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Paradigms of the impacts of ICT on culture and knowledge

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Abstract
Introduction. The social uses of the new information and communication technologies (ICT) are transforming culture and knowledge. This article discusses how scientific and academic literature interprets those changes and their consequences. **Method.** The research is based on the content analysis of a representative sample of relevant literary works. **Results.** The repertoire of cultural and cognitive effects attributed to ICT applications is described. The arguments contained in these descriptions are examined as units with system analysis methods. The study shows that such descriptions can be transferred to typologies, whose components and relations are represented in models. **Conclusions.** These models explain how scientists configure the collective production of knowledge about the cultural and cognitive effects of ICT. The study confirmed that these representation models reflect certain paradigms of the communication sciences.

Keywords
Content analysis; knowledge; culture; communication paradigms; ICT.

Contents

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1. Introduction

It is widely accepted that the incorporation of new information and communication technologies (ICT) is part of an on-going scientific-technological revolution. It is assumed that this incorporation will have socio-historical effects, i.e. consequences derived from the use of such technologies, which can transform societies and our existence in an irreversible way. This issue was, is and will probably remain an object of study for the social and human sciences. In fact, we have found that in the scientific literature there are abundant references to what such effects may be.

Based on the review of this type of scientific publications, this article offers a systematic study of how the historical changes related to the use of ICT are conceived in the scientific literature. This type of studies has been carried out during previous scientific and technological revolutions and is considered as necessary for the renewal of knowledge **[1]**. However, the current revolution has yet to be the object of a similar study. Based on the previous panorama, the "Social Identities and Communication" research group of the Complutense University of Madrid (UCM), with funding from Spain's National R&D programme, has conducted a content analysis of a sample of scientific and academic works, which provided the data needed to carry out this review. The collected data were processed in order to understand the scientific interpretations of the cultural and cognitive transformations that may have socio-historical effects and are related to the social applications of ICT.

***The specific objectives of this research are:**
- To identify in scientific and academic publications references to the social uses of ICT that mobilise cultural and cognitive dynamics.
- To calculate the importance granted to those cultural and cognitive dynamics in the on-going historical changes produced by the social applications of ICT.
- To show how such transformations are represented, based on a system-based analysis of their arguments.
- To verify whether those representations share characteristics that allow us to create typologies or categories.
- To prove whether scientists and academics apply paradigms that can be represented in models, in order to be able to produce the corresponding representations and models of the cultural and cognitive effects of ICT applications.
- To identify these models and verify whether they are related to the paradigms that are or have been in use in the social and human sciences.

***These are the objectives that guide this research, which is designed to make the following contributions:**

- To produce models and obtain results that position in an epistemological level the debates about the functions and dysfunctions generated by the applications of new technologies. If a metaphor is allowed here, one objective is to analyse "trees" in order to "show" the way "the forest" is configured.

- To offer an analysis of the history of ideas. Specifically, the references currently used to understand and anticipate the role of ICT in the transformation of knowledge and culture. This is in order to

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contribute to resuming the link between scientific heritage and the contributions of contemporary authors.

This research study gives continuity to other research works that analyse these historical changes from the perspective of the social uses of print, audiovisual, and digital technologies **[2]**. The following quotations reveal the social projection of the research studies on the social uses of technology. These quotations come from the works of Martín Serrano, which constitute the main reference for this study:

> "Since the beginning of the scientific-technological revolutions, the political struggles also took place in the field of the social applications of technologies. Once again, the question is whether the social use of knowledge and technology will be based on humanist or instrumental criteria" (Martín-Serrano, 2014a: 20).

> "Now that "globalisation" is in its early stage, it is important to examine the transcendence that the applications of communication/information resources may have. (...) The current ICT applications will determine the existence of future generations" (Martín-Serrano, 2014b).

These objectives determined the approaches from which it is necessary to depart and the hypotheses to be tested. These hypotheses are presented below, along with the evidence and arguments they are based on:

1.1. Previous approaches and research hypotheses

***Previous approaches**

The study takes into account two approaches that can be easily verified through the direct observation of the use of technology:

1) ICT innovations enable a diversity of social applications. Some of them affect culture and/or knowledge.

In principle, the benefits of ICT make it possible to carry out new cultural practices. For example, the internet gives people access to user-generated contents and tools that can be used and altered. But, this benefit can be applied according to different and even opposing criteria. There are applications that condition the development, access and use of these resources, the preservation of property or copy rights; and alternatively, there are applications that bet on free access for all people.

A similar analysis can be applied in the realm of knowledge. For instance: these technologies make it possible to show what is happening, to recreate it and to introduce non-existent events. These technologies allow the production of stories based on objective or manipulated referents.

2) Some applications of ICT mobilise cultural and cognitive dynamics. Some of them can generate socio-historical changes.

A "dynamic" is a modification that might occur in opposite directions. Examples:

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- The social uses of social networks, like sharing information, can lead cultures towards homogenisation or diversification.

- The cognitive abilities needed to organise information can be developed or reduced, according to the use people make of the internet's search engines and hypertext.

