Visual-Graphic Learning

Visual and Graphic Learning

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Abstract: This contribution seeks to draw attention to the integrated use of different languages (graphic, visual, audio-visual…) in relation to the development of an innovative didactics. A multimodal and multimedia approach to didactics relates to the possibility to stimulate and trigger pre-knowledge adequate to the objects of learning, to develop the capacity to problematize, to foster processes of acquisition and re-elaboration of knowledge. In respect to this specific field, the results of an explorative investigation conducted in two university courses proposed by the Department of Education Sciences of the University of Bologna are presented. Indeed, within these courses, special emphasis was given to the use of visual and audiovisual languages to elicit the creation of multiple and original points of view, through activities based on encounters and sharing.

Keywords: Didactics; Graphic intelligence; Visual intelligence; Digital video; Learning; Images; Multimodality; Multimedia; Concept maps

1. Learning by Images

A much-debated issue today concerns the need to rethink traditional didactics in terms of change and to single out the fundamental elements that determine its innovation. In this sense, a multimedia and multimodal perspective of educational experience takes on particular importance through the integrated use of different languages (e.g. graphic, visual, audio-visual…) in the processes of knowledge acquisition and re-elaboration. Specifically, in a society that is increasingly oriented towards the visual, the use and the production of fixed images (photographs, graphics, illustrations,…) or moving images (films, animations,…) elicits the possibility to stimulate and active pre-knowledge suited to the objects of learning and to develop the capacity to problematize the contents proposed with reference to complex contexts.

A broad-ranging scientific literature indeed recognizes how the modalities of diffusion and access to knowledge have multiplied exponentially, along with the opportu-

nities for learning by means of the use and production of visual and audio-visual resources in a developed multimodal environment, implemented through the use of technological and digital instruments (Kress 2009; Brumberger, 2011; Calvani 2011; Landriscina 2012; Serafini 2014; Vieira, Parsons, Byrdc 2018; Lacelle, Boutin, Lebrun 2017; Panciroli 2019).

With reference to the theory of multiple intelligences articulated by Gardner (1983), visual intelligence is positioned in a relationship of complementarity with graphic intelligence: visual intelligence defines the cognitive abilities linked to the imagination and to the capacity to "think by images," that is to mentally picture the concepts even before verbalizing them, allowing one to make an immediate experience of the world; graphic intelligence concerns the capacity to integrate perception, thinking and representation of reality to create artefacts finalized to the acquisition and the construction of new knowledge (Robertson 2003; Cicalò 2016; Fiorentino 2018). The viewing/production of an image or a video allows the student to trigger knowledge and explorative processes, of categorization, memory, expectations, understanding, emotion and empathy. In this regard, Clark and Lyons (2010) identified some functions of the images concerning attention, knowledge activation, the minimization of the cognitive load and the support to motivation. In particular, the images can exert a function of mediation, anticipation and modelling in respect to knowledge (Rivoltella 2012).

In this field, *visual literacy* is tied to a specific core of competencies concerning perception and visual communication thinking, language and visual learning (Mitchell 2008; Avgerinou, Pettersson 2011) which allow one to find, interpret, evaluate, use or create images and visual media. "These competencies make the subject capable of understanding and analysing the context and the cultural, ethical, aesthetic and technical components involved in the production and in the use of visual materials" (Vezzoli 2018).

In respect to visual literacy, the *graphicacy* makes explicit reference to the ability to communicate through images, videos, maps, diagrams and graphics, functional to the development of project and problem-solving competencies that call for a high level of attention and allow one to "grasp things" (Glaser 2008).

In the learning processes visual intelligence and graphic intelligence thus take on a significant role in respect to a cognitive style that is developed through visual-iconographic and visual-graphic forms. The solution to problems and the discovery of new meanings is tied not only to the vision of images of the world but also to the representation of the world by images, in which one's attention is addressed both to the visual *product*, and to the cognitive *process* that has led to the elaboration of that product. The image as product determines an activity of reading, comprehension, interpretation and re-elaboration of meanings; the image as process involves an activity of design, realisation and diffusion of new semantic contents.

