



Infodemic, Visual Disinformation and Data Literacy. How to Foster Critical Thinking Through the Emerging Data-Graphicacy Competence

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Abstract. In an infodemic the citizen must quickly process information, using parameters of thought automation, rather than analytical parameters, and therefore preferring interpretations that employ less cognitive effort and that mainly reflect previous knowledge. Decoding of any infographic appears unknowingly easy, due to the strong use of iconographic elements, whose intuitiveness makes it simple, effective and free from misleading interpretations, even though graphs can lie.

It is necessary to learn to read a graph, before understanding it, as the truthfulness of the information contained in a data visualization is never absolute, but rather must be critically contextualized based on the objectives of those who want to use the initial data. Correct reading presupposes the acquisition of a new holistic digital competence: the data-graphicacy, that intends to be a natural evolution of the concept of graphicacy, which summarizes the skills necessary for a citizen in the correct production and consumption of infographics.

If on the one hand, developing the factual, conceptual, and procedural domain of the infographic project is a consolidated practice in design schools, on the other hand, a lack of support activities for metacognitive and critical development of infographics, as a key to breaking the disinformation wheel, is undeniable. To do this, it is necessary to implement strategies that focus attention on the logical-procedural structure with which an infographic is created, and activities are carried out starting from the analysis of the products themselves.

Keywords: Infodemic · Digital Education · Data Visualization · Data-graphicacy · Dataful Thinking

1 Introduction

This paper proposes a reflection that, starting from analysis of the production system of fake news, especially visual news, proposes a legitimation of graphicacy and data literacy – introducing the *data-graphicacy* concept – such as strategies of democratization, able of contributing towards spreading critical competences in the citizen with the aim of contrasting the visual misinformation phenomenon.

2 Anatomy of Fake News

WHO [1], following its declaration of the Covid-19 pandemic, has drawn attention to the spread of the *infodemic* [2], in other words the rampant phenomenon of uncontrolled production and dissemination of information whose degeneration is attributable to fake news. However, the fight against disinformation is not a recent issue. The AGCOM [3] in 2018 published a report entitled “*News vs fake nel sistema dell’informazione* (“News vs fake in the information system”), which summarizes the six main elements underlying online disinformation according to the definition stated by the House of Commons¹ [4]:

1. False content.
2. Its contagiousness based on the user’s strong emotional involvement.
3. ‘Malicious’ intention behind its creation.
4. Political/ideological or economic motivation of those who create it.
5. Its rapid mass diffusion.
6. Its ability to influence public opinion.

The production mechanism of disinformation is in all respects comparable to the *cultural industry system*² [5] which, in Hirsch’s interpretation [6], is structured by 4 main production flows:

1. The technical one of talent scouting,
2. The managerial subsystem,
3. The institutional subsystem
4. The functional subsystem.

The first production flow – the technical one – grasps the newsworthy idea or event. It evaluates its cultural potential, as well as its ability to catch a market share; in this sense, the idea is projected into the cultural industry circuit, adapting it to the rules and mechanisms of mass production. The second one deals with staging of the cultural product – or news – from an ethical and aesthetic point of view, making syntactic and narrative adaptations to create a narrative as close as possible to the needs of the potential target audience. The third one, refers to the validation of the news’ “packaging” by communication critics and their function of accreditation of the news regardless of the feedback of the end users – in other word the functional subsystem – decreeing its success [6].

2.1 The Fake News Process

By transposing this reasoning onto disinformation, it may be maintained that the fake news production mechanism also has four main passages that relate to the cultural industry system: *creation, production, spread* and *valorisation of data* [3].

¹ Disinformation is often described as “the deliberate creation and sharing of false and/or manipulated information that is intended to deceive and mislead audiences, either for the purposes of causing harm, or for political, personal and financial gain”.

² Historically, this concept arose to denounce the packaging processes of modern cultural artefacts, which make use of the production logic of the manufacturing industry, reducing culture to a consumer object.

The first phase – related to the technical subsystem – refers to economic and political factors that condition the production process of fake news. The so-called disinformation creators are identified with editorial organizations, political players, groups of users, or even bots, which generate fake news, for commercial, political or ideological purposes. In this phase, the same organizational logics underlying the design of a news item are valid. In the first place, orientation towards the potential target audience, its profiling and subsequent datafication by online platforms. The so-called big data, are then collected, classified and processed for the purposes of a digital economy [7]. Subsequently, the identification and selection of hot topics capable of capturing the citizens' attention and involving them emotionally. Lastly, the contextualization of the hot topic in the users' *echo chambers*³ to satisfy the so-called confirmation bias, or the information expectations corresponding to polarized public opinion, generated online by the social platforms' own algorithms [8].

