Ramus's conception of images. For that purpose, I will rely on Walter J. Ong's book on Ramus.[5]

2. What Is an Operation Diagram?

In Book 1 of his *Algebra*, where he exposes the method for operating with "algebraic" numbers, Ramus presents a number of operations in the form of diagrams.[6] The most typical of these operation diagrams are those dealing with irrational numbers (*numeri surdi*) and binomials (*binomii* and *residui*).[7] In the Appendix, I reproduce the folio 7 recto-verso, where Ramus exposes the method for adding two irrational numbers. Below, I will focus on this unique example to explain what an operation diagram is.

2.1. Adding Two Irrationals: The Method

In a preparatory paragraph, Ramus explains the method for adding two irrational numbers. The first sentence is a general definition of *additio surdorum*, expressed in a concise/condensed (and quite obscure) form.

> Addere surda latera, est é reductorum lateribus compsitum multiplicare & per se pro suo genere, & per communem mensuram, tum facti latus invenire.

Then, he illustrates the definition by solving (*in words*) two numerical instances. I reproduce below the Latin text corresponding to first numerical instance and then propose a translation:

---

[5] Walter J. Ong, *Ramus: Method, and the Decay of Dialogue: From the Art of Discourse to the Art of Reason*, Cambridge, MA: Harvard University Press, 1958.
[6] I study some of these diagrams in my 2018 paper mentioned above (cf. note 4).
[7] It is worth noting that the mathematical language of Ramus is not designed for writing down equations. The equations he solves in Book II of his Algebra are presented in a rhetorical language.

> Ut in lateribus quadratis, primum addatur latus 27 ad l12, reduces per 3 communem mensuram ad veros quadratos 9 & 4, eorumque latera 3 & 2 addes, & ex his collectum 5 multiplicabis primò per suo pro suo genere id est quadraté, deinde factum 25 multiplicabis per 3 communem mensuram: tum denique facti 75 latus summa erit datorum laterum.
>
> Let add first l27 à l12. Simplify by 3, common measure, you'll get "real squares" 9 et 4, and add their roots 3 et 2. First, multiply the sum 5 *per se pro suo genere*, *i.e.* square it. Then multiply the result 25 by 3, common measure. Finally, the root of the product 75 will be the sum of the given irrational numbers.

These instances make the definition more explicit, by a calculation on given numbers, and by breaking down the stages of the calculation. Along with the instances, the definition constitutes a sort of *recipe* that the student has to read – and to learn – to master the calculation.

2.2. Adding Two Irrationals: The Diagrams

After this paragraph, six operation diagrams are displayed on pages 7r-v to exemplify the addition of irrational numbers. The first two diagrams (page 7 recto) are those that were first solved literally ($\sqrt{27}+\sqrt{12}$ et $\sqrt{16/3}+\sqrt{27/4}$)… At first sight, it appears that each of these diagrams is isolated on the page and that they have the same (distinctive) typographical layout.

Let's consider the first diagram. I reproduce it in Figure 1. A careful examination shows that the lines of the diagram roughly match the stages of the *recipe*. So, the diagram appears to be a non-rhetorical equivalent of the *recipe*.

l27 ad l12
3
9 4
3 2
5
25
l75

Figure 1.

A transcription in modern (symbolic) language (Figure 2) makes more explicit the procedure Ramus follows. It shows that Ramus factorizes (just like a high school student would do today). But the factorization is hard to decipher on the diagram, while in the modern ("cartesian") writing, it appears clearly, as each line is a mathematical formula made by replacing by an equivalent expression part of the preceding formula.

l27 ad l12	$\sqrt{27}+\sqrt{12}$	datas
3		
9 4	$\sqrt{9\times3}+\sqrt{4\times3}$	
3 2	$3\sqrt{3}+2\sqrt{3}$	factorization
5	$5\sqrt{3}$	
25	$\sqrt{25\times3}$	
l75	$\sqrt{75}$	result

Figure 2.

To sum up, Ramus's method is exactly same as ours, but his writing isn't as explicit or meaningful as ours. Due to this lack of intelligibility, one must refer to the *recipe* to get a full understanding of the calculation. The reader cannot decipher the diagram if he hasn't read the instructions related to it first.

2.3. The Iconic Dimension of Operation Diagrams

Operation diagrams are linguistic artefacts. Ramus employs specific signs (lowercase letters, numerals, operation symbols) to write down mathematical expressions. He employs (implicit) syntactic rules to put these signs together. The stages of the operation are written on successive lines (his mathematical writing is actually *two-dimensional*). Those are the reasons why I would argue that Ramus's operation diagrams are written in a sort of proto-symbolic mathematical language.[8]

But operation diagrams also have an iconic dimension. Each diagram is displayed on the page separately and is a sort of typographical unit. All of them are framed in the same (standard) typographical layout. In the case of the sum of two irrational numbers, the triangle-shaped diagram, with the successive lines converging on the final result, is typical. Thus, a specific layout used for similar operations characterizes operation diagrams as images. They are images made of types.

3. Operation Diagram in Light of W. J. Ong's Views

3.1. The "Aural to Visual Shift" in the 16th Century[9]

In an essay published sixty years ago, Walter J. Ong studies Ramus's contribution to Renaissance philosophy and logic. He draws a history of logic which leads him from medieval universities to the Renais-

[8] For more details on this aspect, see section 4 (pp. 95–98) in my 2018 paper.
[9] In the present section, I rely on Ong's *Ramus*, pp. 105–112. The few quotations I make are followed by a page number.

sance, from scholasticism to the dialectic of Rudolph Agricola. This panorama gives way to the study of the origins and the development of Ramus's thought, then to its diffusion ("Ramism"). Ong criticizes Ramus's theoretical background, but in the meantime he presents him as a an important protagonist of Renaissance philosophy.

Ong's history of logic is rooted in his analysis of Aristotle's predication theory. In Aristotle's logic, he explains, the categories are "types of predicates conceived of more or less as 'accusations' (or 'outcry' in the market place)" (p. 106), that one attributes or "urges against" a subject. Such attributions constitute assertions, or (universal) propositions, that are the material of Aristotle's syllogistic.

According to Ong, there remains in the notion of the categories a certain "aural or auditary residue", due to the fact that "Human knowledge for Aristotle exists in the full sense only in the enunciation, either interior or exteriorized in language. … [Therefore] the enunciation cannot be conceived of solely in terms of visual analogies; these must be complemented with the aural if we are to form a concept at all adequate to this elemental cognitive process" (p. 108). This aural dimension of enunciation cannot be eliminated and it gives Aristotle's logic a psychological dimension. Thus, if Aristotelian logic admits of formal developments such as those of medieval logic, it cannot be reduced to a pure formal logic.

In the course of the 15th century, the Dutchman Rudolph Agricola integrates into his presentation of logic the theory of "places", traditionally included in the treatises of rhetoric. In this logic, the aural/auditory residue of Aristotle's logic disappears for the benefit of a conceptualization in terms of purely visual/spatial analogies. A heir of Rudolph Agricola, Ramus is the promoter after him of a "logic of places" as a substitute to the medieval "class logic" based on Aristotle's categories.

Agricola and Ramus's "logic of places" favour the development of what W. J. Ong calls the "visualist mentality". At the root of this mentality, there is a tendency to consider all intellectual activity through visual analogies, and to exclude analogies with other sensory fields (such as aural-type analogies). In formal logic, one observes this tendency, as "[it] is interested in the 'structure' of our intellectual

activity – a notion which cannot even be conceived except by analogy with some sort of spatial diagram. It does not concern itself with 'tone' or other aural-type phenomena" (p. 107). It neglects the psychological dimension of language.

The tendency to represent intellectual activity – and primarily logical processes – by means of visual analogies is in fact common to all types of knowledge: "All explanation and all science, metaphysics included, attempts as far as possible, to reduce the sensory analogies it employs to those drawn from vision, and thus tends to traffic in quantity and number. A drift toward the visual is inseparable from any economy of explanation" (p. 108). Thus, the development of the visualist mentality is connected to the raise of scientific knowledge in the 16th century. The growing recourse to diagrams and to other symbolic means – including geometric or arithmetic means – to represent cognitive or physical processes is characteristic of the visualist mentality as well as of the scientific revolution.

As a result of Agricola and Ramus efforts, Ong explains, we pass of a mental universe dominated by aural in a mental universe dominated by vision. The words are no more considered as part of a universe of sound but in the space of writing. The processes of thought are spatialized. All the knowledge, all the products of the spirit, are considered as "things" occupying certain space. That's what Ong describes as the "aural to visual shift" that occurs in (Western) culture.

3.2. "Visualist Mentality" and Print Culture

The development of the visualist mentality,[10] Ong explains, is favoured by the development of the printing press. The proliferation of complex diagrams in early 16th-century treatises of logic was made possible by the control of the technology of the printed matter.

Furthermore, Ong asserts that the development of Ramus's notion of method, central to his philosophy as it will be in Descartes's, is connected with the art to arrange materials in the printed

[10] Cf. Ong, *Ramus*, pp. 307–314.

book: "Ramus' notion of method is not only a product of the humanism which sponsors both printing and the topical logics, but is also thought of (by Ramus) as an arrangement of material *in a book*" (p. 311). Ramus's textbooks were published at a time when the printed book was to become the leading medium for the transmission of knowledge, and they were shaped to fit this purpose. Referring to W. J. Ong, one can assume that these treatises were handcrafted by Ramus's printers to display the knowledge and to help the reader to master it by reading.

Thus, the dichotomized tables, usually considered as an emblem of Ramus's logic, must be analyzed as a feature of print culture. If dichotomized tables were present in some manuscripts, print gave them currency to a degree never approximated before. As for Ong, these tables show the logical relationships between the main concepts of an art. They summarize the art, and play a role as mnemonics: Dichotomized tables are printed artefacts made for summarizing and memorizing the content of the book in a scribal culture. They replace the mnemonic schemes of the old treatises of rhetoric, made for the ancient aural culture.

3.3. Operation Diagrams as Mnemonic Devices

My hypothesis is that operation diagrams are also designed to facilitate memorization – namely, the memorization of algorithms. They are part of Ramus's (visual) mnemonics. In the example presented above, the reader/student who has first read (and learnt by heart) the *recipe* and seen the triangle-shaped diagram will be able to recollect the successive stages of the operation to write it down and to calculate the sum of any two irrational numbers. So, just like dichotomized tables, operation diagrams plays a role as mnemonic devices.

As I said above, diagrams have a linguistic dimension, but the (mathematical) language in which they are written down is not readable as such. The iconic dimension compensates the weakness of this language. The standard form in which operations are typeset is supposed to function as an aid for the reader to operate with algebraic

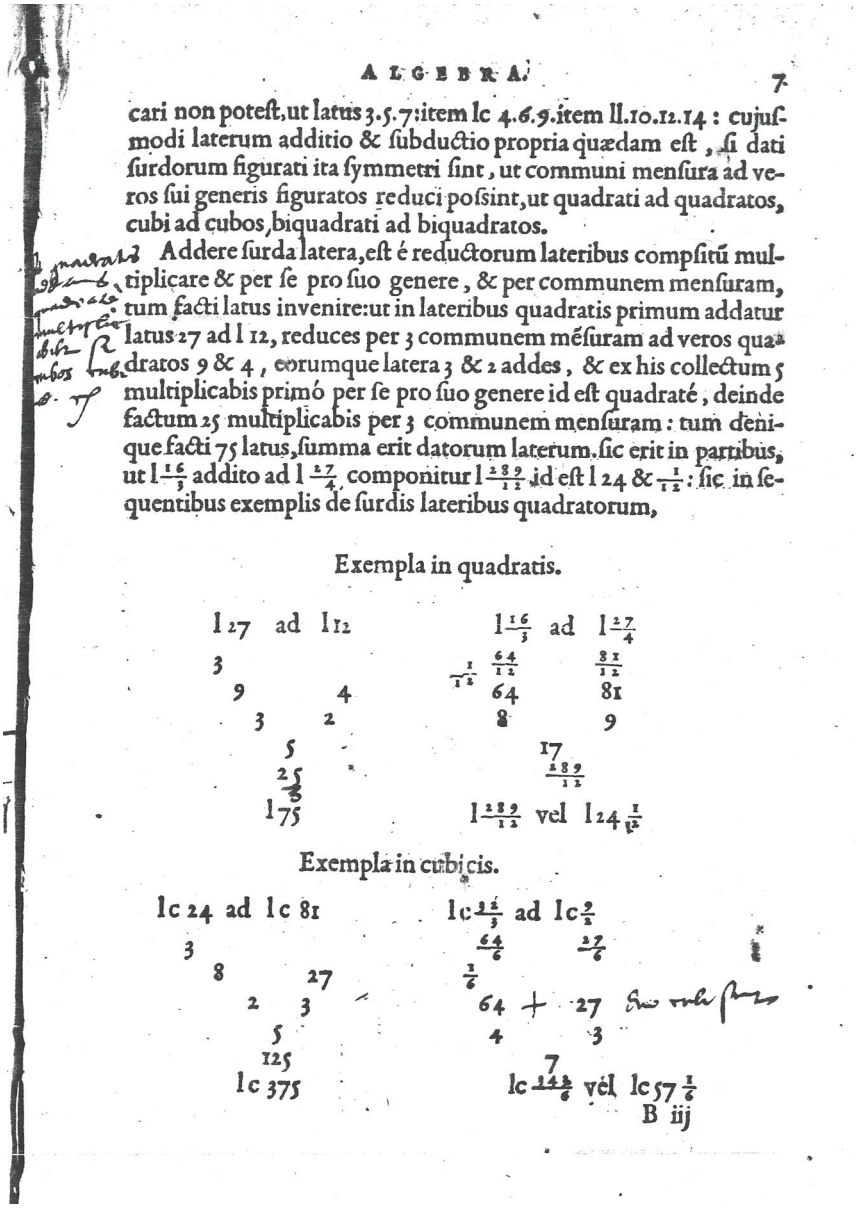
numbers, as he's supposed to be able to recall this form and to connect it with the corresponding algorithm.

4. Conclusion

Walter Ong didn't pay much attention to Ramus's mathematics.[11] However, his mathematical textbooks, and his *Algebra* above all, illustrate the "visual shift" Ong strives to describe. In Ramus's view, operation diagrams, just like dichotomic tables, are visual instruments that allow the reader to learn from the book.