Hence, taking into account the contribution of the graphic-visual dimension in didactics in a *media multimodal* (textual, visual, audio or kinetic) perspective, implies not only the possibility to understand the contents, but also recalls the possibility to create new visual forms in a constant process in which the images as didactic mediators serve to stimulate the construction of new knowledge. In this respect, Damiano

(2013) argues that the mediation is realised through processes of metaphorization that allow what is real to be substituted with another one corresponding to it. The mediation this allows the student to converse with the world and with knowledge, and to construct bridges between different levels of that knowledge itself. The mediators cannot be relegated to mere representations, but are also spaces of actions, just as Damiano states: "The representation of a things is not its reproduction, more or less faithful, rather the construction of our interaction with the object" (2013, p. 317). However, the images not only allow one to recognise our relationship with reality, but also to manipulate and re-elaborate it in an involving and motivating way. The mediators thus allow one to cross the space that is created between a learning subject and an object to be learned from several perspectives, whether it is an abstract entity or a real situation, constructing new meaning networks (Rivoltella, Rossi 2019).

2. Audio-Visuals and Training

Audio-visuals are potentially instruments for the development of different cognitive styles as they elicit the diverse sensorial modalities of perception and elaboration of the informational data: texts, images and sounds are interwoven in a video and are merged, thus creating a multimodal moment of knowledge representation.
What is meant by the term audio-visual today? The question does not have a univocal answer and recalls different cultural horizons. The Treccani Italian dictionary highlights the dual function, masculine noun and adjective of the Italian term ***audio-visivo*** and refers to what "allows one to see and hear at the same time," also in relation to the message that the means bears with it.
The meaning of *video*, again in the Treccani dictionary, is more closely referred to the "electronic device which is used, for various purposes, to analyse, elaborate, record and possibly transmit images, either fixed or moving, and either accompanied by sound or not."[1] For Wikipedia, instead, video is "the electronic information representing images." In this case the shift is from the device to the informational flow and to the temporal dimension associated to the images. The term is also commonly used and by extension in the meaning of "videoclip" e "film."[2] The Nuovo De Mauro online[3] proposes the meaning of video as the contraction of the English language terms "videotape" and "videoclip."
Another term that can help us to define the word *audio-visual* is *film*, to which the Treccani dictionary associates three different meanings: "photographic and cinematographic film," "single cinematographic production," "cinematographic art in general." The term thus seems to be associated with all that the cinema industry pro-

1 http://www.treccani.it/vocabolario/audiovisivo/

2 Online dictionaries of Corriere della Sera and La Repubblica

3 https://dizionario.internazionale.it/cerca/video

duces, bearing with it a vision that is culturally-oriented and determined by the history of the big screen.
As a consequence, the term audio-visual seems to bear with it a broader meaning in respect to *video* and *film*. Understood as a qualifying adjective "it shifts the focus from the technological means and from its various products (the *machines* and the *texts*), towards what today is believed to be the true novelty, the advent of a new language, which is transforming communication and culture."[4] It is indeed the concept of language that shifts the focus from the audio-visual object to the audio-visual conversation and the audio-visual text, contemplating a phenomenal peculiarity of the digital media formats inserted in a communicational system that today has been totally renewed by the Web.

2.1 Cinema and Television

A great director who dedicated himself to 'educational' or documentary cinema was Roberto Rossellini. The father of Italian neorealism showed his documentary intentions right from the outset, trying to photograph the multiform and never comparable realities so as to bring the individual closer to knowledge. "I think that the cinema like television and the other means of communication can be complementary means for culture. That is, they can provide to modern man, to the specialist, a quantity of notions and information that allow him to become conscious of the complex world he belongs to" (Rossellini 1987, p. 261). In its recent history, cinema has been considered a very useful instrument for the development of knowledge and, at the same time, misleading and dangerous from the educational point of view. What is striking in audio-visual language is its narrative power endowed with an extraordinary emotive strength and an undeniable psychological fascination (Farnè 2006).
When it was first launched, the Rai – Radiotelevisione italiana represented for the public the State-run television company with a strong educational vocation and with the purpose of contributing to the cultural development of the Italian citizens. A mission that the Rai has embraced since its inception is the battle against illiteracy with programmes addressed to people who had never had followed a school pathway or who had interrupted it. Once that season of television had come to an end, in the late-1970s, popular programmes and ones dedicated to scientific and cultural information, also of a generalist kind, made a lot of headway. The advent of commercial television, and thus of the market rationale which supports that of public service, decreed the crisis of the pedagogic model, but not its end. The Rai defends its role of public broadcaster: "In actual fact, the "educational dimension" of television becomes increasingly pervasive, less clearly defined: it creeps into an entertainment programme in the space given to a cultural topic (via a certain guest, the presentation of a book etc.) and enters the popular fiction series whose protagonists (doctors,