- These dynamics can produce irreversible cultural and cognitive transformations. When this happens, we can say that socio-historical changes are taking place.

Examples: The gradual digitisation of cultural contents created in physical formats or platforms is irreversible. And so it is the convergence in digital networks of news created by private and institutional agents.

***Hypotheses**

1st hypothesis: In scientific and scholarly publications, cultural and cognitive dynamics have to be an important part of all the references made to the social uses of ICT that are capable of generating socio-historical changes.

To assess the importance granted to these dynamics in this kind of publications, the texts that describe how the applications of ICT contribute to social and historical changes must be analysed. These publications (hereafter, "the sources") constitute the universe of reference from which the samples that will form the body of this research will be selected (see the methods section).

2nd hypothesis: The references to the social applications of ICT that mobilise cultural and cognitive dynamics are narratives that contain representations that can be identified by means of content analysis techniques. The methods section describes these techniques and the way they were used in this study.

3rd hypothesis: The production of these representations included in scientific literature on the relationship between ICT and cultural and cognitive transformations responds to certain guidelines. Therefore, it is expected that they can be classified into a reduced number of categories, that these categories will be related to each other, and that they will be susceptible to be analysed as systems.

As part of the study we have examined the chain of "citations", and confirmed that the authors of these texts often refer to other authors who provide them with the most widely-accepted contextual data and references. The generalised use of a limited number of "authors" substantiates the hypothesis that the issues and approaches that constitute this scientific and academic production probably share certain features. This hypothesis was tested by means of content analysis.

Because there are similarities, it will be possible to classify in categories the repertoire of representations included in the sample of literary works. We expect to identify few typologies; and that in the case that they are related, they will be part of representation systems. Both hypotheses were tested by means of system analysis.

4th hypothesis: The systems of representation of the links between technologies, culture and knowledge in the globalisation era will likely correspond with some of the paradigms underlying the social and human sciences.

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The hypothesis is based on a principle proposed by Kuhn (1962): the production of knowledge in every scientific and technological revolution is organised based on certain paradigms. The representation systems have been transferred to models that allow us to determine whether they respond to certain paradigms.

2. Method

The detailed description of the methods used in this study is the subject of another publication (Bernete & Velarde, 2014). This section will briefly describe: 1) the universe of representations from which the samples of material about culture and knowledge was selected; 2) the content analysis technique; 3) the selection of sources and samples; and 4) the features of the units of analysis.

1) The universe of representations from which the samples of material about culture and knowledge was selected

The framework of reference is constituted by all the socio-historical changes that are attributed to the social applications of ICT in scientific and academic publications. It is in this broader area where representations of the transformations of culture and knowledge acquire their relevance. Therefore, the samples come from this universe. With it, this research study gives continuity to the studies on the impact of innovations in social change carried out since the beginning of the industrialisation age.

2) The content analysis technique

The views on the effects of ICT applications included in the sources are narratives. A transcription technique was used to give these narratives the format of sentences, which contain arguments and statements, according to a logical structure. The descriptions of the effects of ICT applications acquire the form of arguments **[3]**. The content analysis focus on the study of the repertoire of arguments used to justify the effects attributed to ICT applications.

3) The selection of sources and samples

The influence of ICT in social changes is a theme frequently addressed in public communication, and also in our sources. In this study we had to select only:

- Texts that describe ICT applications that can provoke socio-historical changes.

- Different descriptions. The objective is to identify the variety, not the amount of references.

These criteria were applied in the selection of sources and samples:

The first step was to use the literature search engine of the Complutense de Madrid to locate recent publications that included a "state of the art review". These publications referred to others, so the selection of sources use a "snowball" technique **[4]**. Valid references were transcribed as sentences and inserted into a database designed to recognise whether a sentence was different or similar with respect to the existing ones **[5]**. This procedure was repeated each time new references were

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found. In fact, redundancy increased exponentially. When the search was completed, the probability of finding another new reference was 2.2%, with a confidence level of 95.5%. Therefore, the sample is adequate and reliable. At that time, the amount of analysed sources were 70 books, 10 book chapters and 33 journal articles, which provided 2,185 valid and different sentences.

4) Features of the units of analysis

The repertoire of sentences, which constitute the units of analysis, have the same narrative structure and refer to the same components. Namely:

[A certain social use of ICT, sets in motion a certain dynamic, which is likely to generate certain socio-historical effect]

This content analysis technique provides units that are representations (and not mere groups of words). The meaning of the representations is expressed in the arguments. These units can be classified in different types, according to their contents (without resorting to categorisations based on components unrelated to the body of research).

These features have allowed us to carry out system analyses, which is method used since the emergence of the first studies on the social production of communication. These methods are descry-bed in Martín-Serrano's 1982 work, which can be downloaded from http://eprints.ucm.es/14039.

3. Results

The findings described below respond to each of the research hypotheses. For this reason, they are described in four sections.

3.1. Results related to the first hypothesis

In the scientific and academic publications a significant proportion of the references to the social uses of ICT that generate socio-historical changes refer to cultural and cognitive dynamics. To be precise: one in five references.

