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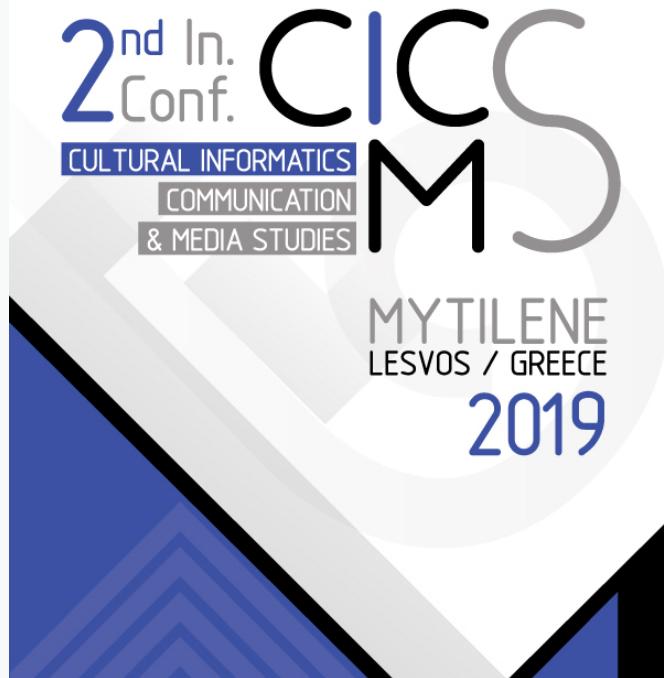
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The use of Infographics as an educational tool for the upcoming digital transition

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Abstract

Infographics have been proved as one of the most efficient visual tools to convey messages in a variety of applications and contexts. From road signage to data visualization and education, infographic designers manage to give a visual explanation for less or more complex concepts through a decreased use of detail, visual elements and text. Infographics can be designed in more than one types but static and animated types are the most frequently used. Whether the two types mentioned are equally effective in achieving a learning outcome, is still a subject of research. Studies that have compared static and animated infographics give different findings, preventing a secure conclusion for both of them. In addition to the above infographics have been used as visual rhetorical figures for creating meaning that persuade and lead to conclusions, perceptions, and emotions that could, in some cases, have a behavioral impact.

The prementioned use of infographics as a means of knowledge transfer has been widely used in recent years in the transmission of information to social groups that may have little or no familiarity with the innovation of ICT and the processing of complex technological advancements. Technological developments and achievements such as Smart Cities, 5G, Internet of Things, Cloud Computing, Blockchain, Artificial Intelligence, etc. will change our lives drastically soon. For that reason, organizations, companies and research centers are trying to communicate the imminent changes with citizens - potential consumers - and to inform them of the upcoming digital transition that many describe as the 4th Industrial Revolution, in a simple and brief way. This paper seeks to identify both the positive effects of infographics and the dangers of such simplification and homogenization through paradigms, especially regarding the cultural characteristics of different sites and communities.

Keywords:

Graphic Design, Information Design, Infographics, ICT Technologies, Digital Culture

1. Introduction

Our everyday life is the challenge of exploring and processing information with our senses. Visual information is a dominant way to comprehend and interact with people and the environment as it provides immediate access to already stored images and knowledge that could affect our behaviour, emotions, and perception. From an early stage of growth, humans learn to interpret the visual signs and give them a meaning according to the cultural context they live in. We may say that we are obliged to learn the visual language as it is used in every aspect of our lives.

During the last decades, the vast growth of mass media and the spread of information of any kind through the internet and new technologies, the challenge of consuming a large amount of data, has been proved of great importance. It is a well-known fact that scientific,

technological and financial information is enough complex and inaccessible for its audience so it can only be communicated through imagery. In addition to that visual communication is appropriate for a multilingual and global population. From road signage to data visualization, infographics have issued the most common example of the visual multilingualism. Acquiring low mental storage capacity and processes, they promote quick perception and understanding so they facilitate the communication process.