[4] Franco L., *Audiovisivo*, in Franco LEVER - Pier Cesare RIVOLTELLA - Adriano ZANACCHI (edd.), *La comunicazione. Dizionario di scienze e tecniche*, www.lacomunicazione.it (28/01/2019).

priests, police officers, teachers etc.) are often grappling with situations that "deal with" human, social, environmental problems, whose solution implies a certain degree of knowledge and awareness, and maturation of choices" (Farné 2003, 15-16). At present the Rai's ethical code still envisages among its priority objectives, the aim to "stimulate an interest in culture and creativity, education and a mental aptitude for learning and evaluation, and develop the viewer's critical skills."[5]

2.2 Digital Videos on the Web

After the birth of the structure of the Internet and the World Wide Web, on the one hand, and the diffusion of the mobile devices, on the other, the new media have become digital media. If the screen, historically speaking, was invented by the cinema and later borrowed from television, and thus has always been associated with the audio-visual language in its various forms and evolutions, today it is used in different ways and places. The web platforms for publishing and sharing have turned video into a product that is widely used also for the personal production of contents. The digital format associated with the potential of the Internet have created a virtuous process in terms of convergence of virtual places and resources, and it multiplies the opportunities for diffusion and utilisation. The screens from which it can be seen are almost endless, of many shapes and sizes, mobile or desktop, with a greater or lesser number of possible interactions but never one-directional. Their use is not only private but can be public as well: the digital user is not just a spectator and almost never remains anonymous. The sharing platforms and the technological artefacts for viewing have their own rationale and a working architecture that condition the use and the behaviour of the users, just as the cinema screen creates the ambience of interaction with the audio-visual product.

The digital media objects correspond to a new visual culture that is born from the previous one to become something different, borrowing the aesthetic strategies and the communicative principles of the cinema. The space for the representations is in fact always the screen, although the monitor, with its underlying rationale, creates a new cultural category (Manovich, 2002).

Unlike the cinematographic product, the digital videos can reach a very high level of enjoyment even without complying with particular aesthetic criteria, as they respond to very different communicative rationales. Part of the structure and the philosophy of the digital videos on the Web is the chance to create interconnections or to comment and make evaluations, also thanks to YouTube which transforms a simple audio-visual product into a cultural object having multiple characteristics. A digital video published on a YouTube channel is a straighforward object, a digital video published on a YouTube channel with a network of comments and links is a different product, a digital video published on a YouTube channel with a network of comments and inserted in a Web page or in an online course is again a different object.

[5] The ethical code of the RAI, updated at the meeting of the Board of Directors on 27 July 2017, http://www.rai.it/dl/doc/1501715285227_Codice%20etico_luglio2017.pdf.

YouTube lays down clear-cut guidelines for those who wish to create effective educational videos. We have drawn some ideas from these guidelines that we are reiterating here.

3. Digital Audio-Visuals: Interactive Multimedia Map

In didactics for years we have witnessed a consolidated use of audio-visual and multimedia materials that, with the shift to digital, has seen a considerable increase. Indeed, the provision of services and instruments that use the audio-visual language for the structuring and representation of knowledge has increased, with the ulterior aim of consolidating the learning and to communicate and disseminate it on the Web. Particularly interesting are the instruments of the construction of multimedia conceptual maps, which allow us to create products with characteristics that are similar to those of the audio-visual. In fact, these are maps that use several elements, such as texts, static images and moving images, music and spoken texts.
The conceptual map is born as an instrument for interpreting. Re-elaborating and transmitting knowledge, information and data visually. A map has a hierarchical