More generally, I would say that diagrams (just like dichotomized tables) show Ramus's conception of the book as designed for learning. Ong insists on the fact that printing technics consists in arranging fonts in a forme in order to product printed pages that reproduce such arrangement. In other words, each page is shaped as an image and Ong supposes that, for Ramus, not only diagrams or dichotomized tables are images, but also printed pages as such. Thanks to printing technics, knowledge is *displayed* in the book in such a form that learning is made easier: identical copies of a book made of identical image-like pages issued from the printing workshop can be considered as allowing every reader to access to the *same* knowledge and as the best medium to spread it. Ramus must have been particularly mindful of these aspects, to the extent he considers that the content of the book has to reflect the content of the mind and that the better the book is organized, the better it presents the model of the processes of the mind. His recourse to operation diagrams is one singular but representative aspect of this effort: they are models for algebraic processes. And they illustrate, at a lower level, the visual shift that occurs in Renaissance culture, as Ramus's treatises as such illustrate it at a higher level.

[11] As far as I know, Ong addressed Ramus's mathematics in a unique paper: W. J. Ong, "Christianus Urstitius and Ramus' New Mathematics", *Bibliothèque d'Humanisme et Renaissance*, vol. 36, no. 3 (1974), pp. 603–610, where Ong shows that Urstitius used a copy of Ramus's *Arithmetica libri duo* annotated by Ramus himself to compose his *Elementa mathematicis* (1579).



ALGEBRA. 7

cari non poteſt, ut latus 3.5.7: item lc 4.6.9. item ll.10.12.14 : cujuſmodi laterum additio & ſubductio propria quædam eſt, ſi dati ſurdorum figurati ita ſymmetri ſint, ut communi menſura ad veros ſui generis figuratos reduci poſsint, ut quadrati ad quadratos, cubi ad cubos, biquadrati ad biquadratos.

Addere ſurda latera, eſt é reductorum lateribus compſitũ multiplicare & per ſe pro ſuo genere, & per communem menſuram, tum facti latus invenire: ut in lateribus quadratis primum addatur latus 27 ad l 12, reduces per 3 communem mẽſuram ad veros quadratos 9 & 4, eorumque latera 3 & 2 addes, & ex his collectum 5 multiplicabis primó per ſe pro ſuo genere id eſt quadraté, deinde factum 25 multiplicabis per 3 communem menſuram: tum denique facti 75 latus, ſumma erit datorum laterum. ſic erit in partibus, ut $l\frac{16}{3}$ addito ad $l\frac{27}{4}$ componitur $l\frac{289}{12}$ id eſt l 24 & $\frac{1}{12}$: ſic in ſequentibus exemplis de ſurdis lateribus quadratorum,

Exempla in quadratis.

l 27 ad l 12

3
9 4
3 2
5
25
75
l 75

$l\frac{16}{3}$ ad $l\frac{27}{4}$

$\frac{1}{12}$ $\frac{64}{12}$ $\frac{81}{12}$
64 81
8 9
17
$\frac{289}{12}$
$l\frac{289}{12}$ vel $l\,24\frac{1}{12}$

Exempla in cubicis.

lc 24 ad lc 81

3
8 27
2 3
5
125
lc 375

lc $\frac{24}{3}$ ad lc $\frac{2}{2}$

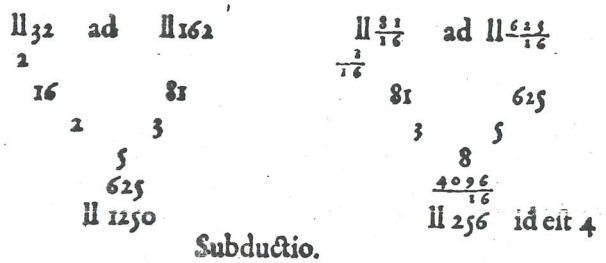
$\frac{64}{6}$ $\frac{27}{6}$
$\frac{1}{6}$
64 + 27
4 3
7
lc $\frac{343}{6}$ vel lc $57\frac{1}{6}$

B iij

Appendix: Ramus, Algebra, *fol. 7r.*

ALGEBRA.

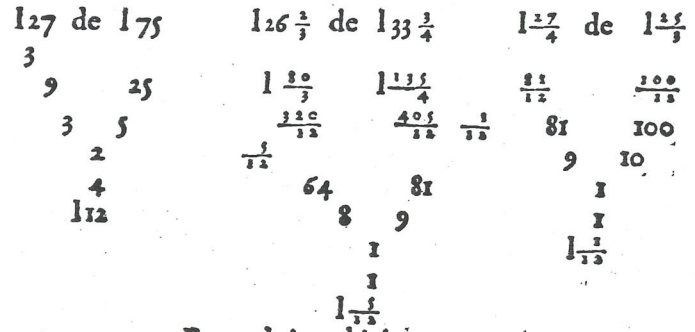
Exempla in biquadratis.



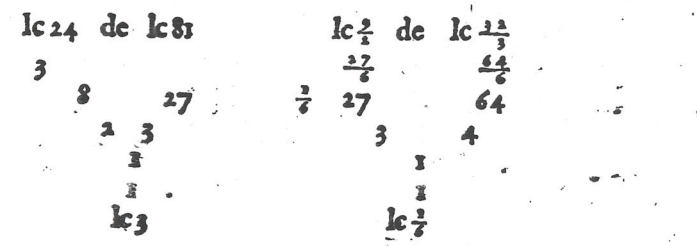
Subductio.

Tollere ſurdum latus á ſurdo latere, eſt é reductorum lateribus tollendum á reliquo tollere, & reliquũ per ſe pro ſuo genere multiplicatum, per communem menſuram multiplicare, & facti latus invenire,

Exempla in quadratis.



Exempla in cubicis.



Appendix: Ramus, Algebra, *fol. 7v.*

LEARNING IN THE DIGITAL AGE

Kinga Biró

New Dimensions of Learning

1. Introduction

The 3D technology is rapidly changing. Augmented reality is considered to be one of the fastest growing branches of ICT that is visible in our everyday lives. With the assistance of it, the physical world can be expanded with virtual elements (e.g. 3D models, videos and animations) that merge into the real-life environment.[1] The obtained system is halfway between the real and the virtual world, and is displayed with the help of a mobile phone, a computer screen or a special device secured to the head.[2]

The technology referred to is still developing. It is not simply a tool, but it allows a student to explore, experience or be involved, as if they were actually present in the environment. The educational experiences using the technology will be entertaining, enjoyable and motivating. This technology is a part of the students' lives. In a world where students consume media, virtual reality helps the educators to teach students about new ways of constructing narratives.

I will explain how we can integrate augmented reality in all fields of education. As a chemistry teacher I present a model of an ammonia molecule.

2. Animation

3D animation is an industry that borrows from many other fields, including film, art, photography, sculpting, painting, technology and

[1] Kinga Biró, György Molnár, Dalma Pap and Zoltán Szűts, "The Effects of Virtual and Augmented Learning Environments on the Learning Process in Secondary School", 8th IEEE International Conference on Cognitive Infocommunications (CogInfoCom), Debrecen (2017), pp. 371–376.

[2] Ronald T. Azuma, *A Survey of Augmented Reality*, Malibu, CA: Hughes Research Laboratories, 1997.

has now expanded into education. 3D animation is used in three primary industries:[3]

- Entertainment
- Scientific
- Other

The process of creating 3D animation can be sequentially divided into three phases: modeling – which describes the process of creating the 3D objects within a scene layout; animation – which describes how objects are positioned and animated within a scene; and rendering – which describes the final output of the completed computer graphics.[4]

3. Introduction to 3D Space

Two-dimensional space is represented with the X- and Y-axes. Pictures are flat, without depth and offer only one perspective. 3D animation adds depth, or the Z-axis. This is seen in Figure 1 of the plane and Figure 2 of the same character in perspective.

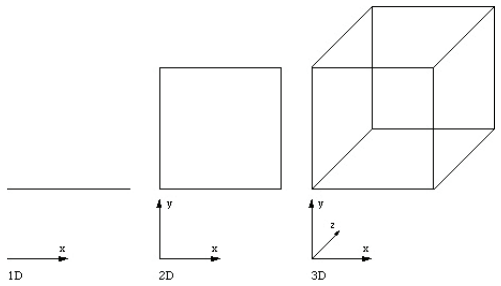


Figure 1: 2D space and 3D space. Source: https://www.quora.com/What-is-the-difference-between-2-dimensional-and-3-dimensional.

[3] Andy Beane, *3D Animation Essentials*, Indianapolis: John Wiley & Sons, 2012.
[4] Cf. http://www.media-freaks.com/the-process-of-3d-animation.

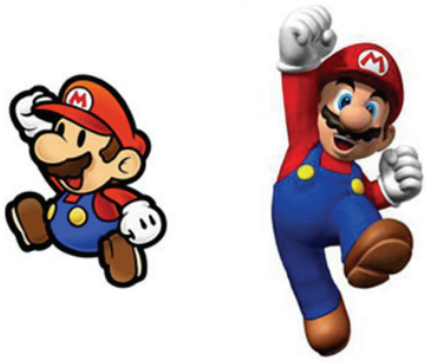


Figure 2: Image Super Mario in 2D (Left) and 3D (Right).
Source: https://darryldias.me/2016/difference-between-2d-and-3d-animation.

In 2D characters look cartoonish and unrealistic. In 3D characters can look cartoonish but realistic at the same time. I've identified and illustrated the 6 common steps involved in producing an animation of a 3D molecule. The steps are as follows:

1. Modeling
2. Texturing
3. Animation
4. Lighting
5. Convert
6. Rendering

3. 1. Modeling

Modeling is an essential part of 3D animation. In 3D computer graphics, 3D models are mathematical descriptions of an object's geometry. These descriptions include points, lines, curves, and surfaces. Models can range from simple primitives to very complex meshes. A geometric primitive is a basic building block of 3D geometry, such as a sphere, cube, cylinder, cone, or torus.[5] Models can be automatically

[5] John E. Park, *Understanding 3D Animation Using Maya*, Springer, 2004.

generated or manually created. The way in which geometric data is manually generated and modelled is in practice very similar to creating spatial plastics and sculptures.

3. 2. Representation

Representing 3D models as objects refers to a set of points that are bound together by different geometric elements, such as triangles, sections, curved surfaces, and so on. The object, as a set of points and other information, can be created manually, algorithmically or even by scanning. 3D models have been widely used for a long time now in 3D graphics as they would have appeared on personal computers. Many older computer games used pre-rendered images of 3D models before computers were able to display them in real time. Nowadays, 3D models are used in many areas. The film industry for animated films uses the characters and objects in 3D modeling. They are also used by the video game industry for console and computer games. For example, the scientific sector performs a detailed representation of the molecules of compounds, and the construction industry prepares plans and designs for future buildings, thereby drawing sketches and mock-ups. The engineering community uses them, among other things, for the design of new tools and machines.

Almost every 3D model can be classified into one of the following 2 categories:

- Solid model

These models also represent the mass of objects (like a rock). They are more realistic, but more difficult to create. Solid models are mostly used in non-visual simulations, for example engineering or medical ones, or in special visual applications such as light tracking, as well as mechanical design (see Figure 3).

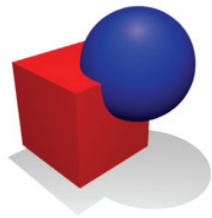


Figure 3: Solid model.

- Shell/boundary model

These models only show the surface, it is the boundary of the object, not its mass, as if we were to portray an endlessly thin eggshell. With these models, it is much easier to work than with a solid model. Almost all models used in films and games were made using surface modeling (see Figure 4).

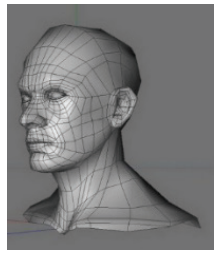


Figure 4: Shell/boundary model.

Surface modeling is common in computer graphics. The two-dimensional surfaces offer a good analogy to the objects used in graphics. Since the surfaces of the objects to be displayed typically consist of undetermined, actually two-dimensional extensions, it becomes necessary to simplify them as discrete digital elements. The polygon network is the most popular, and especially point-based representation has become outstandingly successful in recent years. The method of level sets is a good way to represent formable, variable topology surfaces such as liquids.

The most typical means of creating a 3D model is to take a simple object, called a primitive, and extend or grow it into a shape that can be refined and detailed. Primitives can be anything from a single point (called a vertex), a two-dimensional line (an edge), a curve (a spline), to three-dimensional objects (faces or polygons). Using the specific features of your chosen 3D software, each one of these primitives can be manipulated to produce an object.[6]

4. Common Modeling Techniques

There are three popular ways to represent a model:

- Polygon modeling

Dots in 3D space, called vertex, are linked to sections (Figure 5). These together form a polygon net. Most of the models are textured with polygon models (Figure 6) because they can be flexibly shaped and rendered easily by computers. Polygons are made up of three or more corners known as vertices (a single one is called a vertex) and the lines connecting those vertices, called edges. Each component (vertex, edge, and face) of a polygon can be translated (moved in 3D space), rotated, and scaled (changed in size).

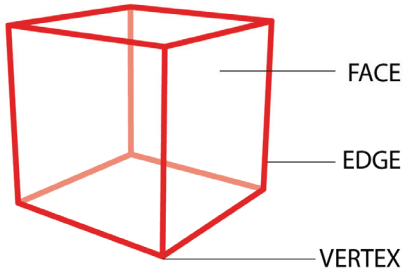


Figure 5: The three main components of a polygon.
Source: Modeled by the author.

[6] Cf. http://www.animationarena.com/introduction-to-3d-modeling.html.

Figure 6: Polygon modeling.
Source: https://www.quimnin.info/types-of-3d-modeling.

- Primitive modeling

This modeling method is based on geometric primitives, such as spheres, cylinders, cones or planes, and builds more complex shapes (cf. Figure 7). The advantage is that it is quick and easy to use, the dimensions are absolutely accurate as the shapes are mathematically defined, and the descriptive language is simple as well.

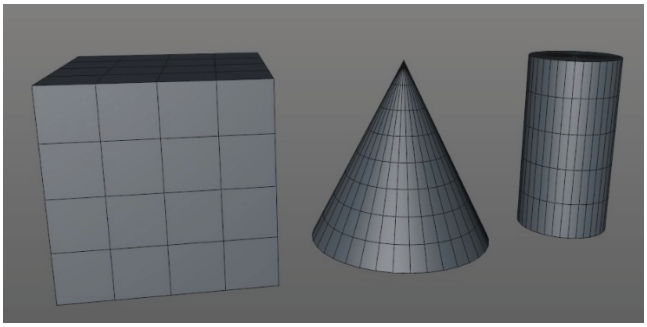


Figure 7: Primitive modeling.
Source: https://www.quimnin.info/types-of-3d-modeling.