A total of 2,185 different sentences that describe the dynamics that have socio-historical effects were extracted from the sources. The areas in which these transformations occur are, in order of frequency, the following: the socio-economic and political fields; the realms of culture and knowledge; everyday life and interpersonal relationships; the educational fields; the scientific fields. The distribution of the total number of transformations mentioned in the references is shown in table 1, whose added value is its novelty, since we have not identified any study with distributions of content that are based on these exact or equivalent criteria.

Table 1 shows that scientists and academics continue addressing the cultural and cognitive dimensions of the scientific revolutions. They represent 20.7% of all the sentences. One of every eight refers to culture (n=271) and one of every twelve refers to knowledge (n=180).

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Table 1. Areas affected by the social uses of ICT, according to scientific and academic publications

Base: Total of sentences referring to the socio-historical effects attributed to ICT uses

Areas affected by the social uses of ICT	BASES	
	N	%
(1) Socio-economic and political areas		
Economic	487	22,3
Political	433	19,8
Labour	111	5,0
Administrative	65	3,0
subtotal	*1096*	*50,1*
(2) Cognitive and cultural areas		
Cultural	271	12,4
Cognitive	180	8,3
subtotal	*451*	*20,7*
(3) Educational area		
Educational	*140*	*6,5*
(4) Scientific area		
Scientific	*99*	*4,5*
(5) Everyday life areas		
Existential	265	12,1
Relational	133	6,1
subtotal	*399*	*18,2*
Base (in each row):	***2185***	***100***

Source: Authors' own creation.

3.2. Results related to the second hypothesis

The cultural and cognitive dynamics are described with sentences that propose different and conflicting effects, of the same ICT applications. They were identified by means of content analysis techniques and are presented below.

It is important to make the following observations: this section describes the interpretations of transformations, which may or not coincide with real changes, but which, in any case, have been proposed by the authors of the analysed texts. For the sake of succinctness, we do not remark that they are not our interpretations each time we describe them. We present them in an organised manner, according to the cultural and cognitive dynamics that apply to them; without altering the

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arguments and, when possible, using the same terms. Sometimes these arguments are estimations, but we do not assess any argument.

In summary, the section offers a description of the arguments contained in each of the cultural and cognitive dynamics. This description shows the alternatives –and sometimes contradictions– that accompany the production of knowledge.

Finally, with regards to the bibliographical selection presented in this section and in the references section, it is necessary to note that in this article no author has been excluded but it was impossible to mention all of them. As in this study is interested in identifying the original sources, we have given preference to the oldest references.

3.2.1. ICT applications that mobilise cultural dynamics

***Dynamics at the level of conformation and state of cultural systems**

This type of dynamics appear in one out of three references. The effects mentioned have to do, directly or indirectly, with the use that is made of three benefits of ICT:

A) Social access to information and knowledge.
B) Comprehension of cultural contents.
C) User participation in the creation, documentation and transmission of information and knowledge.

A) ICT facilitate both connection and disconnection with the culture of origin (García, Beltran & Núñez, 2010). For instance, immigrants can retain religious, linguistic, and cultural connections by using the internet (Barranquero & González, 2006). The disconnection occurs when "mini-cultures" with no particular geographical ascription emerge. Youth subcultures are mentioned in this case (Solé, 2006). "A planetary conscience", which transcends identities, emerges (Brzezinski, 1979).

Other sentences contend that the Internet opens societies to foreign cultural perceptions and habits (Hadj-Moussa, 2006). In consequence, the cultures that exist in certain populations multiply. Multicultural exchange increases cultural diversity (Lull, 1997) and creates social capital (White, 1995). A dialectic of cultural flows and re-flows between open communities can enable human development (Chaparro, 2004). This opening makes people to re-evaluate their own culture because it establishes the basis for "cultural resistance" (Gerace, 2008). In indigenous communities the internet generates political empowerment, which will ensure its survival (Gurstein, 2005).

But most of the sentences considered that this multicultural exchange is unbalanced. The increase in information flow comes, overwhelmingly, from the dominant cultures, which influence or replace local cultures (Dissanayake, 2006). Therefore, the incorporation of dependant societies to web-based networks involves transculturation. Multinational industries produce programmes to be broadcast internationally, without translation into the local language; even without spoken language. These audiovisual stories focus on action with no justification or argument (Martín-Serrano, 2004). Vernacular languages are subordinated or disappear; also in scientific and artistic materials. In

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this way, the cultural gap that marginalises the poorest societies deepens (Pathania-Jain, 2006). Multicultural exchange can consummate a widespread and irreversible collapse of the cultural diversity of peoples (Sreberny-Mohammadi, 1997).

The internet enables the creation and circulation of cultural contents in social networks. Such interpersonal exchanges also are analysed from the perspective of cultural homogenisation. They are examined because they are horizontal and participatory (Gerace, 2008). They expand the available choices for culture consumers (Garnham, 2000) and provide an outlet for independent artists (Suhr, 2009). On the other hand, they take into account peer pressure, which favours uniformity of thought (Pineda, 2002).