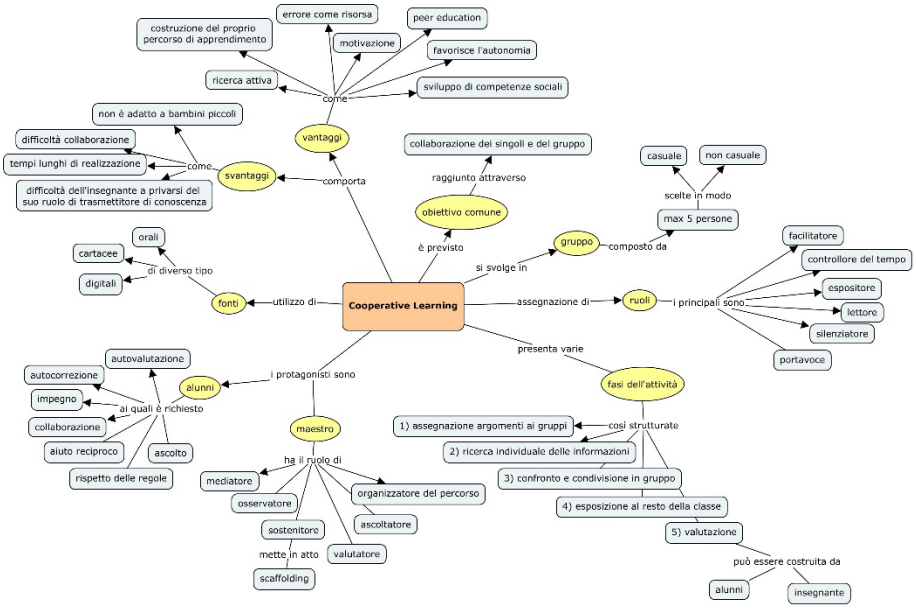

Fig. 1 – Cooperative Learning. Map by a group of students of the Didactic Technologies Laboratory, Undergraduate degree course in Primary Education, academic year 2018/2019.

structure that involves all the elements of the subject of the communication: the pivotal concepts, the bonds between these and the overall path of the reasoning. But it can also have a reticular structure, steeped in connections (figs. 1 and 2).

It is indeed the architecture that makes the map a creative product, thanks to which the knowledge is enriched with new ideas and elements: each graphic image rendered by the map, with its close-ups, colours, forms, equilibriums, aesthetic criteria, identifies a new structure within already known concepts. For the same contents different people are capable of creating visual architectures and with differing meanings, overcoming the simple idea of the scheme.
Recently, the development of specific software has made it possible to confer an audio-visual character to the maps, enabling an animated navigation. These are multimedia, dynamic maps, characterised by animations and by the possibility to interact with each content, modifying the methods of visualization by means of changes in perspective, enlargements, rotations, changes in the speed of the animation.
Just like an audio-visual, the multimedia map renders to the user – viewer but also actor – the image of the movement, thanks to the game of alternation between close-up and background of the single elements, with all the depths and the levels organised in a comprehensive architecture.
A multimedia map thus constructed ca also become an audio-visual product, as at every node it can associate different languages and materials (graphic, photographic, animated, audio, video clips). In addition, the insertion of hypertextual links determines a further declination of the map that from being a closed text expands the concepts represented by opening to the unlimited resources of the Web (Figs. 3, 4).