- NURBS (Non-Uniform Rational Basis Spline)

NURBS geometry is a mathematical model type that uses smooth curves as guideposts that will span a surface between them (Figure 8). NURBS models are great at representing smooth, rounded shapes but do have limitations, which makes them more difficult to use than polygons.[7]

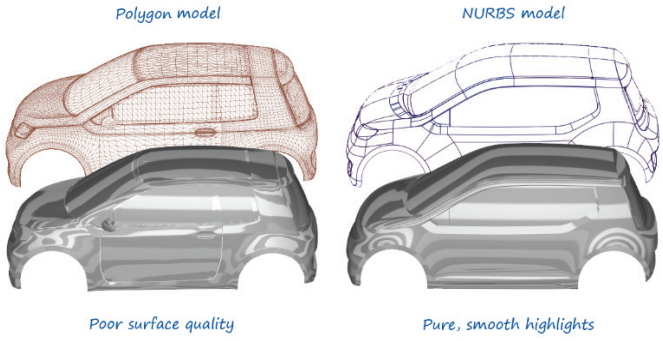


Figure 8: NURBS modeling.
Source: https://www.aliasworkbench.com/theoryBuilders/TB1_nurbs1.htm.

Creating an Augmented Reality experience is a multi-stage process. There are different methods and practices for distinct uses. I will walk you through the concept of 3D models and show you how to create an AR content in 3D.

Augmented Reality allows to visualize 3D models in real-time and in a real environment. AR developed to be the only way to see 3D models as an overlay to the world in front of you. There are two ways to approach creating your first AR experience: create your own 3D content or start with already built models from a 3D library. In this paper, I am going to introduce my own 3D model. You can use

[7] Andy Beane, *3D Animation Essentials*, Indianapolis, IN: John Wiley & Sons, 2012, p. 150.

several software to create a 3D model.[7] The most popular software are 3ds Max, Cinema 4D, Maya and Blender.

5. Creating an Animated 3D Aura

The more complex the model, the longer this stage will take. A simple box shape with only a few surfaces takes very little time to complete, while a 3D character that moves and talks requires additional stages of work, as the bones and facial muscles of the character must be rigged for realistic animation. Their details are also more intricate, so texturing these models requires more time. This ensures that the final character moves smoothly and naturally so it appears as it would if it actually existed.[8] The Cinema 4D program starts out with the basics of working in 3D dimensions: simple shapes and geometries.[9]

- 1st step: modeling

It is the process of taking a shape and moulding it into a completed 3D mesh. The most typical means of creating a 3D model is to take a simple object, called a primitive, and extend or "grow" it into a shape that can be refined and detailed.[10] When you create a model in 3D, you will usually learn one method to create your model, and go back to it time and again when you need to create new models. As we have seen, we can use three basic methods to create a 3D model.

My model is a low-polygon model (Figure 9) so that the animation can be run quickly and efficiently over the smartphone or tablet. Thus not only the animation runs more efficiently, it also takes less space to store the animation.

[8] Cf. https://www.augment.com/blog/3d-models-and-processing.
[9] Cf. https://www.instructables.com/id/Intro-to-3D-Modeling.
[10] Cf. http://www.media-freaks.com/the-process-of-3d-animation.

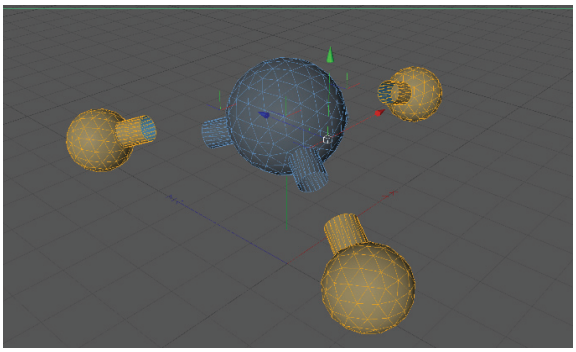


Figure 9: Molecule model.
Source: Modeled by the author.

- 2nd step: texturing

The art of giving clothes to the 3D models. When a 3D model is created, 2D images can be overlaid on it to add colours, designs, and textures. This is called mapping. Its level of detail will determine how realistic the finished model will look. The size and resolution of colours and textures on the 3D object are also important. In this case, the molecule only received colour to avoid having to work, in case, on a phone by rendering jpeg or other formats (Figure 10).

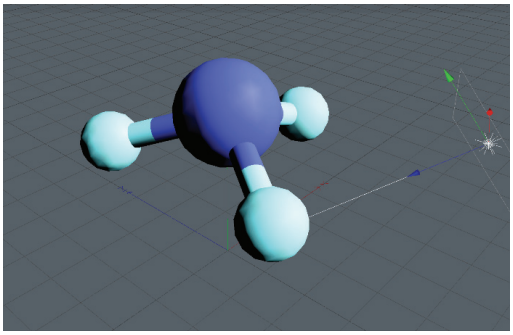


Figure 10: Texturing.
Source: Modeled by the author.

- 3rd step: animation

Animation is the process of taking a 3D object and getting it to move. Animation comes in a few different flavours. There's key frame animation, where the animator manipulates the objects on a frame-by-frame basis, similar to old hand-drawn cartoons. Other methods of animation include placing objects on splines and setting them to follow the path of the curve, or importing motion capture data and applying it to a character rig. Yet another way to animate is to use your 3D application's built-in physics engines, such as when your scene requires that objects fall.

Here you can see a simple rotation animation that lets you visualize optically the molecular form (Figure 11).

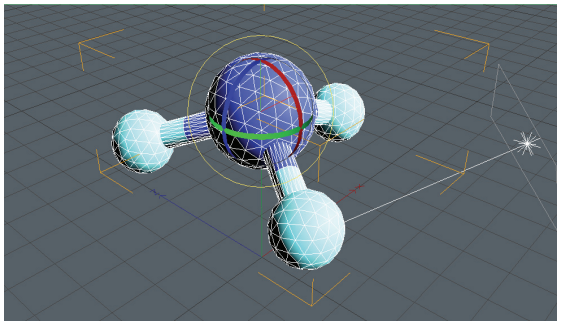


Figure 11: Animation.
Source: Modeled by the author.

- 4th step: lighting

As in real life, we see not the objects, only the light reflected on them. Therefore we need to create artificial light sources to see the object. In 3D, lights do not actually exist as in the real world. 3D lights are objects that are designed to simulate the operation of lighting in real life. In 3D space one also needs at least one or more light sources that are reflected in our eyes from the object. In this case, our virtual point of view.

- 5th step: convert to application-compatible format

Most of the 3D design software allows you to create a couple of different file types. The animation needs to be converted to the correct format when using an AR application.

- 6th step: rendering

Rendering an image is typically the last step in the 3D production pipeline, and is perhaps the most important part. AR applications generate a lot of rendering pictures during operation, but in low quality. Rendering is the final step to give a realistic look (Figure 12).

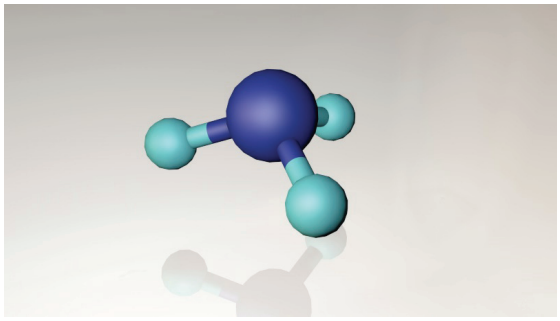


Figure 12: Rendering.
Source: Modeled by the author.

6. Opportunities for Education

The best educational experiences using this technology will be entertaining, delightful and practical. We must remember that this technology will be a natural, usual part of our students' lives. The integration of VR and AR allows students to meet some of the skills and experiences afforded by the new technologies curriculum. Imagine being able to look at the activity of the human brain at an atomic level. In the near future, AR will make our entire learning environ-

ment look technologically augmented.[11] AR in education will increase students'

- Knowledge base
- Participation
- Interest in learning the content
- Intellectual curiosity

AR can be a great tool in education. Students can use modern gadgets to get a better understanding of the way things work and to make learning much more interesting.

7. Summary

With the help of AR apps, materials can be made more spectacular and interesting. One of the tasks of any teacher is to motivate students, and with the use of smartphones and other smart devices it seems manageable. What is impossible in real life due to the laws of physics can become reality in a virtual environment. With the help of smart devices, a new and interactive world is to be explored around us.[12] What the real laws of physics do not say is what we can create in a virtual space. By using smartphones we can open a new and interactive world around us. We can depict 3D objects, people, videos, experiments which show the physical space in real time. The use of digital tools in the teaching-learning process enhances student motivation, arouses their attention and makes the learning process a rich experience.

A strong computer configuration is required to run and display the 3D world. Today the speed of the processors is very fast, but we have arrived at a new turning point threshold. Thanks to the new technologies number crunching tasks are transferred to video cards.

[11] Gary Bitter and Allen Corral, "The Pedagogical Potential of Augmented Reality Apps", *International Journal of Engineering Science Invention*, vol. 3, issue 10 (Oct. 2014, pp. 13–17), cf. http://www.ijesi.org/papers/Vol(3)10/C031013017.pdf.
[12] Kinga Biró et al., *op. cit*. (cf. note 1 above).

The NVIDIA[13] Corporation computing company displays outstanding research efforts. Every day there are new developments that seem to be promising in the VR and AR world. We look forward to an exciting future.

[13] Cf. https://www.tomshardware.com/news/nvidia-ai-research-render-graphics,38185.html.

István Danka

Gamification: Old Wine in New Bottles

1. Introduction

A serious challenge online education has not been able to overcome is motivating learners. A most recent hope for many to solve this problem is gamification, i.e., developing educational techniques that build on an analogy between educational environments and (video) games. Gamification is attractive because games are especially motivating. Applying their benefits to education can help learners get committed to learning.

I shall argue that gamification is an old wine in new bottles because the educational technique it applies is not novel. As a synthesizing framework, gamification can be effective, insofar as the old and new elements it synthesizes can work together effectively. But if gamification is educationally useful, it is useful partly because of the old educational techniques, and their compatibility with technological advantages. After introducing the idea and defending it from some standard criticism, a characteristic example for these old techniques, formative assessment will be discussed.

2. What Gamification Is and What It Is Good For

2.1. Gamification: The Hype

"Gamification" is a buzzword in contemporary educational research and practice referring to the phenomena of importing elements from video game design into education. Though the term itself is very new, gamifying educational environments is not a new idea (consider e.g. role-playing in education). Predecessors of gamification include so-called "serious games" and "edugames" specifically in education. Google Trends stats show that the popularity of "gamification" started

in late 2010 / early 2011, and it is still rising with no sign of an exhaustion to be expected in the near future.[1]

The scientific (or rather semi-scientific – often in the form of blog posts of game designers and educators) reception of gamification mostly shows extremely optimistic tendencies. Game designer Jane McGonigal argues that gaming will possibly solve world problems.[2] Others emphasize its motivating character and success in developing skills, driving innovation and changing behaviour.[3] Decisive evidence for or against gamification is missing though, and a lack of it should make us cautious.

"Gamification" lacks a proper definition but an approx. definition is as follows: gamification is the application of game design elements and/or game principles to non-gaming environments (and education in particular). However, a popular understanding of the gamificationist movement is often just letting learners play in class and expecting them learn in the meantime. Santau Sinha, president of the e-learning pioneer Khan Academy, stresses that "hiding" learning material behind game design is too transparent a trick for learners to be deceived and argues that the educational aim should be making learners "*want* to learn".[4]

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[1] For "serious games", see esp. Clark C. Abt, *Serious Games,* New York: Viking Press, 1970. For edugames, see K. Werbach and D. Hunter, *For the Win: How Game Thinking Can Revolutionize Your Business,* Philadelphia: Wharton Digital Press, 2012. For history and data, see Ilaria Caponetto, Jeffrey Earp, Michela Ott, "Gamification and Education: A Literature Review", https://pdfs.semanticscholar.org/2b9b/64350c1d2d6f9103b8505612e98afb1da3bb.pdf; Michael Jackson, *Gamification in Education. A Literature Review,* MA thesis, United States Military Academy, 2016, https://www.usma.edu/cfe/Literature/MJackson_16.pdf, and software developer Nick Pelling's "The (Short) Prehistory of 'Gamification' ", https://nanodome.wordpress.com/2011/08/09/the-short-prehistory-of-gamification.

[2] See https://www.youtube.com/watch?v=dE1DuBesGYM.

[3] Marc Prensky, *Digital Game-Based Learning,* New York: McGraw-Hill, 2001, and Brian Burke, *Gamify: How Gamification Motivates People to Do Extraordinary Things,* Brookline, MA: Bibliomotion, 2014.

[4] In his *Motivating Students and the Gamification of Learning*, https://www.huffingtonpost.com/shantanu-sinha/motivating-students-and-t_b_1275441.html.

Rather than arguing against bad applications, for the rest of this paper, I shall take gamification at its best, ideal form. Still, the question arises how education can make learners want to learn? How can possibly unmotivated learners be taught to be motivated?

2.2. Gamification and Motivation[5]

The answer to these questions lies in gamification for many. The general line of reasoning behind their expectations is as follows:

(1) Education is short of motivated learners.
(2) Games are motivating.
(3) In order to make learners more motivated, education should be gamified.

Premise (1) is hardly deniable, especially since the worldwide introduction of mass education. Education is not a privilege but an obligation, motivating learners is a primary concern for educators. So if premise (2) is viable, the conclusion follows. How games are motivating (in an educational environment) is the only questionable part of the syllogism.

Games alone are certainly motivating: a huge amount of time and energy is spent on gaming for no material compensation.[6] Apply-

[5] For games and motivation in education, see esp. Thomas W. Malone and Mark R. Lepper, "Making Learning Fun: A Taxonomy of Intrinsic Motivations for Learning", in R. E. Snow and M. J. Farr, *Aptitude, Learning and Instruction III: Conative and Affective Process Analyses*, Hillsdale, NJ: Erlbaum, 1987, pp. 223–253; Krisztina Szabó and Alexandra Szemere, "The Role of Motivation in Higher Educational Gamification Practice – Extending the Issue", in Jan Beseda, *DisCo 2016: Towards Open Education and Information Society*, Prague: Creative Commons, 2016, pp. 52–71; Christo Dichev and Darina Dicheva, "Gamifying Education: What Is Known, What Is Believed and What Remains Uncertain: A Critical Review", vol. 14, no. 9 (2017), DOI: 10.1186/s41239-017-0042-5; Krisztina Szabó and Alexandra Szemere, "Engaging Students in Higher Education: Some Considerations on the Relation between Gamification, Movitation, and Flow", *Ricercazione*, vol. 9, no. 2 (2017), pp. 51–72.
[6] For details, see McGonigal, *op. cit*., and Prensky, *op. cit*.

ing game elements to educational environments can possibly inherit this motivating power. Arguably, these elements include

(a) Points, experience points and a levelling-up system;
(b) badges, prizes, in-game rewards, achievements;
(c) challenges, replay or do over;
(d) immediate feedback, progress bars;
(e) leaderboard, scoreboard;
(f) peer interaction, collaboration;
(g) customisation;
(h) storytelling, visual elements, avatars. [7]

Points (a) and (b) are setting up short-term, easy-to-achieve goals that make progress well-measurable, and satisfaction going with success keeps learners motivated. Points (c), (d) and (e) relate to a trial-and-error way of progress, along with expert help. Point (f) is perhaps self-explanatory; (g) and (h) relate to what I shall call as "the garnish": the fancy part of gaming that most probably can attract, and keep up, attention. But its price is being deceptive and possibly even distracting if learners' motivation for gaming suppresses their motivation for learning. This leads towards some criticism on gamification and motivation.