B) Audiovisual technologies allow the understanding of cultural contents to groups of people that were excluded from communication flows. It is argued that the audiovisual screens were what started media and digital literacy (Lessig, 2005). This achievement is associated with the emergence of index communication, which uses images that are taken from objects of reference and are disseminated in synchrony. Online access enables the 'virtual presence' of the internet user in the place and the time of the events. For instance, internet users can "visit" museums without leaving their home (Joyanes, 1997).

Four verification criteria were identified in relation to these referential images: 1) when non-manipulated images of what is being narrated are shown, there is no need to include reputation-based judgements, whose credibility depends on the mediator's reputation. 2) However, the possibility of creating "virtual reality" re-establishes the need for reputation-based judgements (Martín-Serrano, 2004). 3). Virtual technologies develop a new "multimedia aestheticism" when they produce "synthesis images" (which combines real and computer-generated images) (Quéau, 1995). 4). "Virtual reality" facilitates escapism towards worlds and situations unrelated to everyday experiences; it is a form of escapism from the poorly rewarding real-world (Burch, León & Tamayo, 1995).

It is argued that the integration of texts, images and sounds in a single system across a global network transforms culture (Castells, 1996). Two consequences are mentioned: an increase in the number of writers, promoted by the reduction of production and distribution costs (Joyanes, 1997); and the disappearance of the printed book, and its evolution into the digital text. Martín-Barbero (1996) concludes that the book will be dethroned as the oracle of knowledge.

C) ICT enable users to participate in the production of information, and the dissemination and conservation of knowledge. It is remarked that these functions were reserved to professionals, who were at the centre of specialised organisations. The analysis of the cultural consequences of the openness of the creative process reproduces the controversies over "high culture/popular culture", "elite culture/mass culture". Assessments about this issue have an equivalent frequency:

-The arguments in favour are:

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> [Web-based] Networks put an end to the cultural transmission monopoly exercised by the *intelligentsia*. There are repeated references to the disappearance of the frontiers between author and reader (Joyanes, 1997).
>
> Mass culture provides raw materials that are used to create new cultural forms. The presence in the internet of "interstitial cultures" are mentioned and their creativity is highlighted, assuming trends and products of the popular culture, for instance, among young people (Solé, 2006).

- The arguments against it are:

> "Mass" is not the same as "popular". In fact, mass production mystifies popular culture. The internet is flooded with redundant, banal and stereotyped contents to the detriment of innovative cultural offerings (Cavallo, 2005). Digital resources to prepare and present materials are also oriented towards stereotyping. For instance, *PowerPoint* (Jiménez, 2000).
>
> Mass reproduction and its massive distribution dilute the "aura" of the artwork. This is an idea proposed by Benjamin (2010).

It is believed that the safeguarding of cultural contents in institutional archives is expanded by conservation in individual archives. The following consequences are identified: the period of 'amnesic culture' that dominated during the era of television could end (Ignatieff, 1989); they provide a future for our past (Lessig, 2005).

***Dynamics at the level of cultural practices**

This type of dynamics appear in (approximately) one out of three references. Most of them have to do with the use of ICT by multinational corporations. The intersection on the internet of the political and economic powers is addressed from various perspectives. The convergence of the control of cultural production and the control of the communication infrastructure and services is mentioned. Such controls subject culture to the logic of the business assessment (Mattelart, 2002); young artists are excluded (Sierra, 2004); while the "artistic sectors" that cannot cope with costs are extinguished (Mora, 2006).

It is argued that independent and commercial cultural productions are integrated in the internet. However, "media conglomerates" centralise the production and distribution of cultural works, at the market scale. Access to truly independent contents becomes limited. The generalisation of the criterion of economic usefulness to the digital realm creates an uncritical and trivial culture model (Muñoz, 2005). The cultural creation has limited possibilities to stimulate the discussion of ideas (McChesney, 1998). Boundaries between free and controlled culture are erased. These corporations do not produce free culture, but a culture of permission (Lessig, 2005).

Internet opens up all the markets for the distribution of cultural and artistic products. This makes customs and national cultural policies inefficient (García-Canclini, 1999). The cultural consequences are interpreted in different ways:

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- Eight out of ten sentences relate these changes to transculturation. This is described as "distance cultural expropriation", which laminates cultural diversity (Blondeau, 2004). Transculturation is integrated with commercial penetration. The identification of these policies, in the 1970s, with "cultural imperialism" is recalled. This dominance was based, at the time, on the technological superiority and the quasi-monopoly penetration of multinational communicative products. Schiller's analysis (1995) is taken up.

- The opposite and minority point of view is: the internet enables the emergence of forms of resistance to transculturation. References are made to "participative communication", "social networks" and other direct forms of cultural exchange. The concept of "national communication policies", which faces a difficult situation in Latin America, is used again. For instance, it is considered that these alternative channels allow "people" to identify foreign propaganda (Lessig, 2005).