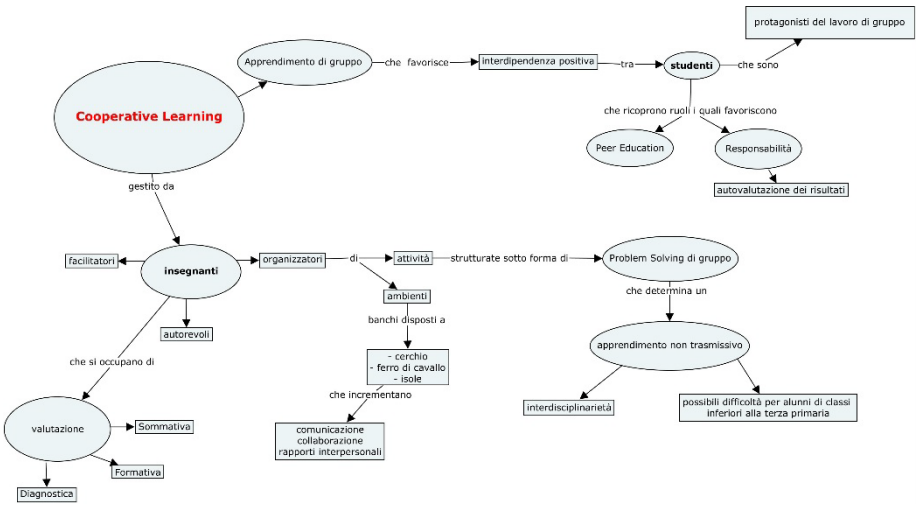

Fig. 2 – Cooperative Learning. Map by a group of students of the Didactic Technologies Laboratory, Undergraduate degree course in Primary Education, academic year 2018/2019.

The repercussions on learning are well-known and manifold. Several logical-visual models have different cognitive purposes. In a map thus conceived, the visual organisation of the elements corresponds to the logical and functional structure of one's own knowledge; indeed, different architectures allow one to explore the many points of view from which one same phenomenon can be analysed and to highlight simple or complex structures, with different levels of expositive clarity and communicative efficacy.

Constructing a map reduces the likelihood of a mechanical learning in favour of an active/meaningful learning, eliciting the process of learning to learn. Giving to knowledge a personal organisation, different from the person who presented it to us previously, allows us to become conscious of the different learning styles, reflecting one's own mental processes (Novak, 2001, 2012).

From a socio-relational point of view, moreover, lending itself to collaborative writing and to group work, the maps have turned out to be an effective instrument on several levels: for creating relations; for exploiting the mechanisms of the social construction of knowledge (Doise & Mugny, 1986) and for the proximal development (Vygotskij, 1973); for fostering reciprocal appreciation; for reducing the bias vis-à-vis those who have cognitive styles that are different from one's own.

The effects on learning are particularly evident when one analyses the maps created in different educational contexts. The student's age, their different learning capacities and their management of complex knowledge, the different learning styles and of knowledge organisation are very well expressed by the type of structure chosen to construct the conceptual map and by characteristics relating to: accuracy of the graphic style in respect to the message and to the target user; aesthetic aspects; complexity of the connections between concepts; adequacy of the choices in relation to the objectives; efficacy of the communicative style determined by the relationship between contents and structure. In this regard, a study conducted in 2015 drew attention to the results of learning in relation to the use of various instruments for the digital presentation of the contents (Chiou et al. 2015), highlighting how the dynamic systems of representation of knowledge positively impact the acquisition of knowledge by the students.

Fig. 3 – From "Illuminismo", by Sara, Silvia, Maria, Andrea, Denis, Paolo, Niccolò, Kristina, Valentin. Class 2.C, school "Il Guercino", Bologna, prof. Marcato https://prezi.com/ykajx_n2kyrl/illuminismo/

Fig. 4 – From "Progetto CNR", by Niccolò, Fabio, Enrico, Leonardo, Matteo. School "E. Majorana", class 3L, San Lazzaro di Savena (BO), prof. Magnani. https://prezi.com/nzxxcls-td4d/progetto-cnr/

4 Explorative Investigation: Images and Videos for Learning and Teaching

In the specific context of university teaching, in 2016 a research study was conducted at the University of Quebec, in Rimouski, on the university training practices that avail themselves, or do not, of visual contents during the classes. The research that involved the students of the education sciences course highlighted the learning practices of the university students in relation to visual literacy, analysing their relative competencies. The results showed two fundamental aspects: the students learn better when multimodal teaching practices are adopted; the students prefer an equilibrium between didactic practices that resort to visual modalities and traditional didactic practices (Martel et al. 2017).
In regard to this research, in the academic year 2018-2019, an exploratory investigation was conducted at the Department of Education Sciences of the University of Bologna into the most important aspects of the visual and audio-visual dimension in the processes of university teaching-learning. The aim was to survey the efficacy of the use of images and videos in the dual sense of product/process, with reference both to the phase of vision/presentation of images/audio-visuals, and to the activity of realisation of photographic shots and short video productions.
The exploratory investigation involved 120 students altogether, attending two university courses. In more detail: 85 students doing the course "Theories and instruments of didactic mediation" (postgraduate degree course in Education); 35 students doing the Didactic Technologies Laboratory (undergraduate course in Primary Education). The two courses were characterised by a didactic set-up based on the transmission of knowledge via a multimodal approach supported by the vision/production of images (paintings, photographs, drawings, illustrations …), videos (documentaries/film trailers) which served as a stimulus to start the discussion on certain theoretical concepts.
The choice of this sample of students is linked to their dual role: students and at the same time trainee professionals in the educational field (educationists/teachers) who have experienced and reflected on the impact of the graphic-visual-dimension in relation both to university didactics, and to future working contexts.