3. Criticism and Responses

Other than a request for refinements in terminology and technology, two substantial objections have been raised against the possibilities of gamification in motivating learners. First is the distraction problem briefly mentioned above: what is motivating in games when gaming might be distracting when learning. Second is the commitment problem, according to which the level of commitment required

[7] Caponetto et al., *op. cit*., and Fiona Fui-Hoon Nah, Qing Zeng, Venkata Rajasekhar Telaprolu, Abhishek Padmanabhuni Ayyappa, Brenda Eschenbrenner, "Gamification of Education: A Review of Literature", in F. F-H. Nah (ed.), *HICIB/HCII 2014, LNCS 8527,* Springer, 2014, pp. 401–409.

for learning cannot be warranted by gaming. These shall be discussed in this section.

3.1. The Distraction Problem

Perhaps the most natural reaction to the gamification idea is questioning whether it is educationally useful in any way to let learners do unserious activities like gaming in classroom. Gaming, even if it is designed to support learning, can distract learners from the learning part precisely because of the extreme attention-attracting character of the gaming part. While gamification theorists, as mentioned, sometimes claim that the distracting features of games are not essential for gamification, and it is also argued that the central part for motivation is the scoring system, evidence shows this to be to the contrary. Game designer and researcher Sebastian Deterding provides the most convincing example: he created a scorekeeping game with zero graphical design. The task is to hit a button as many times as one likes in order to receive one trillion points per hit. On the screen, there is nothing else but the button and a counter. If scoring were motivating, this should be a tempting game. But playing it even for a couple minutes only requires quite a self-discipline.[8] Without the garnish, even getting scores is unmotivating. Just think about education: if marking alone could motivate learners, they would be happy to take exams all the time and there would be no need for introducing any motivational factors like gamification into education. It is also worth noting, however, that a realistic visuality alone is not sufficient for effectively motivating learners. If it were so, video lecturing or Second Life would be successful in the long run (which they are not). The scoring system that constantly provides short-term goals for learners to achieve is painfully missing in the case of watching video lectures and Second Life. That deficiency has prob-

[8] See a slideshow of a conference paper of his at https://www.slideshare.net/dings/pawned-gamification-and-its-discontents and also the "game": http://www.progresswars.com.

ably contributed to their downfall as major online educational techniques.

All the same, Deterding's criticism implies that the garnish counts. Visuality, storytelling and all the gaming parts that are irrelevant for educational purposes are relevant for gamified environments to be motivational. It is not necessarily a problem though: slideshow presentations or even books are partly visual and also often story-telling, and they are very useful in education. Visuality or a good story can even help learners remember the learning material.

But the response for this problem in favour of gamification is not that cheap: there is a bullet to be bitten. Namely, if gamification is about the garnish, gamification is not a new educational *technique* but it is a background idea of an educational *technology*. This may be hard to bite for many because it implies three (for gamificationists) undesirable consequences that prevent gamification from being the salvation of education.

First, gamification will not provide educational principles and methods. It does not tell us what to do and how to do so in classrooms. This cannot be expected from pure technology. Second, gamification does not reflect on the teacher–learner relation. It does not tell us how teachers as digital immigrants should relate to learners as digital natives but only how digital natives can learn in their natural environment. Third, gamification does not offer an alternative to other, existing educational techniques. A however novel educational technology does involve a novel educational technique, and hence gamification is not that revolutionary as many think. Gamificationists would perhaps respond that even if gamification is *partly* about the garnish, it does not follow that there is nothing educationally novel in it. To this point, I shall come back in section four. Now let us see the second objection.

3.2. The Commitment Problem

The second objection is an application of Hubert Dreyfus' problem of commitment. Dreyfus argues that online education is a hopeless enterprise because it can never make learning possible above the

level of competence.[9] One of his reasons is that online education is not suitable for developing *unconditional* commitment to learning – i.e., a commitment that makes learners committed to learning intrinsically for the sake of learning. Dreyfus thinks, as opposed to many advocates of the distinction between intrinsic and extrinsic motivation, that conditional commitment *can* lead to unconditional commitment, and hence it can be a good entrance to self-motivated learning. But he claims online educational environments (at the millennium) not to be suitable for developing this achievement.[10]

As applied to gamified learning, the commitment problem is as follows. Gamification as a scorekeeping system offers learning *on the condition* of gaming and getting scores. If an act is done in order to receive a reward, the actor's motivation for doing so is not genuine (or unconditional).

Conditional commitment may be beneficial (it is much better than not being motivated at all), but a problem is that learners stop being motivated as soon as they stop receiving the reward. Leaving the school, former learners will not be rewarded for further educating themselves. In an age of lifelong learning, conditioning learners for

[9] Hubert Dreyfus, *On the Internet: Thinking in Action*, London: Routledge, 2001.

[10] Even though, for historical reasons, Dreyfus criticised e-learning 1.0 environments only (and the second edition in 2008, while confessing several limitations of the first, left this aspect untouched), his criticism seems applicable to e-learning 2.0 environments too. Second Life or Massively Open Online Courses suffer from the same problem as e-learning 1.0 did: a massive resistance to getting committed to learning. Second Life has become virtually empty after a few years of success (see reports incl. William Thomas Finley, "Second Life in Decline – 396 Sims Lost in 2 Weeks", *Gridology: The Study and Observation of Virtual Worlds*, 2012, http://gridology.blogspot.co.uk/2012/07/secondlife-in-decline-396-sims-lost-in.html, or Rupert Neate, "Second Life's Span Is Virtually Over as Firms Decide to Get Real", *The Telegraph*, March 30, 2009, http://www.telegraph.co.uk/technology/5078444/Second-Lifes-span-is-virtually-over-as-firms-decide-to-get-real.html), and the average activity of a MOOC usually starts declining just after a couple of weeks (Rita Kop, "The Challenges to Connectivist Learning on Open Online Networks: Learning Experiences during a Massive Open Online Course", *International Review of Research in Open and Distance Learning*, vol. 12. no. 3 [2011], pp. 19–38).

adopting a "learn for a reward" system is not a good strategy. A solution can be keeping learners stay in gamified environments throughout their lifetime incl. in their workplaces (as e.g. McGonigal seems to imply), but this can hardly be different from solving addiction issues by raising the dose of the addictive material.

Even though unconditional commitment or intrinsic motivation is desirable, there is no established way of developing it in education. But precisely because of the generality of this problem affecting education all the way, it cannot be an argument against gamified education in particular. Attitudes cannot be taught or learnt in the classroom; they are *preconditions* of teaching and learning. Even if gamification alone cannot develop these attitudes, it can help developing them in a Dreyfusian way: it keeps up conditional commitment in the hope that commitment will be internalized by learners in the long run.

4. Gamification: A Good *Because* Old Wine

Now back to the point that even if gamification is partly about the garnish, it can be at least partly about educational techniques too. The problem with this defence is that the educational technique gamification entails can offer nothing novel. Recall the list of gamification features provided above. The first five, i.e. (a)–(e) are also characteristic of a traditional, ungamified assessment procedure called *formative assessment.* Formative assessment is to be contrasted with summative assessment; the first being in-progress and processual, providing informative feedback, aiming at further development, offering constant monitoring, the second being a final evaluation of the end product of learning, providing an evaluation of complete periods in the form of marking rather than in-progress informative feedback, and it compares learning outcome against some standard rather than the internal process of development.[11]

[11] For the distinction, see Michael Scriven, "The Methodology of Evaluation", in R.E. Stake (ed.), *Curriculum Evaluation*, Chicago: Rand McNally, 1967; Michael Scriven, *Evaluation Thesaurus* (4th ed.), Newbury Park, CA.: Sage, 1991; Paul

Some gamificationists like Dichev and his colleagues acknowledge that something similar to formative assessment occurs in gamification but they argue that "gamification incorporates ongoing assessment and a feedback that is separated from the permanent marks or grades", and informative feedback is essential for success.[12] However, the implication that formative assessment lacks informative feedback[13] and consists of mid-term grades only is an oversimplification. In-progress informative feedback is an essential part of formative assessment at its best (and anything can be criticised if not taken at its best). Formative assessment, if applied properly, results in the same regarding (a)–(e) as gamification (if applied properly), and there is nothing in formative assessment that would necessarily exclude an application of (f)–(h) either. Hence, apart from the exact ways how gamified education and formative assessment monitor development, their very essence of a constant in-progress informative feedback is common, and the exact ways like badges or scoreboards in the case of gamified environments are part of the garnish only.

Consequently, what is novel in gamification is not the educational technique but the technology. If gamification as an educational technique is successful, it is so because of the old technique applied to a new environment, and if the old technique is bad, the new environment alone will not help in making it good. Technology can and often does help in improving education, but a technological improve-

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Black and Dylan Wiliam, "Assessment and Classroom Learning", *Assessment in Education: Principles, Policy & Practice,* vol. 5, no. 1 (1998); Bronwen Cowie and Beverley Bell, "A Model of Formative Assessment in Science Education", *Assessment in Education* 6 (1999), pp. 101–116.

[12] *Op. cit*. (cf. note 5 above), pp. 91 f.

[13] Just to avoid verbal confusion: formative assessment is about development to be assessed constantly, whereas informative feedback is about written pieces of advice how to improve. There is no contradiction (or any relevant connection) between "formative" and "informative" in this context.

ment is not an educational improvement. Gamifying education cannot make education better (or worse), even if it can, and hopefully will, improve the outcome of educational processes by better motivating learners.

János Horváth Cz.

Microcontents
Visual Content Management in a Networked World

1. Introduction

"Words Divide, Pictures Unite." – Otto Neurath's thought is more timely than ever. The ability to understand and apply images and visual items is becoming widespread, especially among younger generations. They are the ones who live in an overwhelming (visual) information flow of the World Wide Web. Due to their changed information-gathering and knowledge-processing habits new teaching methods and tools has to be innovated to educate these young people.

The world of microcontents is one of these new educational innovations. In my paper, I introduce the ecosystem, theory and practice of microcontents. In addition, I point out what visual content management methods can be used with icon-based marking technology for microcontents. Finally, I put forward my point that by icon technology, knowledge networks can be formed and developed between large quantities of microcontent units, thus a local knowledge domain can be realized.

2. (Visual) Information Overload and Contemporary Ways of Content Usage

Let's start with a citation from Otto Neurath: "Words Divide, Pictures Unite". Neurath had made efforts to develop a universal pictorial language.[1] During the early decades of the 20th century he had pub-

[1] Sybilla Nikolow, "'Words Divide, Pictures Unite': Otto Neurath's Pictorial Statistics in Historical Context", in R. Heinrich et al. (eds.), *Image and Imaging in Philosophy, Science and the Arts*, Heusenstamm bei Frankfurt/M.: ontos Verlag, 2011, pp. 85–98.

lished the ISOTYPE system (International System of Typographic Picture Education). Maybe he had sensed the changing world where information should be simplified and turned into pictograms, icons to reach a better understanding.

Neurath's vision may have failed in the past but the basic situation still interweaves the present: we have less time to get, process and understand more and more information.

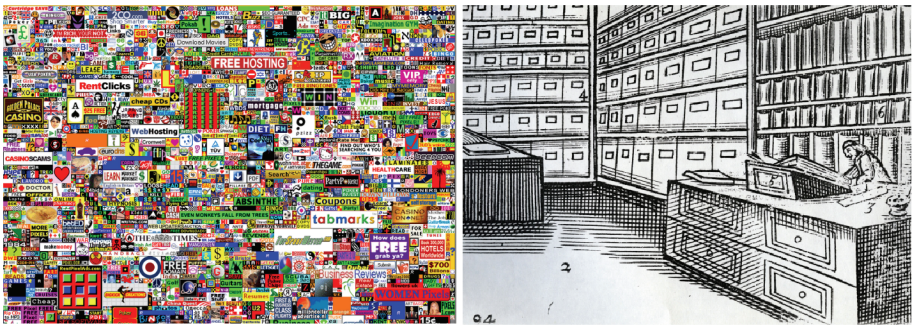

Figure 1.

The image on the right of Figure 1 is taken from Comenius' *Orbis Pictus*[2] (1659). It shows a bookseller and his shop where every book has its own box in a clear system. In contrast with this, the picture on the left of Figure 1 is a screenshot from the "Million Dollar" website[3] (2005). The story of this site is very interesting: a unversity student started an empty web page with this domain name at the begining of the third millennium. He offered pixels from this page for advertises, 1$ per pixel. The project got a huge propaganda so he earned 1 million dollars very quickly. This homepage contains many advertisement-blocks as icons in a chaotic order. The sight is shocking but the page works well: each icon has a link behind it.

[2] See https://www.pbslearningmedia.org/resource/xjf444314/bookshop-illustration-from-orbis-sensu-ger-xjf444314.

[3] See http://www.milliondollarhomepage.com.

Generation Z has appeared.[4] They were born into the age of overloading information. They observe the world in different ways unlike older generations. Ubiquitous internet access is common for them. They have different information processing habits.[5] Probably the members of generation Z feel better in the spectacular confusion of the visuality of the "Million Dollar" homepage. These people think and learn in different ways but their teachers are from elder generations with not so modern didactic capabilities. There is a special gap between teachers and students.

How should these young students be tought who have been born into a networked world where internet access is completely natural, search engines are sometimes more user-friendly than human teachers? We need to improve new methods. One of them is microcontent.

3. Microcontent Ecosystem

According to our own definition microcontents (mC, μC) are created to convey information in the most compact form possible.[6] Of course, it is a soft definition. The local community has to make own decisions about the limits of compactness. There are different types of μCs: text, image, article (text and image), sound, video, web form, etc. It means that there is a central media type used to transfer and express content to the receiver side.

Microcontents try to quantize information into unit blocks. A mC has the following parts: title, author information, body of content, keywords and labels, other metadata. Dimensions of unit blocks of information depend on community consensus, e.g. a text-based

[4] Neil Howe and William Strauss, *Millennials Rising: The Next Great Generation*, New York: Vintage Books, 2000.