The second phase - related to the managerial subsystem - refers to the process of “staging” the fake news, by choosing from a syntactic point of view the codes to be used – *image, video, written text* – and, from a semantic point of view, the type of contents to be conveyed, selectable among those most publicly discussed – or of public interest – and choosing their degree of manipulation.

In this phase a series of rules underlying the production of fake news is found, such as: the strong emotional impact that such news contain in order to have a rapid and wide public resonance; the approximate argument, often the result of the work of non-professionals; attention to the life cycle of the news, mainly focused on ‘time 0’, which, moreover, is devoid of anticipations; the concentration in a single day of a high coverage index of fake news and the simultaneous collateral discussion of further news that represent sources of noise at the expense of in-depth analysis [3].

The third phase - related to the institutional subsystem - refers to the publication and dissemination of the mainly online message. In this case, the most widely used distribution strategy is *peer to peer*. In fact, via online platforms, the automatic personalization mechanisms on the one hand, and the users sharing actions – i.e., *like, click* and *view* – on the other as well as the software to create and manage bots and servers that allow to simultaneously handle multiple devices – i.e., *Facebook* – encourage the proliferation of fake news, and their rapid viral propagation.

Lastly, the fourth phase refers to the valorisation of the content through the viral effect of online sharing, which result in earnings. In this last phase, the search algorithms of the platforms that define content ranking, and the protocols for the management of advertising transactions through IT systems – such as ad servers, Demand Side Platform, Sell Side Platform, etc. – play a significant role. In this sense, the disinformation production systems rely mainly on automated systems to increase their dissemination.

³ An echo chamber is a specific condition of social networks in which users tend to select only information similar to their own beliefs and ideological views, generating polarised forms of public opinion in which dissenting opinions are ignored. This phenomenon is implemented by the action of filter bubbles generated by the algorithms of the platforms that progressively orientate the contents of the network on the basis of the content preferences expressed by the individuals themselves.

2.2 A Counterstrategy: The EU International Position

The fight against disinformation seems unable to keep pace with its uncontrolled production and diffusion [9] whose form is increasingly visual [10] and present on multiple digital platforms [11]. To obstruct disinformation, in 2015 the *Declaration on Promoting citizenship and the common values of freedom, tolerance and non-discrimination through education* suggested investing in critical thinking in the perspective of media literacy⁴ [12] in order to strengthen digital competences, also with the aid of socialization agencies, such as school and family⁵.

In 2016 the European Council itself promoted the development of Media Literacy and critical thinking to allow students to “access, interpret and produce media content in a conscious and responsible way”. Lastly, along the same lines in 2018, the European Commission, with its report *Teaching media literacy in Europe: evidence of effective practices in primary and secondary education* [13], proposed three specific guidelines against disinformation:

1. Raise awareness about disinformation and the misuse of data in education.
2. Invest in further research of good practices to teach Media Literacy against disinformation and Media Literacy Education across all school levels.
3. Develop Media Literacy curricula capable of including the five digital competences for media literacy proposed by DIGCOMP⁶.

In specific terms, *Information and Data Literacy* are configured as one of the 5 main areas of digital competence underlying DIGCOMP [14, 15] whose objective concerns the implementation of critical analysis as a digital soft skill [16]. In this sense, the three indicators of this digital competence upon which to reflect and invest in terms of education regard:

- a. browsing, searching and filtering.
- b. evaluating.
- c. managing.

⁴ In the recent Council Recommendation on key competences for lifelong learning of 2018 in the definition of Media Literacy a reference to digital competence is included in the DIGCOMP perspective which provides: “information and data literacy, communication and collaboration, media literacy, digital content creation (including programming), safety (including digital well-being and competences related to cybersecurity), intellectual property, problem solving and critical thinking”.

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⁶ DIGCOMP is the international European digital competence framework proposed by the European Union in 2013 for all EU countries.

Returning to the analysis described in the previous paragraph, these indicators can be considered the antidotes to the three main mechanisms of the cultural industry of fake news. Therefore, there is a need to implement an educational strategy based on implementing capacity for critical analysis of the media message – i.e., *evaluating* – on gaining awareness of the text encoding mechanisms – i.e., *managing* – and on understanding and recognizing the systems of decoding, distributing and valorising of the content – i.e., *browsing*.

3 Data-Graphicacy as Antibody Against Fake News

We live in a visual environment [17] whose information is omnipresent and of fundamental importance for understanding different fields of knowledge [18] because “what we see is what we know” [19]. The consumption of infographic news lends itself well to ‘visual misinformation’ phenomena [20], often the result of processes of errant coding [21] of the graphic signs with which data are represented [22].