For that reason, the use of infographics as a means of knowledge transfer has been widely used in recent years in the transmission of information to social groups that may have little or no familiarity with the innovation of Information and Communication Technologies (ICT) and the processing of complex technological advancements. However, the simplification of the information provided by infographics sets a great risk of eliminating the diversity of cultural characteristics of different places or social groups. Especially as far as it concerns cultural heritage, tangible or intangible, infographics unify the physiognomy of sites, promoting certain lifestyles and stereotypes of the image of the cities.

The remainder of the paper is organized as follows: Section 2 describes the use of infographics throughout history, section 3 discusses the function of infographics and section 4 refers to the digital transition explained through infographics. Subsequently, section 5 presents the risk of simplification of infographics and finally section 6 concludes the paper.

2. The use of infographics throughout history

Infographics, as it is indicated by the word, is a short term of information graphics and the process of developing and publishing infographics is called data visualization, information design, or information architecture. Images combining data with design facilitate the communication of messages to an audience in an intuitive manner (Smiciklas 2012).

They are noiseless illustrated presentations combined with verbal information to evoke certain messages. The reduction of detailed design objects by using strong shapes and distinct colours leads to recognition by retaining the most important feature and information. This benefit of infographic use is based on perceptual processes that take place in an early stage of perceptual operations. A perceptual process is “preattentive” as it doesn’t operate under the attention’s hierarchy which is the case in cognitive processes. In perceptual processes data are organized directly regardless of the reader’s goals, content knowledge or characteristics.

The use of infographics is not a recent solution to communication issues. We are aware that humans have been communicating through imagery since the very beginning of their appearance as organized communities. Utilization of graphics depictions to represent information is constant either as primitive cave paintings or as data visualization of the modern era (Smiciklas 2012). The most distinct example of early infographic use comes from the Victorian Era. It was created by Florence Nightingale presenting diagrams for the causes of mortality of the British Army during the Crimean War. Its graphical representation of time and quantitative qualities, the meaningful use of colour and form along with its contemporary aesthetic, introduces its historical importance for infographic design.

Since the beginning of the 20th century, in conjunction with the rise of mass media, infographics were populated on editorial use, as detailed illustrations and later on less iconic with attention to clear and strong forms of expression. The importance of infographics in the way our societies communicate and exchange information has been a research issue for more than one discipline.

3. The function of infographics

By using infographics, we should be aware that their elements are understood. These elements could be regarded as iconic forms deriving a property that is called computational efficiency by cognitive theorists. Computational efficiency refers to the reduction of all cognitive processes to achieve accurate interpretation. All iconic forms incorporate this quality of instant and memorable meaning-making. Comparing silhouette that communicates and memorizes its meaning only by shape, iconic forms come to that point through efficient use of shape as well as lines and colours. In case that iconic form is a recognizable symbol, it must be learned and used in a certain cultural context (Malamed 2009). Road and map signage are typical examples. Despite the fact that reading a phrase or a text paragraph is a brief and direct way to activate meaning, images attain meaning-making in a fraction of a second. This instant and efficient activation enables images to convey certain kinds of information (Ware 2008).

The perceptual association is accomplished through the activity of two sorts of preattentive processes. First are those that empower the separation of one image from another in the same graph and second those that define symbol groups (Winn 1993). In that early level of the perceptual process, readers distinguish geometric shapes, texture, and colour and supply them with meaning utilizing primary knowledge. Graphic designs delineate via contour or region are utilized in abstract ways to express the structure of ideas. (Ware 2008). From the huge amount of data inserting into the brain from the senses only a small amount gets into the consciousness because the processes that filter the important information is taking place quite far before they are converted into memories and primary knowledge. Things that pop out from the environment they are placed, are effectively perceived by the brain; consequently, strong visuals have the ability to obtain the reader's attention. The way the brain interprets visual information relies upon a variety of factors. Still, there are certain conditions where it automatically jumps to conclusions and fills in missing data (Lievemaa 2017).