[5] Nicholas Carr, *The Shallows: What the Internet Is Doing to Our Brains*, New York: W. W. Norton & Company, 2010.

[6] János Horváth Cz., "Micro-content Generation Framework as a Learning Innovation", in András Benedek and Ágnes Veszelszki (eds.), *In the Beginning was the Image: The Omnipresence of Pictures,* Frankfurt/M.: Peter Lang, 2016, pp. 171–179.

mC has recommended size (~1024 characters), an image-based mC should be interpreted imaginatively in an easy way.

The construction of a mC is individual, there are no absolute rules. Main requirements are that a mC has to be created, published, shared and understood very quickly and easily. We assume that mCs can be used in computer/mobile frameworks, so they should be optimized for different screens. Because of the small size of mC they can be printed on paper (usually).

There are some aspects of creating a microcontent framework:

- Registered users with IDs can create and publish mCs with own and irremovable copyright data.
- Other users can re-edit, re-publish these mCs (with tracking information about changes).
- Other users can rate, prize, make comments to mCs (rating scales, forums, badges).
- Other users can gather mCs into different collections that can be used further (tracking information, making links among mCs, rating, prizing, making comments, etc).
- There could be right and wrong solutions in mC forms, but the community will raise or forget them (only the best ones will remain).
- Filters can be applied (to hide certain mCs, topics, authors, comments, etc).
- You cannot delete contents (the network does not forget – use filters if you wish).
- Instead of outdated or incorrect mCs you can offer an edited version (others may accept it).
- The framework offers searching functions by labels, full texts, popularity, newness, etc.
- The framework has export functions (HTML, other document types, xml).

4. The MC HUNGLE Framework

The microcontent framework described above is called HUNGLE. In this framework new microcontents can be created in an easy way. Each microcontent can be represented by an icon or thumbnail view. A microcontent can be opened to read or to watch by clicking on its icon. Figure 2 shows[7] an image and a text-based microcontent and a mass preview of microcontents.

Figure 2.

Figure 3 represents[8] how microcontents could be grouped into hierarchical structures. An author can form a collection by microcontents, and can organize a domain constructing from former collections.

[7] Screenshot taken by the author.
[8] Screenshot taken by the author.

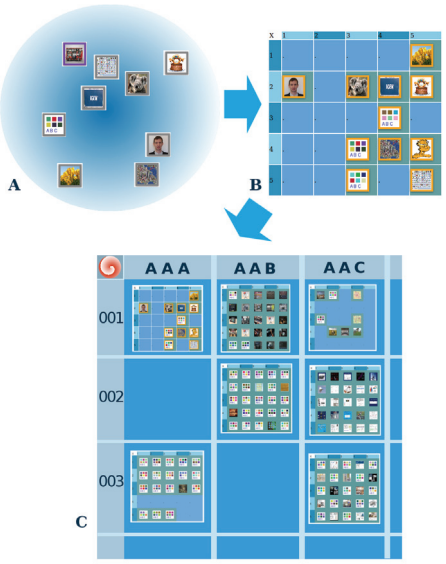

Figure 3.

5. Differences between Mind Maps and Microcontents

I have to mention the differences between mindmaps and microcontents. Mindmap is usually a paper page oriented work. There is only one central idea, a word is to be elaborated in radial hierarchies of labels. Tree-like structures, branches are in relationship with the central idea. Mindmap is generally an artistic development.

In case of microcontents we can substitute the original document with various configurations of microcontents (see Figure 4)[9]. For example a common document can be derivated into only one microcontent or a collection of micorcontents or a domain of microcontent collections. There are well prepared contents behind levels of the content pyramid.

[9] Screenshot taken by the author.

Figure 4.

6. Value of a Local Knowledge Domain

Let me draw up a quick and short economic thought-experiment about the value of a hypothetic local knowledge domain. Assume that ten vocational teachers decide to work out a microcontent collection about a common topic. They agree in the way how to divide it into separated microcontents. Finally they create 100 microcontents and 1000 links between microcontents. The value of their work can be expressed by a simple calculation (let say the cost of 1 mC is 0.1€, 1 link is 0.05€, total value of this local knowledge domain: 10€ + 50€ = 60€). But not the money is the most important result.

Earlier a non-expert person could evaluate a classical teaching material by counting characters, pages, images. An expert can reconstruct a mental map of the teaching material and after this event can make a decision wheather this material is good or not. Now, during the development of a new teaching material the inner structures of the topics can be represented by microcontents and links!

7. Closing Thoughts

The HUNGLE framework is under continuous development.[10] Microcontent methodology is also in continuous use, our partners, educators, professionals and students apply it to everyday learning and education. A report on long-term results is hoped to be the topic of a next research paper.

[10] Our OCD (Open Content Development) Research Group is supported by the Hungarian Academy of Sciences (MTA). This group does methodological research for Hungarian vocational education by inviting teachers, students, other researchers into an innovative network based on vocational schools. HUNGLE microcontent framework is one of main tools and methods.

TOWARDS A VISUAL FUTURE

Dóra Horváth – Attila Cosovan – Zita Komár

#Visual #Communication #Development
Designcommunication Projects Integrated into the Education of Future Economists

1. Introduction

In recent years, higher education has become affected by the rise of visual culture, but still there is a gap between the mere use of "visual aids" (as educational tools) and visual thinking, which is a strong ability of understanding and adapting to the demands of a more complex, constantly changing and more visual culture. Therefore, our paper aims to stress the idea of development integrated visual communication and communication integrated into development, designcommunication and its potential outcomes in education by our practice, representing innovative exercises and methods based on the improvement of visual thinking, interests and skills.

The questions we plan to answer in our essay are: How to integrate and implement visual learning methods into the non-visual learning sphere of higher education? In which ways do we need to support students' development of visual thinking in order to unlock the potential of the brain? Is there a way of transforming contemporary educational theory, tools and methods into radically new types of learning strategies that aim to open up for visual methods of understanding and facilitate creative thinking?

2. Significance of Design Approaches in Business Education

Mainstream education and reforms are deeply committed to the given cultural standards that tend to ignore the peculiarities of each and different attendant of a specialized course or lecture, in order to stan-

dardize the experiences of students. Contemporary visual culture is not commonly an integral part of the business education curriculum which could serve as a potential for encouraging active engagement. Practices that promote the dominance of general experience over an individualistic approach are taken for granted and rarely challenged – without noticing that it may alienate students from dealing with social, local, artistic or creative issues.[1]

Therefore, it is quite evident that students gain a great deal from doing creative group projects, where they have a platform to develop, share, channel and articulate their thoughts and professional experiences, rather than writing tests where they are only expected to reproduce existing frameworks instead of developing and producing concepts independently. As a result, students involved in such projects not only learn, but engage in the course curriculum in an interactive way which is more meaningful and sometimes also joyful for them and for us teachers too. As an outcome of such (visual) learning methods focused more explicitly on the contexts and objects of personal interest, students' development can go deeper and by the end they become not just mere users, but rather producers and managers of processes and learning outcomes knowing that their opinion is of value.[2]

Another point is that issues of education (e.g. understanding knowledge fragmentation problems within separated disciplines) should influence teachers to implement ideas of different academic fields and resolve knowledge fragmentation by establishing cross-disciplinary programs for students.[3] For example, marketing master students at the Corvinus University of Budapest (CUB) co-work on

[1] Mark A. Graham, "Art, Ecology and Art Education: Locating Art Education in a Critical Place-based Pedagogy", *Studies in Art Education*, vol. 48, no. 4 (2007), pp. 375–391.

[2] Paul Duncum, "Visual Culture Art Education: Why, What and How?", in Richard Hickman (ed.), *Critical Studies in Art and Design Education*, Bristol: Intellect Books, 2005, pp. 151–162.

[3] Don H. Krug and Nurit Cohen-Evron, "Curriculum Integration Positions and Practices in Art Education", *Studies in Art Education*, vol. 41, no. 3 (2000), pp. 258–275.

various entrepreneurial projects together with the designer students of the Moholy-Nagy University of Applied Art and Design (MOME), confirming the idea that a heterogeneous learning environment can trigger peer-learning activities, support engagement and enhance professional discourses among students.

Today marketing students at CUB design logos[4]; create and shoot films (editing, directing and acting in these films)[5]; imagine and shape products (fulfilling the criteria of design exercises)[6], etc. These methods are built on types of competencies and knowledge which haven't been shaped by the course curricula or their former knowledge of marketing.[7]

These require a change of focus in education (business studies) comparing the goals and challenges we face today (relying on competencies and skills that were not part of the curriculum / we did not teach it) to those that have been circumscribed 10 years ago (competencies / skills / strategies / cooperation within and outside the profession / good brief / analytical thinking).

3. Design Tasks in the Education of Future Economists

Education of future economists – especially marketing students – is to train and prepare a new generation of experts who will be able to

[4] Marketing master students at CUB created the logo of the Hungarian Marketing Educators' Association in collaboration with CUB teachers in 2016, see https://emok.hu/.

[5] For student visions on the future of education in 2016 see https://youtu.be/-9xD7MAA4Hk; for a designcommunication project, in 2018, where students experienced crossing their boundaries in communication, see https://youtu.be/YecYLlPeQiE.

[6] A designcommunication project where students reframe the design and communication of a Red Dot award winning product DSI inhalo in 2016: https://www.facebook.com/breathinthefeeling/.

[7] Dóra Horváth et al., "Video-produkciós projektek a marketingoktatásban", in Szilvia Bíró-Szigeti et al. (eds.), *Marketing hálózaton innen és túl: Az Egyesület a Marketing Oktatásért és Kutatásért XXI. Országos Konferenciájának tanulmánykötete* (Conference date, place: 2015.08.27–2015.08.28, Budapest: Budapesti Műszaki és Gazdaságtudományi Egyetem, 2015, pp. 9–15.

make the best possible decisions based on the employment of independent strategies. Innovative education techniques help rethink the role and purpose of education; moreover support the creative reshaping of in-class exercises based on individual/group learning processes and activities. Chiefly, in the creation of the CUB marketing master program we're aiming to implement proportions of present marketing practices into the course curricula, creating those types of subjects which refer to actual challenges of marketing. These subjects cover and represent the theoretical and practical problems, questions and marketing functions of smaller and medium size companies. Students executing the program possess a profound and structured understanding of the applications of marketing: differentiating between the levels of product-, brand- and corporation based solutions. But is this all they need? Has anyone ever asked them (students), who they are and what do they think?

As a society of teachers and academics we need to question: 1. Why not to ask our master students what do they want/need to know? 2. Why not ask about their individual interests and preferences for personal expressions? 3. Why not to step out of our closed and sealed boxes of well-known practices and everyday routine in order to create new qualities?

Today's higher education students (especially future economists) face enormous challenges: having to fulfil studies, work experience and enjoy life simultaneously. In our research and education work we seek to find methods, approaches that are capable of resolving these tensions. We recommend to integrate all the above three tasks at the same time. We provide an education approach that integrates design methods – namely DesignCommunication – which puts students into designer roles, therefore allows them to use holistic view and visual expression.[8]

[8] Attila Cosovan, *DISCO: Co&Co Communication*, Budapest: Co&Co Communication, 2009, http://issuu.com/cosovan/docs/ca_disco_web; Dóra Horváth et al., "Beyond the Scope of Design Thinking: DesignCommunication", in *The 21st dmi: Academic Design Management Conference Proceeding*, Boston: Design Management Institute, 2018, pp. 653–662, http://unipub.lib.uni-corvinus.hu/3626/1/2018_DMI_ADMC_Beyond_DISCO.pdf.

4. Generations' Y and Z Challenge: Time Scarcity

Education is a sector for achievement: it is to offer various success experiences for both students and teachers. Teachers can act, educate and express themselves by finding their audiences and students can (re)act, learn, discover, recognize and realize. In our current experiences we rarely encounter these – e.g. on the teachers' side it is more often the experience of students not being present or not being attentive during the courses, while on the other hand, students experience that the course wasn't interesting, engaging enough or they aren't really informed about the topics and expectations of courses.

It is evident today that those who strive to work in the business field need a higher education degree, however, at the same time diverse work experiences are highly expected, which creates hardly bearable challenges for today's higher educators and students. Today's university students have to balance between the requirements of full time studying and full time work. TIME has an extraordinary influence on our lives, especially on the lives of Y and Z generations. It is often painful for them having to study at the expense of work and having to work at the expense of studying – we have to add that multitasking is not always time-compatible. Therefore, our aim is to highlight and implement solutions which support the students in studying and working at the same time, collecting holistic professional experiences – respecting that both activities are equally important.

Teacher and student roles need to be re-imagined and re-interpreted. Students are not only passive listeners of university courses. Moreover they become responsible for their actions, activities and the outcomes of these, as owners and creators of projects. In this learning situation personal experience is of the highest value: supporting students to integrate the ideas of others/peers; to examine, understand and evaluate their own performance (strengths and weaknesses as well) is prior to the achievement of other learning goals. Therefore, educational success derives from co-operation and co-

creation which make us come to the conclusion that teacher and student roles need to be reconsidered.

5. DesignCommunication a Design Approach for Learning in Action

Designcommunication by definition is communication integrated into development.[9] The authors use the compound noun "design communication" as "designcommunication" written in one word as by DESIGNCOMMUNICATION they intend to refer to the patented expression and phenomenon: "communication integrated into development".[10]

Designcommunication is compounded of two inseparable notions: design and communication. Design is not equal to form-giving. Form-giving is one component of the holistic human constant that we call design. Design in this case implies design art, creative planning and creative behaviour.[11] Planning and establishing a business activity is designing a business. As Herbert Simon states "engineering, medicine, business, architecture, and painting are concerned not with the necessary but with the contingent – not how things are but how they might be – in short with design".[12] A leader's responsibility is not to discover the rules of the universe, but to act with responsibility, so as to turn current situations and capabilities better or preferable. In that sense, a leader is a form giver, who shapes the organization and its economic processes. If leaders approached emerging problems as the best designers, many products, services and procedures would become more functional, and would be able to create

[9] HIPO (Hungarian Intellectual Property Office), *Hungarian Gazette for Patents and Trade Marks*, 113 (12/I, 2008.12.15.), 2008, Registration number: 196961.
[10] Horváth Dóra et al., "Beyond the Scope of Design Thinking", the quoted passage on p. 654.
[11] Victor Papanek, *Design for the Real World: Human Ecology and Social Change*, New York (USA): Pantheon Books. 1971.
[12] Herbert A. Simon, *The Sciences of the Artificial*, Cambridge, MA: MIT Press, 1966, the quoted passage on p. xii.

long lasting values for the organization and society.[13] More briefly: DESIGN = DO GOOD.[14]

Design is complemented with communication, which is a creative way of connecting both at the level of self-reflection (inner conversation) and the human interaction phenomenon. Therefore, DESIGNCOMMUNICATION represents such an initiative for connection that serves as a BRIDGE between different disciplines and discourses, phenomena of society and economy. Designcommunication creates a real-time connection among classroom learning, research and entrepreneurship. It takes the time factor into consideration with respect of the apparently multidimensional and objective digital and expectedly later conceptual age.