As Fontana has maintained [23], when faced with news, people apply a thought system based on *cognitive blending* and *belief systems*, in other words, they simplify the information, reaching a partial and incomplete interpretation. In an infodemic, the citizen must process information quickly, using parameters of thought automation, rather than analytical ones, and therefore preferring interpretations that employ less cognitive effort and that mainly reflect previous knowledge. The decoding of any infographic appears unknowingly easy, due to the strong use of iconographic elements, whose intuitiveness makes it simple, effective and free from misleading interpretations, even though graphs, as stated by Jones [24] and Cairo [25] can lie.

Decoding difficulties are due to – first of all – a low level of what Bolchin and Coleman [26] define as *graphicacy* and which plays a key role in the cognitive learning process [27] and in particular in Data Literacy [28, 29]. This happens because the visual translation of data into information makes use of a language that has a specific grammar of signs and channels [30] capable – if correctly applied – of being *translinguistic*, as in the case of Otto Neurath’s Isotype [31]. However, reading images is anything but intuitive, since the understanding of the message can only take place if one is aware of the compositional codes of encoding and decoding [32]. If this doesn’t happen, communication fails [18]. For this reason, it is important to invest in strategies of developing the skill of reading the infographic product, since critical decoding allows to break the circle of disinformation.

3.1 Data-Graphicacy as a Soft Skill

According to Cairo [33], it is necessary to learn to read how to read a graph, before understanding it, since the truthfulness of the information contained in a data visualization is never absolute, but rather must be critically contextualized based on the objectives of those who want to use the initial data. The data are objective, and their visualization-interpretation is subjective [34]. The correct reading presupposes the acquisition of a new holistic digital competence: *data-graphicacy*.

Data-graphicacy – a neologism coined by the authors starting from the concept of *Datafication* [35] – can be described as “the ability to encode and decode data

into infographic information through datafication processes”. Over the years, numerous researchers have theorized various literacy frameworks – Information Literacy [36], Visual Literacy [37], Statistical Literacy [38] – in which they have focused on the reading of the visual product. *Data-graphicacy* intends to be a natural evolution of the concept of *graphicacy*, which summarizes the skills necessary for a citizen in the correct production and consumption of infographic artefacts. Infographics are in fact the result of skills related to:

- *Information Literacy*, since the interpretation has an information purpose.
- *Visual Literacy*, since language is visual.
- *Statistical Literacy*, since the translation of data into information requires knowledge of statistical relationships.
- *Graph Literacy*, since the use of graphemes in visual translation is key.
- *Data Literacy*, in the analysis, manipulation and management of data information.

As expressed by Jones [10], Kirk [39] and Munzner [22], the visualization of data in infographics - and their consumption - involves iterative design phases that place the role of critical competence and analysis at the centre (see Fig. 1).

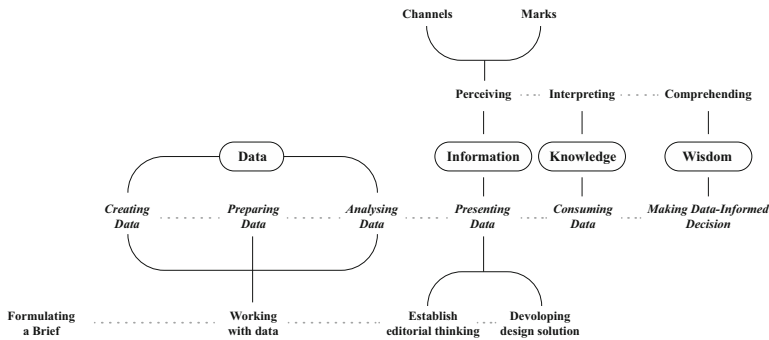


Fig. 1. The datafication process according to the study of Jones, Kirk and Munzner about Data Design.

3.2 Devolving Data-Graphicacy: From Artful to Dataful Thinking

It is not wrong to state that before being a product, infographic is a way of thinking, coherently connected to *Visual Thinking* [40]. In the process of translation from *data* to *information*, purely visual strategies of analysis, synthesis, abstraction and figuration are put in place. The architecture of an infographic is in fact already a pre-visualization of the information that presupposes design [22]. For this reason, in order to develop a proper *Data-graphicacy*, it is necessary to frame everything within a mental process of visual (data) thinking. *Data-graphicacy* competence implies different levels of skills acquisition, combined with different settings of cognitive domain: *factual, conceptual, procedural, metacognitive*. From the educational point of view (see Fig. 2), it is possible

to reconstruct the progress of construction of *Data-graphicacy* competence through the revised Bloom scale [41].