As already mentioned above, the use of infographics is a tool for communicating complex data and information. By creating them visually accessible they convert data into compelling and engaging information for people's attention. Research findings conclude that colour visuals increase willingness to read by 80%. In addition, visuals introduce the information form and statistics only by an eye glance, a useful quality for time pressure and instant decision-making situations (Lonsdale and Lonsdale 2019).

Visualizations fill out our perceptual and information-processing systems due to the fact that we have the skills to detect and identify patterns. We intuitively comprehend spatial metaphors, and we process information most effectively as long as it is well structured and organized (Malamed 2009). Information visualization is not referring only to the use of illustrations and visuals but also textual elements that explain those visuals. Effective visualization derives benefits when both modes collaborate for resulting in the creation of infographics where function meets aesthetic. From a technical point of view, visualization promotes information communication by communicating key aspects of complex content and data by representing large numbers of data and reports in a clear comprehensive way (Lonsdale and Lonsdale 2019).

Infographics can be designed in more than one types but static and animated types are the most frequently used. We see static infographics in printed publications like newspapers and magazines but also on digital applications like websites, on screens as digital presentations without integrating any motion, or animated elements.

Animated infographics refer to the graphics displayed animated videos, on screens, websites such, TV ads or animation displayed on smartphones. Objects and data of animated

infographics are in continuous movement which is described by its creative movement choices (Afify n.d.). Detecting motion is one of the most distinctive human ability therefor animated images surpass comparing to static ones. Human's sensitivity to static elements instantly moves away from the central fovea. Contrary, sensitivity to motion falls off less, so we can see any movement even with the corner of the eye, despite shape recognition (Ware 2008). As a result, animated infographics have an enhanced role in evoking meaning and messages. Whether the viewer can visually imagine a text content or not, still infographics facilitate forming the idea and animation infographics enhance realization (Lievemaa 2017). Infographics are outlined and explained by some authors as a witness of culture development. From word-based information to visual culture (Yanyan 2010). As our skill to gather, store and manage data increases rapidly and our ability to comprehend it remains stable, information visualization compile concepts from computer science, graphic design and data mining. Each of these concepts solves specific issues of a problem (Lengler and Moere 2009). Infographics, like all images, have been used as visual rhetorical figures for creating meaning that persuade and lead to conclusions, perceptions, and emotions that could, in some cases, have a behavioral impact. As they are used in a wide range of contents and a variety of contexts, usually communicating scientific measurements and research results to the public, they also provide specific conclusions that lead to certain perceptions. The rhetorical nature of communication design permits both designers and viewers to co-construct meaning actively through visual messages (Tanyoung and DiSalvo 2010). In cases where animated infographics are used to convey new concepts in a promotional way, they acquire common features and qualities with advertisements.

Like common ads, with infographics, we make correlations between objects, their features and real-world elements that have a notable implication for the concept of iconicity. The iconicity of images makes it possible for ads and animated infographics that operate as ads, to distract attention and emotions by simulating various significant features of our real-world visual experiences (Messaris 1997). As we collectively pay attention to specific information and images it is likely to convert it to knowledge component, stored in long term memory and withdraw it when is needed. Considering this aspect of infographics, we come up with the conclusion that they could have a perceptual and behavioral impact on the audience.

4. The digital transition explained through infographics

As it is already mentioned, the use of infographics as a means of digital storytelling has the potential to put complex information into easily digestible and understandable concepts and make audiences want to learn. As far as it concerns animated infographics, they serve to combine the aesthetic sensitivity of artistic values (storyboard, music, design etc.) with the quantitative precision of numerical data in a format that is both understandable and dramatic (Antonova 2016). Scientific and technical information can be complex and sometimes out of intellectual reach of lay audiences. The use of animation in the transfer of complex STEM (Science, Technology, Engineering and Mathematics) information is not something new (Hill and Grinnell 2014). In 1923, the Fleischer Studios, best known for their Betty Boop cartoons, produced a 20minute silent black and white animated film in order to explain Albert Einstein's Theory of Relativity (Pratley 1996). Though it is almost a hundred years old project, its simple but ingenious animation is very effective in demystifying Einstein's theory, without the need of advanced physics or mathematics.