4.1. The Questionnaire: Analysis and Results

To collect the students' feedback, we used a questionnaire administered anonymously. The questionnaire was finalized to deepening some aspects tied to the use of visual and audio-visual languages in teaching, surveying the positives and the critical aspects. The questionnaire was structured into four questions, one of which with a closed answer and three with open-ended answers.

Fig. 5- Word Cloud relating to question no. 1

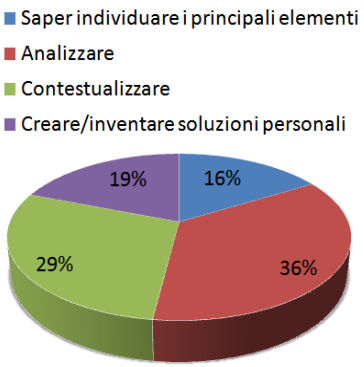

Fig. 6. Graph relating to question no. 2

From the elaboration of the answers to question no. 1 (*The images and the videos used in class served to* …, Fig. 5) it emerged that images and videos have a significant impact on the students understood in terms of attention, critical for stimulate observation, reflection, analysis and learning. Here are some of the most significant responses:

The images and the videos used in class served to:

- capture one's attention better;
- minimise the risk of getting bored and getting distracted;
- stimulating the reflection and the desire for further study;
- implementing the capacity for analysis;
- facilitating the direct learning of the meanings;
- supporting the reflection.

From the elaboration of the responses to question no. 2 (*The observation of the images and the videos, in respect to the topics/themes analysed in class, helped you to: 1. Be able to identify the key elements; 2. Analysing; 3. Contextualising 4. Creating/inventing personal solutions*, Fig. 6) it emerged that the students identify, among the main purposes, the possibility to analyse a given argument/theme (36%) and the its contextualisation (29%). Nineteen per cent refer to the possibility to create or re-elaborate personal solutions/contents through images and videos, while 16% recall the capacity to identify the main elements dealt with in class.

The responses to question no. 3 (*Single out three positives in respect to the use of the images and the videos in class*, Fig. 7) stress some specific aspects: immediacy, involvement, capacity to make use of visual memory and imagination, to provide stimuli and to make abstract concepts concrete.

Fig. 7. Word Cloud relating to question no. 3: positivity

Fig. 8. Word Cloud relating to question no. 4: critical aspects

Here are some of the most significant responses:
Images and videos:
- arouse interest;
- stimulate one's imagination;
- foster greater involvement;
- allow one to memorise abstract concepts;
- allow one to use and train one's visual or iconographic memory;
- make the concepts more immediate;
- foster input and personal interpretation;
- encourage critical thinking;
- elicit debate and discussion that lead to thinking together;
- stimulate active discussion;
- make a given situation visible and contextualizable.

The critical aspects highlighted in question no. 4 (*Single out three critical aspects in respect to the use of images and videos in class*, Fig. 8) instead concern the possible distraction, the risk of misconstruing the meaning of the images, susceptible to several interpretations and the dispersion among several perceptive channels. Here are some of the most significant responses:
- images and videos can confuse the viewer;
- images and videos can be misleading or lead to a wrongful interpretation if not sufficiently explained;
- the images do not always manage to transmit one's thinking;

- the images can channel different meanings for each individual;
- the images are unable to transmit the complexity of reality;
- the interpretations of the images and the videos can differ from person to person, they nonetheless require clear captions in order not to cause misunderstandings;
- subjective interpretation of the images;
- they mustn't be too numerous otherwise they risk becoming banal.