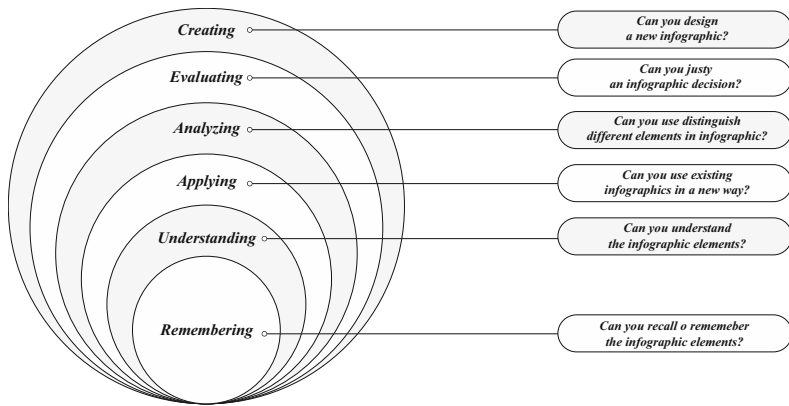


Fig. 2. The Data-graphicacy scale according to revised Bloom's scale.

While on the one hand, developing the factual, conceptual and procedural domain of the infographic project is a consolidated practice in design schools, on the other, there is an undeniable lack of support activities for the metacognitive and critical development of infographics, as the key to breaking the disinformation wheel.

As previously stated, critical competence is one of the fundamental keys to fight the uncontrolled spread of fake news, including infographics and visual news.

To do this, it is necessary to implement strategies that focus attention on the logical-procedural structure with which an infographic is made, and for activities to be carried out starting from the analysis of the products themselves.

An interesting meta-model from which it is possible to draw inspiration to build a metacognitive stimulation experience based on infographics is the Artful Thinking (AT) developed by Harvard [42]. This is a Visual-Based educational procedure based on the logic of Inquiry-Based Learning, which uses images to activate critical thinking and reflection. AT defines six dispositions of thought, which is to say procedural activities that are related to cognitive patterns capable of developing critical and analytical skills. Starting from this scheme, it is possible to make a correlation between the phases of the information design process and the thinking activities developed by Harvard. Each of the AT thinking dispositions can be accompanied by one or more actions of the information design process (see Fig. 3).

From *Artful* to *Dataful* Thinking⁷. This structure highlights how the datafication activity is intrinsically a critical thinking activity; a process of visual (data) thinking, based upon a critical observation of reality that, from data, becomes infographics and then information.

⁷ Dataful Thinking are activities designed by A. Caccamo (author) and currently under pilot experimentation, through a series of online workshops at the Department of Education and Human Sciences of the University of Modena and Reggio Emilia.

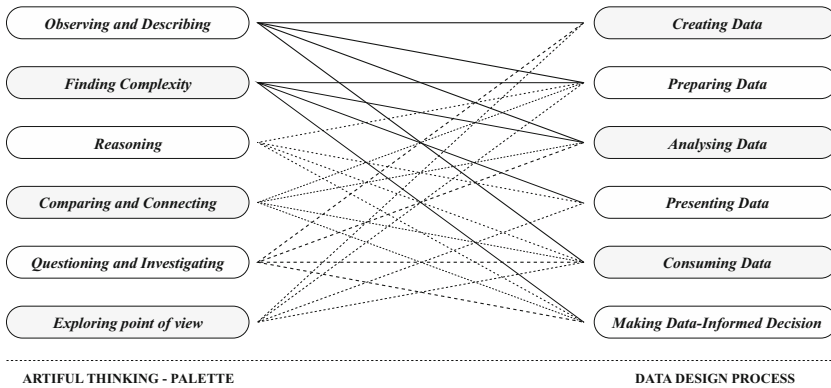


Fig. 3. Thinking Disposition applied to Data Design process.

4 Conclusion

The competences of the discipline of *Communication Design* – and *Information design* in particular– must now be conveyed to the society in order to offer a solid literacy to the visualization of information. We are dealing with a new era of literacies, one, however, that risks creating a cultural and social gap, thus making infographic an elite cultural product destined only for a few experts in the sector.

The issue does not only regard production, but also the opportunity of offering citizens the basic literacy tools to allow a correct reading and use of the infographic contents, since that is the result of a visual language that must be taught. This problem is part of the international debate that has developed in recent years on the central importance of political investment in digital literacy and digital skills, in order to provide citizens with adequate cognitive tools for decoding and coding information starting from data [14, 15].

To do this, it is important to start thinking about educational paths aimed at the population, that combine technical, cultural and thinking skills in a process of democratization of the information design culture.

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