Nowadays, the use of infographics as a means of knowledge transfer has been widely used in the transmission of information to social groups that may have little or no familiarity with

the innovation of ICT (Information and Communication Technology), raising new digital literacy challenges (Osteman et al. 2013).

However, the upcoming digital transition that many describe as the 4th Industrial Revolution will cause a numerous of technical, economic, social and cultural rearrangements. Changes will be immediate and will affect housing (smart homes, smart networks), transport (autonomous driving, unmanned aerial systems - drones), communications, services, legislation and the perception of public and private premises and goods in general. It is enough to reflect on the impact of the discovery of electricity during the 18th century to envision the large-scale changes that technological developments such as Smart Cities, 5G Networks, Internet of Things, Cloud Computing, Blockchain, Artificial Intelligence, etc. will bring to our everyday lives.

Organizations such as the European Union (EU), International Telecommunication Union (ITU), the United Nations (UN), companies and research centres, are trying to communicate the imminent changes with citizens - potential consumers (Siricharoen 2013) - and to inform them of the upcoming digital transition in a simple and brief way. Scientists and technical professionals must speak to highly diversified audiences, from non or semi-professional people as well as to their scientific colleagues. For that reason, highly technical information must be conveyed into "digestible" concepts (Hill and Grinnell 2014). Further, with the globalization of science and technology, IT professionals must communicate across different cultural and language environments as well. Communicating to audiences who do not share the same culture is a demanding task, especially when the information to be conveyed is new or difficult to understand (David and Glore 2010; Mocek 2012; Metros 2008).

In the prementioned fields of technologies, infographics are increasingly helpful to move people to the point of understanding what is innovative and how the advances of ICT are used to improve people's real lives.



EU #5G Action Plus (Source: <https://ec.europa.eu/digital-single-market/en/news/have-your-say-coordinated-introduction-5g-networks-europe>)

5. The risk of simplification of infographics

It is proven that the expansion of Information and Communication Technologies (ICT) can transform everyday life and services, enabling people to upgrade the quality of their city and

working environment, dealing, in the same time, with questions of how major technology companies are about to bring changes to our society, our privacy, and democracy.

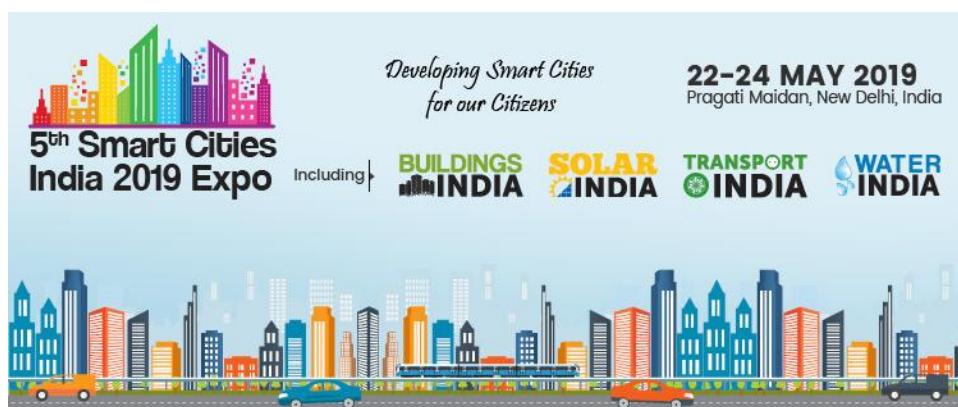
The changes by the adoption of new technologies in the lives of citizens that will happen either consensually or will be imposed will have both positive and negative consequences. The shifting of powers to the benefit of large companies and the mechanisms that control the collection of data, requires constant social engagement, information, and participation.