Designcommunication is not merely a function or a form, but it is also content, message, style and culture together. Designcommunication is an approach that strives to connect design, everyday economies, strategic communication and their real status. Communication in this form is not an additional frippery, but is created simultaneously with research and problem solving and is coded into the development of the given product, service or process. In a brief expression: COMMUNICATION = SAY GOOD.[15]

6. Integrative Model for Easing Time Scarcity – Learning and Doing at the Same Time

Today's schools of management often lack the vision of the leader who brings in new ideas, new content and new form in response to apparent opportunities. That missing element is an image of the manager as an idea generator who gives form to new possibilities with a well-developed vocabulary of design. Managers as form-givers care deeply about the world that is being shaped by a business

[13] Richard J. Boland, Jr. and Fred Collopy (eds.), *Managing as Designing*, Stanford: Stanford University Press, 2004, p. xi.
[14] Cosovan Attila, *DISCO* (see note 8 above).
[15] Horváth Dóra et al., "Beyond the Scope of Design Thinking", the quoted passage on p. 654.

and refuse to accept the default alternatives.[16] Management schools are to integrate design methods in their managerial programs in the future. Also, design schools are to consider the same question and make their students capable of becoming part of top management.[17] Furthermore higher education could benefit from using successful business models in its organization and management, but also in their systems of education.[18]

The DIS.CO EXPERT education program is a leadership training concept (at the level of courses or a complete education program) where participants coming from different fields independent of previous qualification, study together and also learn from each other. Participants would solve differentiated and integrated, namely complex leadership tasks.

The concept (see Figure 1) connects established leadership theories and managerial concepts (this is present in most managerial study programs) with an entrepreneurial designer creative approach. Besides acquiring theoretical base, participants work on an entrepreneurial project which could be new operation models, new systems, new methodologies, reconsidered current practices and conventions, new products or services.

Designcommunication, the DIS.CO EXPERT program is a comprehensive, integrated (trans-disciplinary and inter-professional) approach, which contributes to connecting research, problem-identification, and design with respect to the needs of the current customer (human being), producer (human being), seller (human being), consumer (human being) and designer/creator (human being).

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[16] Richard J. Boland, Jr. and Fred Collopy, "Design Matters for Management", in Boland and Collopy (eds.), pp. 3–18, the quoted passage on p. 8.

[17] Richard Buchanan, "Management and Design: Interaction Pathways in Organizational Life", in Boland and Collopy (eds.), pp. 54–63, the quoted passage on p. 54.

[18] Attila Cosovan and Dóra Horváth, "The DIS.CO EXPERT Program on Designcommunication and Leadership", *Arts Management Network* (2016), see https://www.artsmanagement.net/Articles/The-DIS-CO-EXPERT-Program-Designcommunication-and-Leadership,3724.

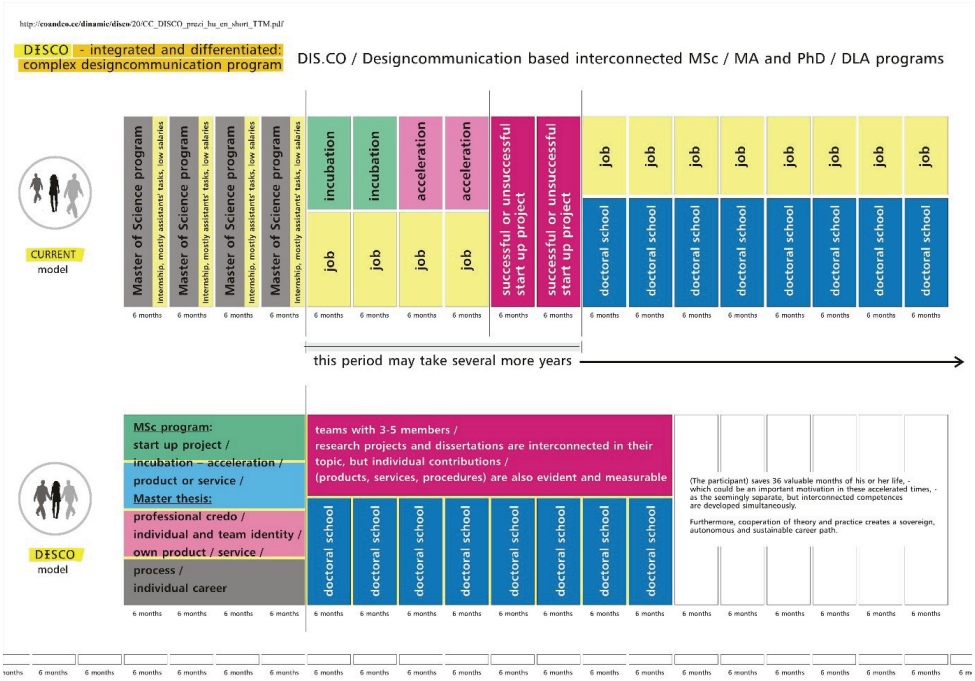

Figure 1: Infographic of the DIS.CO EXPERT master and PhD program (source: Cosovan and Horváth, "The DIS.CO EXPERT Program").

The program is structured on the basis of skill acquisition targets and process objectives, not on separated courses. Teaching takes place by the interactive collaboration of numerous instructors who are from different disciplines: economics, philosophy, sociology, management, marketing, media, art, cultural history and design. The teaching method itself is a demonstration of a successful enterprise which today is necessarily a collaboration of different disciplines. Participants will acquire new capabilities and skills of designcommunication based management: that is complex overview of the complete product life cycle, systems of in-depth collaborations and parallel development. Current knowledge will be broadened by art and design initiated connections where leadership opportunities of cre-

ative value creation will be highlighted with respect to the economies and societies of the digital age.[19]

7. Conclusion: Inspired from Jazz – Need for Coexisting Fundamental Tensions

Current and future leaders, independent of educational background seek new forms of learning: inspiration, capabilities for recognizing new relations and constructive collaboration. John Kao on creative organizations suggests connecting successful management and art: as jazz and business both have balance retaining elements. Discipline is a requirement (we have to be able to play from sheet music), but it is not the final goal (students also have to acquire fundamental theoretical base). In both, music and business, we also strive to expand the limits and move out from a resting position. The power of improvisation in jazz and business alike arises from the alignment of certain vital tensions or contradictions.[20]

Based on the jazz conceptual framework, the question is how to get from basics to improvisation, how to break the routine of the usual training structures, so that the created new content can still be interpreted and have the proper constant values. This is our major question and mission in an inter- and trans-disciplinary education practice: how to reconcile and make coexist crucial tensions or contradictions (that shape our current thinking of education): traditions AND novelties; quest for patterns or schemes AND search for openness; constrains, rules AND entrepreneurial will; the security of known things AND the attraction of the unknown; being responsible for a group AND independence of self-expression; discipline AND freedom; self-control AND desires; expertise AND novice discoveries.[21]

[19] *Ibid*.
[20] J. J. Kao, *Managing Creativity*, London: Prentice-Hall International, 1991.
[21] *Ibid*.

Rita Lisa Vella – Anna Chiara Sabatino

The New Body of Medial Images in the Urban Space: Audio-Visual Narratives, Virtual and Augmented Reality

1. Introduction

Nowadays we live in a world overflowing of audiovisual stimuli as a result of an intrusive mediatic system while the spatial experience is more and more structured through multi-layered information, both geographical and coded. Specifically, our cities are full of commercial screens and electronic devices, and surveillance cameras are always on. The media are reshaping the human experience developing different kinds of visuality and narratives. The contributions of sociologists, architects and urban planners[1] are combined with those of urban artists[2] and researchers in the field of media aesthetics[3] in

[1] Carlo Ratti and Matthew Claudel, *The City of Tomorrow: Sensors, Networks, Hackers, and The Future of Urban Life*, New Haven, CT: Yale University Press, 2016; see also Manuel Castells, *The Informational City: Information Technology, Economic Restructuring and the Urban-Regional Process*, Oxford: Basil Blackwell, 1989; W. J. Mitchell, *City of Bits: Space, Place, and the Infobahn*, Cambridge, MA: The MIT Press, 1996; Saskia Sassen, *The Global City: New York, London, Tokyo* , Princeton, NJ: Princeton University Press, 1991.

[2] Screen City: http://2017.screencitybiennial.org; Streaming Museum: http://streamingmuseum.org/from-world-cities-to-remote-locations; Media Facade Festival: http://mediafacades.eu.

[3] Scott McQuire, Meredith Martin and Sabine Niederer (eds.), *Urban Screens Reader,* Amsterdam: Institute of Network Cultures, 2009; see also Alise Tifentale and Lev Manovich, "Selfiecity: Exploring Photography and Self-Fashioning in Social Media" in David M. Berry and Michael Dieter (eds.), *Postdigital Aesthetics: Art, Computation and Design,* London: Palgrave Macmillan, 2015, pp. 109–122; Elisabetta Di Stefano, "Iperestetica: Arte, natura, vita quotidiana e nuove tecnologie", *Aesthetica Preprint*, 95, 2012.

underlining the importance to take into account the associated proliferation and the dislocation of the image.

This paper aims to understand and interpret the role of the new medial images in the urban context and, in particular, the contributions of these images to building and sharing specific urban narratives and identities. Understanding the cinema as a living medium,[4] with hybridization of multiple narrative practices and media,[5] we intend to outline how this organ and its visual regime interact with audio-visual technologies used to represent and rebuild urban life and narratives. Here, we describe practical cases and examples where urban storytelling is assumed to be the result of the dynamics in between the city, the users and the devices, whose codification techniques are strongly linked to the contemporary experience of cinema and its latest trend of relocation, assemblage, expansion and performance.[6]

2. The "Hyperaesthetics" of the City: Urban Devices – Embedded, Mobile, Free

The city is a privileged context to observe the diffused aesthetics or "hyperaesthetics"[7] connected to the proliferation of medial images, and also to investigate the possibility of a corresponding process of anesthetization as "a kind of numbness and the connected weakening of the ability to create our experience through the senses"[8].

For a taxonomy of the devices implicated in the images production and consumption in urban everyday life, a first step is to recognize the presence of at least two different kinds of technologies:

[4] David Norman Rodovick, *The Virtual Life of Film,* Cambridge, MA: Harvard University Press, 2007.
[5] Henry Jenkins, *Convergence Culture: Where Old and New Media Collide*, New York: New York University Press, 2006.
[6] Francesco Casetti, *The Lumière Galaxy: Seven Key Words for the Cinema to Come,* New York: Columbia University Press, 2015.
[7] Di Stefano, *op. cit.*
[8] *Ibid.*, the quoted passage on p. 58 (original in Italian).

the material technologies, physically located in the body of the city or in people's pockets; and the non-physical technologies, as geo-referenced websites or social networks groups, that are "highly local and potentially very meaningful"[9].

2.1. Devices Embedded in the Body of the City

Such devices are usually surveillance devices or screens of different shapes and sizes located in contemporary public spaces for commercial purposes. Far from being just coded information about the city life, surveillance devices reshape the urban appearance and experience. The Adam Harvey Hyperface project perfectly represents that: "from fractal face paint and hairstyles … to reflective underwear, anti-surveillance camouflage ostensibly allows people to hide in plain sight. These designs, however, enact an aesthetization of resistance".[10]

The other types of devices are the screens that are part of a place, but are also produced by their place. As consequence, the resulting augmented sense of place must be understood not just by "what the screen shows", but also by "where the screen is", "why it is located there", "to whom it is oriented" and so on. It is about the relation between the text and the context that leads to reconsider the distinction between the physical and the digital, between space and information. This distinction is much more critical than as it appears, because "elements of space increasingly are powerful conveyors of information, whilst information – materialising into them – becomes more and more spatially-related"[11].

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[9] Alessandro Aurigi, "Augmented Spaces", in Alessandro Aurigi and Fiorella De Cindio (eds.), *Augmented Urban Spaces: Articulating the Physical and Electronic City*, Hampshire, UK: Ashgate Publishing, 2008, the quoted passage on p. 1.

[10] Torin Monahan, "The Right to Hide? Anti-Surveillance Camouflage and the Aestheticization of Resistance", *Communication and Critical/Cultural Studies*, vol. 12, no. 2 (2015), pp. 159–178, the quoted passage on p. 159.

[11] Aurigi referring to Patrick Allen's "Framing, Locality and the Body in Augmented Public Space", in Alessandro Aurigi and Fiorella De Cindio (eds.).

2.2. Mobile Devices

We consider three levels of mobility:[12]

- the mobility of the device
- the mobility of the player/user
- the mobility between places and users

By mentioning the case of navigation devices, where "our physical occupation of space and the inhering coordinates, make on-screen navigation possible", Nanna Verhoeff[13] describes "performative visuality", a new kind of aesthetic practice at the intersection of the mobility *of* the screens (and the users) and the mobility *on* the screens, the one of the images. For our purposes, this particular kind of producing space while seeing it, is highly relevant both in terms of comparison and difference with the cinematic regime and in terms of both the scientific and the spectacular ambitions of augmenting technology. Firstly, as comparison of the hybridization process of seeing and making through new technologies both in the cinematic and the mobile regime. Secondly, in terms of the relation between simulating reality, with scientific and knowledge ambitions of perfectly describing it, and augmenting reality with artistic and spectacular additions supporting an immersive experience.

2.3. Device Free

Finally, there are a lot of city images that are not directly connected to a particular material device and could be produced and consumed from laptop, fixed computed position, smartphone, etc. Contents shared by official urban actors (i.e. the major's or municipality official channels, etc.) or by common users (citizens, tourists) on social

[12] Cf. Nanna Verhoeff, *Mobile Screens: The Visual Regime of Navigation*, Amsterdam: Amsterdam University Press, 2012.
[13] *Ibid.*

networks.[14] Due to the lack of permanent and direct connection to the device, it seems that the information and the images shared exist in a fully virtual space, and circulating and spreading within that, they contribute in both the processes of perception and production of a particular image of the city. We believe we could and we should consider the city images shared on the internet as unstructured but meaningful data to investigate the city as a cultural system.