4.2. Discussion and Conclusion

The results that emerged from the comparative analysis of the responses recall some significant elements both on the level of the dimension of vision and of the production of images (photos, maps of a multimedia nature…), ascribable to three dimensions:
- *Informational-receptive*: an image or a video can provide a certain amount of information on the grounds of the greater or lesser wealth of details and support the visualisation of the concepts.
- *Metacognitive*: the images and the videos constitute resources and aids that allow knowledge to be deepened. Indeed, it is possible to propose and/or have an image or a video produced to analyse and/or contextualise an argument/concept and start up a shared reflection. Before the complexity of some images/videos a problematising approach determines the elaboration of new solutions. "Translating a concept into the form of image allows us to objectivize it so as to be able to then observe it from a different angle and understand it better, more in depth. Many people (…) when the y reflect to look for a solution to a problem cannot do without a notepad on which to make some sketches" (Todesco 2016, p. 11).
- *Creative*: images/videos not only allow one to communicate, but they represent an instrument of expression/re-elaboration. They allow one to image and stimulate one's imagination: the creation of images becomes one of the most effective instruments that "the mind has at its disposal, to understand and to invent" (Todesco 2016, p. 11). Images and videos are an effective way to explore and construct new knowledge and provide new interpretations.

On the level of socio-relational dimension, the images and the videos develop both the level of autonomy and that of collaboration. Indeed, the visual stimuli help each student to start up a research process in order to comprehend relevant aspects vis-à-vis his/her own knowledge, besides casting doubt over the social construction of oneself in respect to the thinking of others. On the relational level, images and videos stimulate active discussion in class and elicit the debate that leads one to construct knowledge in a collaborative way.

The results emerging from this first investigation, in spite of its specific limitations (e.g. sample size, targeted nature of the questionnaire…), highlight the appreciation, on the part of the university students, of teaching based on the use of visual and audio-visual languages which, if not integrated with other languages and instruments

and if not inserted within a precise project design, risk providing misleading reading keys.
Such critical aspects recall the need for a didactic architecture that provides for the use of visual and audio-visual languages, apart from verbal ones, in connection with different strategies that guide the student towards new re-elaborations of knowledge, with the result of triggering the construction of new explicative and interpretative hypotheses concerning reality.

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Bibliography

Avgerinou, M.D., Pettersson, R. (2011). Toward a cohesive theory of visual literacy. *Journal of Visual Literacy*, 30, 2, 1-19.

Brumberger, E. (2011). Visual literacy and the digital native: An examination of the millennial learner. *Journal of Visual Literacy,* 30(1), 19-46.

Calvani A., (ed.) (2011). *Principi di comunicazione visiva e multimediale. Fare didattica con le immagini*. Roma, Carocci.

Cardarello, R., and Bertolini, C. (2012). *Insegnare a vedere per insegnare a capire*. In: Cardarello R., Contini A (ed.). Parole, immagini metafore. Per una didattica della comprensione. Azzano San Paolo, Edizioni Junior.

Cardarello R., and Contini A., (ed.) (2012). *Parole, immagini metafore. Per una didattica della comprensione.* Azzano San Paolo, Edizioni Junior.

Chiou, C.C., Tien, L.C., Lee, L.T. (2015). Effects on learning of multimedia animation combined with multidimensional concept maps. *Computers & Education*, vol. 80. pp. 211-223

Chou, P.-N., Chang C.-C., and Lu P.F. (2015). Prezi versus PowerPoint: The effects of varied digital presentation tools on students' learning performance. *Computers & Education*, vol. 91, pp.73-82.

Cicalò E. (2016), *Intelligenza grafica*, Roma, Aracne.

Fiorentino, E. (2018). *Il vero, il bene e il bello: le immagini come occasione di apprendimento significativo*. In S. Ulivieri, L. Binanti, S. Colazzo, M. Piccinno (eds.). Scuola Democrazia Educazione. Formare ad una nuova società della conoscenza e della solidarietà. PensaMultimedia

Fogarolo, F., and Guastavigna, M. (2013). *Insegnare e imparare con le mappe. Strategie logico-visive per l'organizzazione delle conoscenze*. Trento, Erickson.