***Dynamics at the level of conceptions of culture**

This type of dynamics appear in (approximately) one out of three references. Most references analyse macro-sociological effects. It is argued that the incorporation of ICT accompanies the transformation of post-industrial capitalism in financial terms. They can be differentiated depending on whether their emphasis is on production or cultural consumption:

- It is argued that the production of cultural goods for the internet takes into account their value in the market. They are designed by advertising for advertising. They promote narratives and imaginaries that correspond to American consumption models (Mora, 2006). The analysis offered by Critical Sociology is resumed (Adorno & Horkheimer, 1981). One author considers that this production for the market innovates languages and formats; it accommodates ingenuity and creativity (Cavallo, 2005).

- Products are sold online, according to rules that favour patents and copyrights (Webster, 1995). Long periods are expected for content to reach the public domain, even when they lack commercial value. Therefore, cultural and historical knowledge is destroyed or lost. For instance, old footage. However, the applications that allow free download of contents question once again the technical and legal limits that can be set to the open access on the internet. It is argued that legislation does not fit to the current technological context. It criminalises users and, nevertheless, it entails the "generalised violation" of rights (Lessig, 2005).

On the other hand, the right to share content is granted in the Internet. The term *Creative Commons* is mentioned. Free *software* introduces community development and cooperation models. Their referents are taken from the *Free Software Foundation*. The collaborative construction of knowledge is analysed: who participates and how (Bosch, 2008). The free movement of knowledge is assessed as "a political bet" (Rodríguez & Sánchez, 2004). It destabilises the Fordist values of capitalism (Blondeau, 2004). The enlightening utopia of a world in which knowledge would be a shared good is considered to be possible (Martín-Serrano, 2014a).

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In that same historical perspective, it is argued that the cultural uses of ICT transform the models of society. They contribute to overcoming the cultural segregation between classes (Martín-Barbero, 1998). In contrast, it is affirmed that the cultural uses of ICT, by themselves, will not have such effects (Wolton, 2000), i.e. that in reality they provide the erroneous idea of the elimination of the social classes, because they put a standardised culture at the disposal of all (Muñoz, 2005).

3.2.2. ICT applications that mobilise cognitive dynamics

***Dynamics at the level of cognitive formation and functioning**

This type of dynamics appear in two of every five references.

It is stated that "web-surfers", "often adrift", jump from some references to others. This dynamic disperses and de-structures reasoning processes. However, there is a more widely accepted criterion among the sources under analysis: the use of ICT develops people's cognitive processes, particularly the cognitive processes involved in the selection and organisation of information:

- Internet's search engines increase the sources and organise the search results according to pre-established criteria (Mora, 2006).

- Virtualisation. "Virtual reality" stimulates imagination and mental abstraction capabilities (Quéau, 1995).

- Digitisation. The management of programs and formalised languages reinforces the ability to systematise information (Vizer, 2011).

Virtualisation and digitisation stimulate the processing of new symbols and more complex levels of formal abstraction (Quéau, 1995). They develop individual intelligence and collective knowledge. De Kerckhove (1998) and Lévy (1994) are cited.

- Index languages (synchronous and iconic). Cognitive operations involved with the information derived from these languages are different from those applied in written languages. Synchronous data transfer requires more fluid and accelerated processes. It affects people's memory (Sierra, 2003). It is stated that images tend to connote multiple meanings. In order to show those differences, the authors take quotes from *La mediación social* (Martín-Serrano, 1977).

***Dynamics at the level of cognitive activities**

Approximately two out of five references focus on whether ICT contribute to freeing or controlling people's mind:

- They think that these technologies free the minds of those who assimilate "access to information", "knowledge exchange" with the development of a critical capacity. For instance, the use of images facilitates the critical exercise of marginalised people (Gerace, 2008).

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- Other authors believe that such practices promote criticism, even hyper-criticism, but channel it towards pre-established objectives (Muñoz, 2005). They mention the avalanche of irrelevant information; the publicity that fragments narratives; the urgency of information. Such practices "stun" critical consciousness. Standardised messages "weaken minds" (Clemente, 2005). They hinder "the search for meaning". It is "anaesthetic" and numbs people towards social problems (Petrilli & Ponzio, 2000). The arguments of "the spiral of silence" are recalled (Noelle-Neumann, 1984).

***Dynamics at the level of beliefs**

One out of four references (approximately) addresses the influence of ICT in the construction of social representations. They promote objective interpretations of the environment (González, 2000). In the opposite direction: they contribute to homogenise people's own visions of the world with those that are considered as valid by the reference groups (Miguel, 1996).

ICT provide representations of "worlds" where you can supposedly live fantasies. For instance, *Second Life*. The "fulfilment" of unsatisfied desires in a fictional existence "splits people's personality" (Muñoz, 2005). That evasion is channelled, on consoles, towards forms of virtual violence (McHale, 1987).

3.3. Results related to the third hypothesis

The production of representations of the cultural and cognitive effects of ICT, by scientists and academics, reflect certain patterns. As a result, these representations are organised in a limited number of categories. In turn, these categories or types are part of systems.

The total number of references to the effects of ICT applications is very large. But this number includes the repetition of a relatively small number of different representations (271 of culture and 180 of knowledge). These are the representations that have been transcribed and constitute the units of analysis.