At the same time, technology changes city infrastructure, without considering, in some cases, the cultural characteristics of different sites and communities and their cultural heritage, both tangible and intangible. For example, the advent of the Smart City, as an idea and as a set of practices that can be implemented, runs the risk of influencing the physiognomy of urban landscapes (e.g. the vertical development of skyscrapers in order to limit the spreading of the urban area due to the increasing density of the population) (Siountri and Vergados 2018).

In that case, the simplification of information of infographics about the offered new products, services and innovative technologies may reduce the resistance and the perceptiveness of the audiences of the upcoming dangers or even violation of their basic human rights. Therefore, they may include hidden risks or dangers, despite its fruitful educative effect. While infographics acquire common features and qualities with advertisements, they are likely to promote more directly a certain perspective of the “ideal imagery” of the city whether it is a true one or not.

Especially, the Smart City model, as shown in the majority of infographics in social networks, corporate and company advertising campaigns, and researcher presentations, appears as a hybrid environment that can grow with the same success, either we are talking about Arizona in the USA, either Shanghai in China or Trikala in Greece. Images of skyscrapers, highways, big antennas, fast trains, and airplanes are not defining the “smart” policy of a city; however, most infographics are using repeatedly the same components. Even the colour palette (based on blue) is in most cases the same.

In India, for example, the campaign of National Ministry of Urban Development for the Mission of the 100 Smart Cities in order to promote cities that provide basic infrastructure and a decent quality of life for their citizens uses infographics that present the sites of intervention as typical “western” environments¹.



The 5th Smart Cities 2019 Expo (Source: <http://www.trade4india.com/SmartCities>)

However, the fact that cultural heritage must be preserved and protected in any context of Smart Cities is not negotiable. Infographic designers, not only should create an informational tool but should also be aware of the cultural and heritage awakening societies should have to

¹ https://www.youtube.com/watch?v=8ASC3kqBU_8

preserve and protect their identity. A city needs an appreciation of its past before moving to a "digital" future. Especially, when even the slightest cultural element can be crucial for the preservation of the physiognomy of a place, like the image of the blossomed trees in a neighbourhood.

The paradigm of smart cities indicates some issues that require urgent and full attention from decision-makers, policymakers, graphic designers, urban planners, IT stakeholders, etc. in order to avoid the "homogenization" of the represented images and preserve the diversity of our cultural and natural environment.

6. Conclusions

Infographics, more than ever before, have become an important element of communicating science. They can explain experiments, communicate findings and promote retention and reuse of knowledge and if they are appropriately presented, infographics can be highly effective educational tools expanding the value of the message to a larger audience.

Nevertheless, infographics that are produced and presented with the help of technological means, apart from the positive effects, they may sometimes lead to negative results dealing with the misleading offered knowledge that opposes to diversity.

The professionals involved in infographic creation and presentation should work on a set of principles and parameters of preserving the diverseness (keeping up the discussion about the "the ethics"² of infographics) while at the same time they maintain the basic lines and components concerning the simplicity of information. But for the most part, infographics must highlight the actual data without promoting or enhancing technological products or services that may set in risk the integrity of our society and the physiognomy of our living and natural environment.

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² "An infographic is, by definition, a visual display of facts and data. Therefore, no infographic can be produced in the absence of reliable information.

No infographic should include elements that are not based on known facts and available information.

No infographic should be presented as being factual when it is fictional or based on unverified assumptions.

No infographic should be published without crediting its source(s) of information.

Information graphics professionals should refuse to produce any visual presentation that includes imaginary components designed to make it more "appealing" or "spectacular." Editors should refrain from asking for graphics that don't stick to available evidence.

Infographics are neither illustrations nor "art." Infographics are visual journalism and must be governed by the same ethical standards that apply to other areas of the profession." <http://occasionalplanet.org/2011/11/10/ethical-standards-for-infographics/>

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