Franco, L., *Audiovisivo.* In: F. Lever, P. C. Rivoltella, A. Zanacchi (eds.) (2019). *La comunicazione. Dizionario di scienze e tecniche*, www.lacomunicazione.it (28/01/2019).

Gardner, H. (1983). *Frames of Mind: The Theory of Multiple Intelligences*, New York, Basic Books.

Glaser, M. (2008). *Drawing is thinking*. Harry N Abrams Inc-

Grandin T. (2006). *Pensare in immagini*. Trento, Erickson.

Kress, G. (2009). *Multimodality: a Social Semiotic Approach to Contemporary Communication*, London: Routledge.

Lacelle, N., Boutin, J.-F., Lebrun, M. (2017). *La littératie médiatique multimodale appliquée LMM@*. Québec, Canada: Presses de l'Université du Québec.

Landriscina F. (2011). *Modelli di riferimento per l'uso didattico della comunicazione visiva*. In: A. Calvani (ed.), Principi di comunicazione visiva e multimediale, Roma, Carocci.

Landriscina F. (2012), Didattica delle immagini: dall'informazione ai modelli mentali, *Form@re. Open Journal per la formazione in rete*, vol. 12, 80: 27-34.

Lumbelli L. (2012), Il ruolo della percezione visiva nell'apprendimento con animazioni, *Form@re. Open Journal per la formazione in rete*, vol. 12, 80: 21-26.

Maiellaro, N., Lerario, A., and Varasano A. (2019). Improving Dissemination and Localization of Cultural Heritage Through Multimedia Maps - The Case of Lipari Island. In: Duguleană M. et al. (eds). VR Technologies in Cultural Heritage. VRTCH 2018. Communications. *Computer and Information Science*, vol. 904. Springer, Cham.

Martel, V., Boutin, J.-F., Lemieux, N., Mclaughlin, D., Beaudoin, I., Boudreau, M., Mélançon, J., & laroui, R. (2017). Appréciation d'étudiants universitaires en sciences de l'éducation des pratiques de formation universitaire, recourant ou non à l'image, en ce qui a trait à la présentation/production des contenus de cours. *International Journal of Technologies in Higher Education*, 14(3), 48-61.

Mitchell, W. J. T. (2008). *Visual literacy or literary visualcy*? In: J. Elkins (eds.). Visual literacy. New York, NY : Routledge.

Novak, J. D. (2001). *L'apprendimento significativo: le mappe concettuali per creare e usare la conoscenza*, Trento. Erickson, 2001

Novak, J. D. (2012). C*ostruire mappe concettuali: strategie e metodi per utilizzarle nella didattica*. Trento, Erickson.

Oliveira, A.W., Cook, C. (2016). Student visual communication of evolution. *Brazilian Journal of Research in Science Education*, 14(2), 9-26.

Panciroli, C. (2019). Innovare le architetture della didattica universitaria. *Education Sciences & Society - Open Access Journal, [S.l.], v. 9.*

Rivoltella, P.C., Rossi P.G. (2019). *Il corpo e la macchina. Tecnologia, cultura, educazione.* Scholé, Brescia.

Robertson, I. (2003). *Intelligenza visiva. Il sesto senso che abbiamo dimenticato*. Milano, Rizzoli.

Schnotz W., and Lowe R.K. (2008). *A unified view on learning from animated and static graphics*. In: R.K. Lowe e W. Schnotz (ed.), Learning with Animation, New York, Cambridge University Press, pp. 304-355.

Serafini, F. (2014). *Reading the visual. An introduction to teaching multimodal literacy*. New York, NY : Teachers College Press.

Todesco, G.M. (2016). L'immagine come strumento della mente. *XY. Rassegna critica di studi sulla rappresentazione dell'architettura e sull'uso dell'immagine nella scienza e nell'arte.* v. 1, n. 2, pp 10-19.From: http://www.xydigitale.it/rivista/index.php/xy/article/view/35.

Vezzoli Y. (2017). Visual literacy: un problema di definizione. *Formazione & Insegnamento*, vol. XV, pp. 2- 20

Vieira C., Parsons P., Byrdc V. (2018). Visual learning analytics of educational data: A systematic literature review and research agenda. *Computers & Education*. Vol. 122, pp. 119-135.