These units share components, although they are configured differently. As it is known, the groups composed of units with these features have an internal organisation. In this case:

- A repertoire of types of social applications of ICT shares a certain repertoire of cultural dynamics. Therefore, the group is organised.

- Another repertoire of types of social applications of ICT shares a certain repertoire of cognitive dynamics.

By having this organisation, it was possible to represent and analyse these groups as systems. Here it is important to recall some concepts of general knowledge:

Systems are sets of interrelated elements. These elements acquire features that derived from the positions they occupy in the system and from their links with other components. This results in

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another level of analysis: the analysis of the organisation and function of these sets. In this case, two sets of representations:

- of the dynamics of culture, related to ICT applications;

- of the dynamics of knowledge, related to ICT applications.

At this level of analysis, we can see how the production of knowledge is configured by scientists and academics involved in the explanation of these dynamics.

When the production of knowledge is configured, it is reasonable to think that the collective work of its authors is based on, explicit and implicit, rules that regulate the themes, sources, formats, on which the consideration of a text as scientific and its publication depends. In this case, the historicist concept of "organic intellectual" is applicable, when interpreted as the existence of a scientific-academic organisation that preserves and develops knowledge according to guidelines that serve as reference in each period time (Gramsci, 1984).

Systems can be represented with models that contain their components and relationships. The most common and simple graphical models are diagrams and tables, like the ones used here.

3.3.1. System of cultural dynamics obtained from the sources

Table 2, titled "Cultural dynamics related to ICT applications", shows that ICT applications can be differentiated in four types:

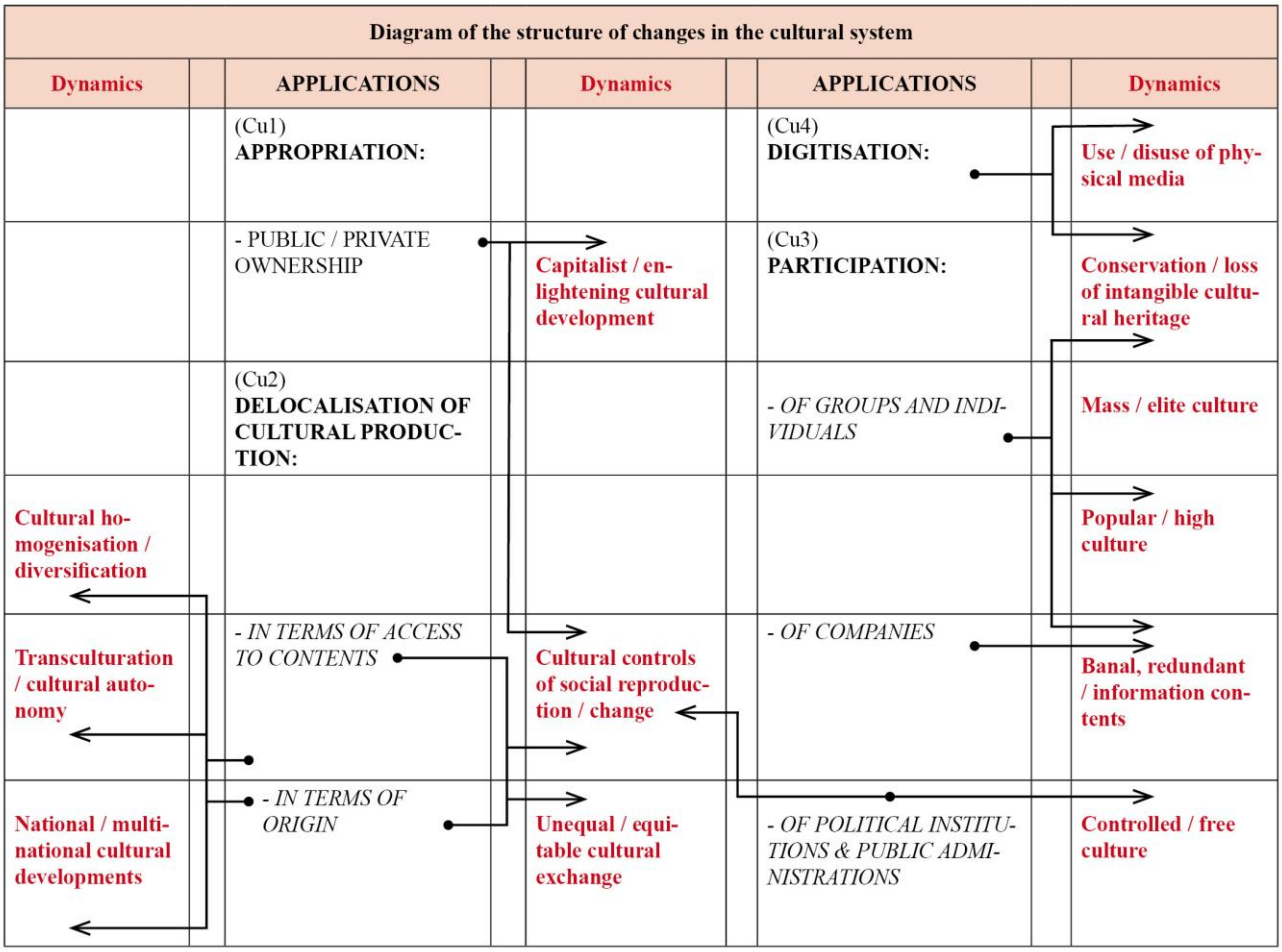
- Appropriation (Cu1). Applications related to the public or private ownership of cultural resources and products.