The position of this paper is that all the images spreading through urban screens, mobile devices or social networks are in some way implicated into the process of building and sharing the meanings of the city and, as a consequence, of the identity of the city. So, we should refer to the aesthetic identity of the city as the whole set of expressive qualities represented *in* the city and *on* the city, where all the images are part of the city as a complex, cultural system.[15]

In the next paragraphs we will consider some useful examples and case studies particularly referring to virtual reality (VR) and augmented reality (AR)[16] technologies in the urban context. If AR is

[14] E.g. Facebook, Twitter, Instagram, TripAdvisor, etc. About the possibility to interpret and describe the shared values of a city starting from a huge amount of Instagram images see Nadav Hochman and Lev Manovich, "Zooming into an Instagram City: Reading the Local through Social Media", *First Monday*, vol. 18, no. 7 (2013), https://firstmonday.org/ojs/index.php/fm/article/view/4711/ 3698.

[15] Long before digital technologies emerged, philosophers and semioticians investigated the relationship between the city and architecture, describing the former as a complex semiotic mechanism and culture generator. See Juri M. Lotman, "The Symbolism of St Petersburg", in his *Universe of the Mind: A Semiotic Theory of Culture*, London: I. B. Tauris, 1990, pp. 191–202.

[16] For definitions see Paul Milgram and Fumio Kishino, "A Taxonomy of Mixed Reality Visual Displays", *IEICE Transactions on Information Systems*, vol. E77-D, no. 12 (1994), pp. 1321–1329; see also Patrick T. Allen – Ava Fatah gen. Shieck – David Robinson, "Urban Encounters Reloaded: Towards a Descriptive Account of Augmented Space", in Timothy Jung and M. Claudia tom Dieck (eds.), *Augmented Reality and Virtual Reality: Empowering Human, Place and Business*, Progress in IS, Springer, 2018; Sehwan Kim – Youngjung Suh – Youngho Lee – Woontack Woo, "Toward Ubiquitous VR: When VR Meets ubiComp", in *Proceedings of the 4th International Symposium on Ubiquitous Virtual Reality*, 2006.

positioned between the real world and the virtual world, VR juxtaposes multimedia content (e.g. 3D models, animation, video, audio, and websites) on a real image captured by a video camera in real-time,[17] whose activation depends on an object that triggers an action, usually for multimedia content interaction and visualization. In simple terms, Augmented Reality technology adds information about the image while maintaining the real view of the surroundings, Virtual Reality makes the user experience a world in a world that simulates the real. Recent approaches[18] confirm the importance to consider AR as a visual regime, and not as a unique device or particular technology. Augmentation is an historical, cultural and aesthetic practice that transforms the physical space into a "data dense" space that thus contains "many more dimensions than before"[19].

3. Audiovisual City Experiences: Bepart and Imageen Tarrago

The term "experience" in general indicates, among other definitions, the possibility of perceiving reality as if for the first time and in the first person.[20] The cinema experience can, therefore, be defined as that particular modality through which the cinematographic institution allows the spectator to perceive, believe and "live" a story about the world, in the world. But going back, the roots of cinematographic experience can be found in all those moments in which the world looks like a scene, able to catch eyes and attention of spectators who

[17] Blair MacIntyre – Jay David Bolter – Emmanuel Moreno – Brendan Hannigan, "Augmented Reality as a New Media Experience", in *International Symposium on Augmented Reality* (ISAR'01), New York, Oct. 29–30, 2001.
[18] Lev Manovich, "The Poetics of Augmented Space", *Visual Communication,* vol. 5, issue 2 (2006), pp. 219–240.
[19] *Ibid.*
[20] The concept of "filmic experience" is well explained in the great synthesis of filmological research compiled by Dario Romano, *L'esperienza cinematografica*, Firenze: Barbera, 1965; see also Martin Jay, "Scopic Regimes of Modernity", in Hal Foster (ed.), *Vision and Visuality,* Seattle, WA: Bay Press, 1988.

face the spectacle of events.[21] We can say, though, that nowadays "[cinema] is in constant search of new environments and devices onto which to transfer itself, from city squares to my smartphone. ... what migrates is not a technical complex but rather a form of experience, which reestablishes itself in a new context"[22].

Looking at relocated cinema experience as something that has moved somewhere else from its original context, penetrating aspects and practices of everyday life, the spectator finds him/herself involved in transmedia storytelling environments while exploring urban space. Transmedia storytelling has been defined as "the art of creating a universe and a process of dispersion of history/fiction in multiple channels"[23] guided by a goal of creating a unique entertainment experience, but coordinated so that each part can contribute to history. The applicability of the transmedia storytelling model for users that, visiting cities, may participate within the narrative structure and plot of virtual and augmented realities in urban contexts, is one of the main questions of this paper.

3.1. Bepart

Defined by its creators "a movement of public imagination"[24], Bepart is an Augmented Reality application that transforms the city into an exhibition space by adding an "invisible" layer every citizen can experience. In Figure 1 there is an example of Bepart using augmented reality, in which Mole Antonelliana becomes the head of a huge octopus through the addition of synthetic elements that appear to be part of the real world: "Free interaction with an invisible layer can stimulate territories, citizens, cultural institutions, museums, administrations and associations to share vision on urban spaces, with an im-

[21] Francesco Casetti, *L'occhio del Novecento: Cinema, esperienza e modernità*, Milano: Bompiani, 2005.
[22] *Ibid.*
[23] Henry Jenkins, *op. cit.*
[24] See https://bepart.net.

pulse to their requalification. The stress is not only on entertainment, the layer is a work instrument that creates engagement."[25]

Three characteristics are activated by Augmented Reality techniques:

■ The work of art becomes something that without the intervention of the user wouldn't appear/exist;
■ the user can experience an "additional element", multidimentional, alive, that isn't physically there;
■ the user can experience the installation moving himself around it, with his own body.

Figure 1: Bepart augmented reality.

3.2. Imageen Tarraco

This application allows the visitor of Tarragona and Costa Daurada an immersion into the roman city of Tarraco through their mobile devices, that become windows to the past through which visitors can admire the greatness and original disposition of the monuments and old spots and get in the real environment of the era that they are vis-

[25] See http://www.benisi.eu/cases/bepart-the-public-imagination-movement.

iting. "The city becomes a unique museum"[26], one can read on the project web site. Figure 2 shows an image from the Imageen Tarraco project. An example of virtual reality, that allows the users to immerse to the ancient Roman city of Tarraco through their mobile devices, that literally become windows into the past.

Figure 2: Imageen Tarraco virtual reality.

Relocated cinema takes part of audiovisual virtual reality narratives, in which user coincides which spectator: looking at the scenes of a past living Tarraco, spectators "no longer immerse themselves in the story being told, but rather navigate its surface; they do not confront an 'other' world capable of speaking about the 'real' world, but rather a 'possible' world that can find its realization"[27].

Living Imageen Tarraco, the visitors face a peculiar experience and have various options:

■ The user can move the device and point it towards key points in the space;
■ the user/spectator can choose splitting the screen and being either in the present or in the past;

[26] Cf. http://www.imageen.net.
[27] Francesco Casetti, *The Lumière Galaxy*.

■ the spectator can enjoy the show made just for her/him, a show that literally goes "towards" her/him like 3D movie images.

Both AR and VR realities use 3D techniques that "high definition" cinema is familiar with, a kind of visual language that, just like it happens in 3D movies, "leads us immediately to the heart of the action; ... it offers us perfect reconstructions of the present and the past. It is capable of mobilizing additional senses, thanks to the presence of music, dialogue, and color. Films [high definition images] involve our entire body."[28] But this user/spectator lives experiences so filled of stimulations that very low participation is needed. Like hot media,[29] AR and VR grant their users such a great wealth of perceptual intensity that no form of completion is required.

In both Bepart and Imageen Tarraco the user meets high-definition body images through a "guided" tour either in the "past" virtual reality or in the present "augmented" city, going from a key point to another in a high-definition and perceived map designed just for her/him. While exploring the city, the user/spectator experiences these fragments of "relocated cinema" like a casual wanderer and observer of the urban context: without the urban user and his "exploring" the effect would simply not occur.

4. Conclusions

Today, just like yesterday, we do not live in a sort of Cartesian space, fully measurable through scientific parameters, but in emotional and narrative spaces. From photography, with static images for static spectators, to cinema, with moving images for static spectators, to the new body of medial images, travelling through a myriad of screens, changing our relationship with the city and our urban experience. In

[28] *Ibid.*
[29] Marshall McLuhan, *Understanding Media: The Extensions of Man,* New York: McGraw-Hill, 1964.

contrast with high-definition ones, low-definition city narratives,[30] built through collaborative processes that involve inhabitants and visitors, turn users/spectators into performers, that don't just attend the premade show, but collect and reshape pre-existent images and materials, creating their own meanings. Even though AR and VR in the urban space are conceived to involve the user as much as possible, they strictly frame her/his possibilities of experience, establishing boundaries within few possible practices and ways of use, not allowing the user/spectator to become a performer. The described cases suggest that it is not just a matter of technology change, mobile screens for mobile spectators, but a matter of narrative and new forms of engagement into the urban stories. It is "performative"[31], because everything is taken within the flow of becoming: the user, who can keep doing whatever he wants while using the screens (i.e. walking, driving, speaking with other users); the screens-devices that are hybrid devices used for seeing, communicating, locating; the off-screen world that surrounds the screen and the user, that is not a dark silent room designed to disappear in favour of vision; the images on the screens, that are related to the mobility of the screen, the user and the off-screen world. All these elements are interconnected in a flexible and intimate way, co-participating to the breaking up and recomposing of urban meanings and narratives.

In conclusion, we hope that our paper led to useful suggestions with respect to urban storytelling as the result of the dynamics between the city, the users and the device. Thus, users are city visitors and both traditional and AR/VR devices users at the same time. In doing so, they participate in building the narrative structure and plot of the urban experience.

Furthermore, we believe that future investigations would be indicated in order to confirm the applicability of the transmedia storytelling model to that kind of user.

[30] For examples of low-definition city narratives, see Mappi-Na, https://www.mappi-na.it; and also Cities and memory, https://citiesandmemory.com.
[31] Nanna Verhoeff, *op. cit.*

Theo Hug

Visualizing Archivals and Discursive Structures
Towards Enhanced Perspectives Using the Example of the Ernst-von-Glasersfeld-Archive

1. Introduction

In the wake of a series of boosts of visualization, new strategies, tools and practices have been developed after the "digital turn". Today, new forms and methods of visualization are opening up innovative perspectives for cultural institutions, academic work and science communication. In many disciplines and especially in transdisciplinary contexts like, for example, those bundled under the umbrella term "digital humanites" a variety of computational and algorithmic methods is being designed in order to visualize, study and evaluate digital material. Furthermore, debates on methodological and epistemological issues of visualization are going on, too.

This contribution aims at presenting contemporary options for visualizing academic archives beyond positivist or technology-driven shortcomings. In doing so, conceptual considerations towards an image-supported, qualitative analysis of argumentative and discursive structures for both research and educational purposes are being outlined. Deliberations are illustrated using the example of the Ernst-von-Glasersfeld-Archive. The chapter delineates balancing acts between conceptual considerations, theoretical reflection, and practical requirements.

2. Changing Media – Changing Archives: Some Points of Departure

It is undisputed that archiving is one of the oldest activities of humankind. From ancient practices of keeping documents to contem-

porary forms of archiving, records of administrative, commercial, social or spiritual activities have been generated in various cultural forms throughout history. We find continuities and upheavals, and sometimes most recent forms of preservation and mediation remind us of ancient practices.

This is the case, for example, when tablets are used in the context of archiving. Looking at ancient uses of tablets (see Figure 1) one can argue for continuity and evolutionary aspects such as the important role of images and writing with regard to recording, storing, understanding, passing on as well as mediating and educating by making use of tablets.

Figure 1: The entrance to the "Archive Chambers" in the palace of Assurbanipal.[1]

On the other hand, significant differences are all too obvious if we consider contemporary forms of usage of tablets. Among others, such differences refer to various dependencies ranging from demands

[1] Source: https://web.archive.org/web/20160825234545/http://www.ib.hu-berlin.de/~wumsta/Milkau/milkau.html (Fritz-Milkau-Dia-Sammlung), Wikimedia Commons, https://upload.wikimedia.org/wikipedia/commons/9/92/Milkau_Eingang_zu_den_%27Archive_Chambers%27_im_Palast_des_Assurbanipals_13-2.jpg.

for electric energy, fast-moving platforms and technologies, changing valuation of different forms of knowledge and its social distribution, scalability of distribution of content and forms of sharing, or possibilities of integrating medial forms[2] and connecting people and devices.[3]

On closer examination, we can see that changing forms of usage of tablets go hand in hand with changing relations of archival institutions to public spheres, changing entanglements of politics of memory and memory of politics, and changing forms of knowledge creation and graphical representation. Modalities of augmentation give a vivid example of potential and factual changes in connection with contemporary uses of tablets and other mobile devices.[4] Today's

[2] Commonly, the term "medial form" signifies a sub-area of media, for example, newspapers or wikis and podcasts as forms of so called "social media". Here, I use the term with reference to shapes and structures of distinguishable tools in transversally linked media systems, for example, structural elements of comic or games in film, or the use of icons in various medial constellations, which are related to dynamics of migration and imperceptible transitions and which can be described and analyzed on the level of middle range theories (cf. Rainer Leschke, *Medien und Formen: Eine Morphologie der Medien,* Konstanz: UVK, 2010).

[3] A very inspiring and detailed collection of research, theory and practices regarding the role of mobile devices and "social media" in museums in particular and in GLAM ("galleries, libraries, archives, and museums") in general has been published by James E. Katz, Wayne LaBar, and Ellen Lynch (eds.), *Creativity and Technology: Social Media, Mobiles and Museums*, Edinburgh: MuseumsEtc, 2011.

[4] Modalities of augmentation also remind us of metaphorical imagery of the term "tablet", and as is well known, such metaphorical uses illuminate some aspects of application contexts while obscuring others. This is especially relevant in cases of "material metaphors" (N. K. Hayles) which not only can mislead us in one way or another, for example, by way of suggesting ontologized things or obfuscating processes of mediation. Material or "transcoding metaphors" (M. van den Boomen) are not only working as linguistic or conceptual frames, they are effectively able to do something material in the world. Cf. N. Katherine Hayles, *Writing Machines*, Cambridge, MA: MIT Press, 2002, https://monoskop.org/images/b/bf/Hayles_N_Katherine_Writing_Machines.pdf; Marianne van den Boomen, *Transcoding the Digital: How Metaphors Matter in New Media.* Amsterdam: Institute of Network Cultures, 2014, http://networkcultures.org/wp-content/uploads/2014/02/TOD14-binnenwerk-def-PDF.pdf.

possibilities of flexibly dealing[5] with augmented realities clearly go beyond respective options with clay tablets. In whatever way we value uses of tablets in view of documenting, communicative, distributive, knowledge-related or educative functions of archival material, augmented reality tools for learning (see Figure 2) bring along not only new opportunities but also new complexities and contingencies as well as related challenges.