- Deterritorialisation (Cu2). Applications that facilitate access from any geographic location, to cultural contents originated in different areas.

- Participation (Cu3). Applications that enable the participation of different entities in the cultural production.

- Digitalisation (Cu4). Applications that enable the digitisation of contents from non-digital platforms.

Table 2. Cultural dynamics related to ICT applications



Source: Authors' own creation.

The four typologies are, in turn, structures. Each is composed of relations between a set of ICT applications and a repertoire of cultural dynamics. They are described and transcribed in the corresponding Tables.

(Cu1) Dynamics related to the appropriation of the digital networks' cultural resources and products

There is coexistence, and to some extent also competition, between the applications that protect the private domain, including *copyright*; and others that promote the public domain, such as free *software*. There are two contrasting models of cultural appropriation: the dominant model in capitalist societies, which regulates the right to use of cultural resources and products according to the criteria of the market economy; and the enlightening model, in its infancy, which links human and social development with shared access to knowledge since the age of enlightenment. Ultimately, the dynamics related to the reproduction of social formations come into play.

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Studies of the political economy of communication, which were at their peak during the 1960s, are revitalised around these dynamics.

Table 3. (Cu1) Dynamics related to the appropriation of the digital networks' cultural resources and products

Competing actions of appropriation of culture and knowledge converge in the internet:	
PRIVATE DOMAIN APPROPRIATIONS,	PUBLIC DOMAIN APPROPRIATIONS,
oriented to protect private production and intellectual property (copyright...)	oriented to establish collective production, free access and use of cultural goods (free software, Creative Commons...)
These actions evaluate cultural resources and products according to different criteria:	
On the basis of its economic value in the development of the market economy	On the basis of its value in the human and social development
Reproduce the capitalist model of cultural appropriation	Introduce the model of cultural appropriation imagined by the Enlightenment
There are cultural controls that guide, in conflicting ways, the dynamic of social reproduction / change	

Source: Authors' own creation.

(Cu2) Dynamics related to the deterritorialisation of the cultural production, in terms of its origin and access

They derive from the internet's capacity to reconfigure the territories in which information is exchanged, overcoming physical and geopolitical barriers. The social applications of these technologies activate dynamics related to the preservation of the cultural heritage of humanity.

The deterritorialisation of cultural production opens communities to multiple influences. Communities can revitalise the native production, integrate themselves into it or exhaust it. ICT applications which, according to the sources, determine whether the cultural exchange is unequal or equitable are described. This will be reflected in the homogenisation/diversification of cultures. They are processes of transculturation that affect the reproduction or change of social formations.

This typology is linked to the analysis of "cultural imperialism" in vogue during the 1970s, mainly that of Schiller's.

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Table 4. (Cu2) Dynamics related to the deterritorialisation of cultural production, in terms of its origin and access

Global networks re-territorialise cultural exchanges, which allows:	
- the concurrence, in the cultural production, of entities located anywhere	- the access to content and cultural products coming from different areas, from any location
THEY DETERRITORIALISE THE ORIGIN OF THE CULTURAL PRODUCTION	*THEY DETERRITORIALISE ACCESS TO CULTURAL PRODUCTION*

- DETERRITORIALISATION OF CULTURAL PRODUCTION IN TERMS OF ACCESS		
Global networks put at the disposal of communities products and contents that respond to multiple cultural visions. Deterritorialisation can affect the indigenous production, with:		
Cultural fertilisation	Cultural hybridisation	Cultural sterilisation
Native cultural production is revitalised	Foreign trends are integrated into the indigenous culture	The creativity of the native culture dries up
Communities resist transculturation		Communities succumb to transculturation

- DETERRITORIALISATION OF CULTURAL PRODUCTION IN ITS ORIGIN		
Global networks break the separation between native cultural production:		
- in users' own areas of membership (local and community areas)	- in other areas of membership, which are alien to users (supra-community, supra-national areas)	
National cultural industries reduce their penetration and influence	Multinational industries increase their penetration and influence	
	in commerce	in culture
They succumb to transculturation	They reinforce cultural imperialism	

Reference is made to the following dynamics:

Unequal / equitable cultural exchange
Development of national / multinational cultures
Cultural transculturation / autonomy
Cultural diversification / homogenisation
Cultural control of social reproduction / change

Source: Authors' own creation.