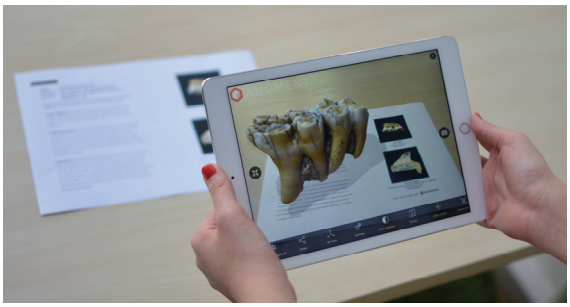

Figure 2: Visualizing the past by means of Augmented Reality tools.[6]

This brief outline already illustrates that interlacing dynamics of changing media constellations and changing archives should not be underestimated. Even if there are no prominent calls for designing GLAM institutions in terms of cyber-physical systems (CPS) or an "Internet of Archival Things", there is a need for epistemological and ethical reflection on interlacing dynamics and also on gains and losses when dealing with digital archival material, when opening up archives or enhancing visitor experiences by digital means, or when en-

[5] Remarkably, "dealing with" opens up various more or less meaningful ways of relating to augmentations of realities like bothering, acting, spending time together, thinking about, working on, distributing, managing, handling, trading, and doing business.

[6] Source: https://www.augment.com/blog/wp-content/uploads/2016/02/Stephanie-Photo1.jpg, used with permission. Cf. "Visualizing the Past: Pioneering Technology in Archaeology", weblog entry by Jennifer Shin on February 12, 2016, https://www.augment.com/blog/visualizing-the-past-pioneering-technology-in-archaeology.

couraging online visitors to create their own content by interacting with digital technologies and other visitor content. Calls for "archives 4.0" aiming at cloud-based "solutions" in order to save time and reduce costs can easily turn out to be costly, inefficient, and unsustainable. Without differentiated consideration of media-cultural contexts, without profound understanding of historical and systematical functions and dimensions of GLAM institutions, and without sophisticated analysis of relevant pedagogies, content and digital media, sustainable educational processes are as unlikely as satisfying visitor experiences.

However, today's digitization policies and programs to promote digitization affect academic and cultural heritage institutions as well as educational and media institutions. On the one hand, there are conspicuous indications regarding serials of empty technology promises, instability of platforms and disruptive developments, lopsided or bad investments, priorities of market-oriented research aiming at the monetization of data flows and digital interfaces, simplification and trivialization of educational and knowledge dynamics, increasing politics of concepts and usage of buzzwords, hegemonic tendencies and fostering new dependencies, hope of (almost) total calculability of all sorts of phenomena, and grotesque fantasies of control and computability of everything.

On the other hand, there are new opportunities for GLAM institutions in the wake of the *digital turn*[7] including following: (a) pro-

[7] Among the many "turns" – as discussed in Sandra Aßmann, Peter Moormann, Karina Nimmerfall, and Mirjam Thomann (eds.), *Wenden: Interdisziplinäre Perspektiven auf das Phänomen turn*, Wiesbaden: Springer VS, 2017 – the *digital turn* allows for integrative perspectives of *media* and *cultural* as well as *pictorial* and *visualistic turns* considering politico-economic and socio-technical dynamics, too. Cf. Gebhard Rusch, "The Many Mediatic Turns … and a Significant Difference", in Theo Hug (ed.), *Mediatic turn – Claims, Concepts and Discourses / Mediale Wende – Ansprüche, Konzepte und Diskurse* (special issue SPIEL 25 (1)), Frankfurt/M.: Peter Lang, 2009, pp. 23–34; Brigitte Kossek and Markus F. Peschl (eds.), *Digital Turn? Zum Einfluss digitaler Medien auf Wissensgenerierungsprozesse von Studierenden und Hochschullehrenden,* Göttingen: Vienna University Press bei V&R unipress, 2012.

motion of free and open online access to digital cultural heritage and large-scale distribution of archival material;[8] (b) visual, aural, textual integration of archives and options for multimodal communication; (c) new modes of dynamic data-, information- and knowledge visualization; (d) collaborative forms of curation and opportunities for engaging users and creating user-generated contexts; (e) enabling media production and perception in transversal media systems, Creative Commons and commons-based peer production; (f) new forms of sharing and data businesses. Correspondingly, there are enhanced perspectives for visualizing archival material in academic contexts, too.

3. Visualizing Archivals and Discursive Structures: The Case of the Ernst-von-Glasersfeld-Archive

The literary estate Ernst von Glasersfeld (1917–2010) covers a period of more than 70 years.[9] It includes a variety of artifacts and all sorts of media used during those decades (see Figures 3–5).[10] Apart from ongoing care and administrative work a series of lectures and a conference have been organized.[11]

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[8] Cf. the OpenGLAM initiative (https://openglam.org).

[9] The Ernst-von-Glasersfeld-Archive is part of the Research Institute Brenner-Archives at the University of Innsbruck since 2012 (see http://www.evg-archive.net). The opening event of the archive took place on March 22, 2013 at the University of Innsbruck. In this context history, establishment and future steps were celebrated and discussed, and basic work like recording and listing archival materials was presented. Cf. Theo Hug, Josef Mitterer and Michael Schorner (eds.), *Ernst-von-Glasersfeld-Archiv: Eröffnung – Inauguration*, Innsbruck: Innsbruck University Press, 2013, https://www.uibk.ac.at/iup/buch_pdfs/9783902936172_buch_web.pdf.

[10] For further details, see the catalog of the estate, http://www.evg-archive.net/nachlassverzeichnis.

[11] Cf. Theo Hug, Michael Schorner and Josef Mitterer (eds.), *Ernst von Glasersfeld Lectures 2015*. Innsbruck: Innsbruck University Press, 2015, https://www.uibk.ac.at/iup/buch_pdfs/9783902936936.pdf. In 2017, *Radical Constructivism – History, Presence, and Future*, an international conference on the occasion of

Figure 3: Bookshelf (Foto: Ernst-von-Glasersfeld-Archive).

Figure 4: Furnishings (Foto: Ernst-von-Glasersfeld-Archive).

Figure 5: Archive filing boxes (Foto: Ernst-von-Glasersfeld-Archive).

Ernst von Glasersfeld's 100th Birthday has been held in Innsbruck on April 20–22, 2017 (http://www.evg2017.net).

As for further research and development, two initiatives have been started. One is aiming at a printed edition (*Werkausgabe*), and the second one builds on new possibilities of the development of generic and "generous" interfaces fostering visual exploration of archives and collections. "Generous interfaces" – as "rich, browsable interfaces that reveal the scale and complexity of digital heritage collections"[12] – serve as flexible complements to conventional search masks.[13] Furthermore, in the recently launched DigiVis-project[14] a modular software architecture is going to be developed that enables discourse mapping and argument analysis on a visual basis. In addition, the study and annotation of paradigmatic structures in mediographic archive portals will be supported.

Both, designing generous interfaces and visual tools for discourse mapping and argument analysis allow for enhanced possibilities of presenting and illustrating archival material and also for enhanced options for visual exploration by diverse user groups and various modalities of adoption and modes of usage. Corresponding modalities of visualization should rather facilitate different paradigms of visualization than sell a set of fairly mechanistic visualization strategies as pinnacle of all forms of the visualization of paradigms.

Both, generous interfaces and use of visual tools for analysis of discursive, argumentative and paradigmatic structures can serve immersive and pleasure-oriented as well as reflective and analytic perspectives. Both can offer invitations to cultivate holistic and par-

[12] Mitchell Whitelaw, "Generous Interfaces for Digital Cultural Collections", *dhq,* vol. 9, no. 1 (2015), retrieved from http://www.digitalhumanities.org/dhq/vol/9/1/000205/000205.html.

[13] See http://www.evg-archive.net/suche/ in the case of the Ernst-von-Glasersfeld-Archive. Diversity of the literary estate that includes more than 60 archive filing boxes, the working library (approx. 1000 books and journals) and special formats (sculptures, skis, etc.) provides an excellent basis for creating a "generous interface" as outlined by Mitchell Whitelaw (*ibid*.).

[14] "Digitization and Visualization of Archives and Collections" funded as a Lighthouse-project in the Field of Digitization by the Tyrolean Regional Government (see https://www.uibk.ac.at/medien-kommunikation/dig-vis).

ticularistic views, and both can accommodate the needs of flâneurs, spontaneous visitors, or systematic research in principle. At first sight, it may seem that generous interfaces are for strolling around online only while visualizations of discursive threads and argumentative strands involve goal-oriented learning and task-based approaches. However, a closer look can reveal that unintentional skimming through a diversity of archivals can evoke specific interests and lead to more systematic investigations. On the other hand, processes of information-seeking and systematic analysis can be disrupted by associative moments in view of a specific narrative element, an unexpected institutional connection, a powerful metaphor, or in light of meanings crossing discursive boundaries in improbable ways when studying constitutive components[15] of discourse.

Diversity of archival material in the Ernst-von-Glasersfeld-Archive and a number of historic documents dealing with basic philosophical issues and various paradigmatic orientations, the archive offers manifold points of entry for the modalities of visualization mentioned. In addition, explainer videos can provide initial orientation, facilitate further engagement, and encourage in-depth studies. For one thing, the development and application of the concepts, methods and tools is going to be realized prototypically on the example of radical constructivism and the Ernst-von-Glasersfeld-Archive. Then again, the modular, computer-aided, visual tool set can be used in public institutions (GLAM) in general. Overall, the project aims to create conceptual, methodological and technical foundations for a sustainable, future-oriented development and application of visualization tools for archives and collections with a view to variable uses for research, academic education and the general public.

The approach presented here provides potentials for research and education. For one thing, innovative methods at the seams of qualitative data analysis, argumentation analysis and discourse analysis are going to be developed; then again reflection of methodological and epistemological dimensions of visual methods and visual-

[15] Cf. Klaus Krippendorff, *On Communicating: Otherness, Meaning, and Information,* edited by Fernando Bermejo, New York: Routledge, 2009, pp. 217–234.

ization are being encouraged.[16] In so doing, considerations of self-application of paradigms play an important role as well as meta-critical thinking between the priorities of *The Structure of Scientific Revolutions* and the *Revolution of Scientific Structures*.[17]

Furthermore, the approach fosters creative opportunities as regards the educational use of archival material including following: (a) research-based learning via internet-based research of archival materials; (b) expansion of spaces for reflection, interaction and narration by way of integration of scientific archives into educational contexts; (c) consideration of individual, historical, conceptual, discursive and user generated contexts; and (d) self-reflexive forms of mediation between individual and collective[18] memory.

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[16] While in Digital Humanities discourses rather technical perspectives on issues of visualization are prevalent (see for example, the *Text Visualization Browser*, http://textvis.lnu.se/), methodological and epistemological reflections include references as following: Dieter Mersch, "Aspects of Visual Epistemology: On the 'Logic' of the Iconic", in András Benedek and Kristóf Nyíri (eds.), *Images in Language: Metaphors and Metamorphoses,* Frankfurt/M.: Lang, 2011, pp. 165–194; James Franklin, "Diagrammatic Reasoning and Modelling in the Imagination: The Secret Weapons of the Scientific Revolution", in Guy Freeland and Anthony Corones (eds.), *1543 and All That: Image and Word, Change and Continuity in the Proto-Scientific Revolution*, Dordrecht: Kluwer, 2000, pp. 53–115; Hanno Depner (ed.), *Visuelle Philosophie*, Würzburg: Königshausen & Neumann, 2015; Elize Bisanz (ed.), *Das Bild zwischen Kognition und Kreativität: Interdisziplinäre Zugänge zum bildhaften Denken*, Bielefeld: Transcript, 2011; Eszter Deli, "Can Images be Arguments? The Possibility of Visual Argumentation in the WWF Nature Conservancy Campaigns", in András Benedek and Ágnes Veszelszki (eds.), *Virtual Reality – Real Visuality: Virtual, Visual, Veridical*, Frankfurt/M.: Peter Lang, 2017, pp. 41–48.

[17] Cf. Thomas S. Kuhn, *The Structure of Scientific Revolutions: 50th Anniversary Edition,* with an introductory essay by Ian Hacking, 4th ed., Chicago: University of Chicago Press, 2012 (first edition 1962); Karl H. Müller, *Second-Order Science: The Revolution of Scientific Structures*, Wien: Echoraum, 2016.

[18] Cf. Christoph Schäfer, *Didaktik der Erinnerung: Bildung als kritische Vermittlung zwischen individuellem und kollektivem Gedächtnis*, Münster: Waxmann, 2009.

4. Conclusion

Digital methods of visualization can support breaking new ground for cultural institutions, academic work and science communication. Understanding scientific archives as nodes in transversally networked media systems offers innovative potentials for research and education. Moreover, it suggests considering historical and future-oriented meanings of archiving and reflecting on roles of visual media as regards cultural and academic practices. This relates not only to public and private usage of materials worth being archived and corresponding relevance criteria. It also relates to basic questions of designing archives and dealing with visuals in contexts where taken-for-grantedness of written or spoken words corresponds with an assessment of images and visual thinking in terms of subordinate importance. In contrast, methodologies of visualizing the non-visual require a critique of knowledge in both scientific and philosophical contexts. Along with the use of visual tools and the analysis of arguments, discourses and images, they also suggest a critique of digital reasoning and critical discourse assessment (*Diskursfolgenabschätzung* by analogy to technology assessment). However, Ernst von Glasersfeld's legacy reminds us that neither digitization nor visualization are values per se – they require contextual considerations. As for visualizing archivals and discursive structures, I want to emphasize what Johanna Drucker says: "*The design of digital tools for scholarship is an intellectual responsibility, not a technical task.*"[19]

[19] Cf. Johanna Drucker, "Blind Spots: Humanists Must Plan Their Digital Future", *The Chronicle Review – The Chronicle of Higher Education*; online document, issued on April 3, 2009, https://www.chronicle.com/article/Blind-Spots/9348, italics in the original.

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In his essay "A New Paradigm in Education: The Priority of the Image", an introductory chapter to the first volume of the series *Perspectives on Visual Learning*, András Benedek provided a comprehensive summary of the fundamental transformations education in the Western world has undergone in the past few centuries, and of the challenges educational theory and practice now face. The present volume spells out the details of those past transformations and upcoming challenges. Learning, education, and the entire school system, are today caught up in a turmoil of revolutionary changes. The rebirth of the visual is a major factor of this revolution.

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