(Cu3) Dynamics related to the participation of different entities in cultural production

In web-based networks there is a simultaneous convergence of individuals and groups of individuals; including organisations, political institutions and public administrations. Each entity gives priority to particular interests, responds to different models and, therefore, mobilises different cultural dynamics:

- The internet has given a "prosumer" status to citizens, who in the unidirectional communication/information media only had the status of "consumers". They generate knowledge

and cultural goods; share and preserve this intangible cultural heritage. These changes set in motion dynamics that affect contents and the value of cultural production as a whole. The comparison between mass and elite cultures and between popular and high cultures is resumed at the global level.

- It is believed that companies ultimately act to obtain benefits. Their cultural production derives from advertising or public relations models. In the internet, they offer more banal contents than informative contents.

- Political institutions and public administrations find in the networks another channel to reach or use power. They introduce rules and controls that keep the tension between controlled and free cultures; and this contributes to the social reproduction / change dynamic.

These approaches originated the School of Frankfurt.

Table 5. (Cu3) Dynamics related to the participation of different entities in cultural production

In web-based networks there is a convergence of:		
- GROUPS AND INDIVIDUALS	ORGANISATIONS, INSTITUTIONS:	
	- COMPANIES	*- POLITICAL INSTITUTIONS, PUBLIC ADMINISTRATIONS*
In each case there is cultural production, mainly,		
to participate	to obtain economic benefits	to exercise power

- CULTURAL PRODUCTION OF GROUPS AND INDIVIDUALS			
They are involved in the following functions:			
Creation of products and contents	Transmission, distribution	Reproduction	Conservation
		This affects the preservation / loss of the intangible cultural heritage	
Participation in such functions results in the abundance of banal, redundant contents or in the incorporation of new forms of expression			
They promote:			
Mass cultures / rather than elite cultures			
Popular culture / rather than high culture			

- CULTURAL PRODUCTION OF ORGANISATIONS, INSTITUTIONS	
- OF COMPANIES:	*- OF POLITICAL INSTITUTIONS, PUBLIC ADMINISTRATIONS:*
Responds to advertising and public relations models	Responds to social control models
Introduces an abundance of trivial and redundant contents	Introduces and applies normative criteria that control cultural production and practice
Dynamic of banal / informative contents	Dynamic of controlled / free culture
	Cultural controls participate in the dynamic of social reproduction / change

Source: Authors' own creation.

(Cu4) Dynamics related to the digitisation of the content of the existing information sources

The digitisation process starts a dynamic in which physical media are giving up their place to the use of virtual media. This transference affects all materials containing cultural content; the transference of reading from printed to digital books is considered as especially important.

Table 6. (Cu4) Dynamics related to the digitisation of the content of the existing information sources

Digitisation allows network-based storage, access and distribution of cultural contents	
It prompts the replacement of physical media by virtual media	
Thus:	
- The practice of reading is transferred from printed to digital books	- Listening to music, the watching of photographs and films on the web produce the obsolescence of vinyl records, CDs and DVDs

Source: Authors' own creation.

3.3.2. System of cognitive dynamics obtained from the sources

Table 7, titled "Cognitive dynamics related to ICT applications" includes four types:

- Control of referents (Co1). ICT Applications that create, in the narratives, the objects of reference; or provide virtual access to real referents.

- Index narratives (Co2). Applications in which the intervention of mediators is limited to the sending in real time, of images and sounds generated by the objects of reference themselves.

- Expressive processes (Co3). Applications whose use and understanding require new cognitive abilities.

- Explorations (Co4). Applications that expand the repertoires of the sources available through internet search engines and hypertext links.

- Participation in social networks (Co5). Applications that allow for the formation of virtual groups. It refers to the interactions that influence participants' signs of identity and belonging.

Table 7. Cognitive dynamics related to ICT applications

Diagram of the structure of changes in the cognitive system		
Dynamics	**APPLICATIONS**	**Dynamics**
Development / limitation of cognitive abilities:	(Co1) **CONTROL OF THE REFERENCE:**	**Reality / fiction dynamic**
a) imagination	*- CREATION OF REFERENCES*	**Existential evasion / realisation dynamic**
b) creativity		**Objectivity / manipulation dynamic**
	- VIRTUAL ACCESS TO REAL REFERENCES	**Verification based on judgment of reality / authority**
c) memory	(Co2) **INDEX NARRATIVES:**	**Autonomy from / dependency on mediators dynamic**
	(Co3) **PROCESOS EXPRESIVOS:**	**Dinámica consenso / disenso**
d) understanding	*- INTEGRATION OF LANGUAGES*	**Development / limitation of expressive capabilities**
e) abstraction	*- VIRTUALISATION*	
	- DIGITISATION	
	(Co4) **EXPLORATIONS:**	
f) organisation of information	*- EXPLORERS*	**Expansion / limitation of the repertoire of knowledge**
	- HYPERTEXTS	
g) self-development and self-assessment	(Co5) **SOCIAL NETWORKS**	**Participation / exclusion dynamic**
		Differentiation / homogenisation of beliefs and worldviews dynamic

Source: Authors' own creation.

The five typologies are structured. The following section describes the ICT applications and the cognitive dynamics they include, each of them represented in the appropriate tables.

(Co1) Dynamics of knowledge related to the control of referents

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ICT enables virtual access to what already exist and that what is happening. Depending the degree to what this presentation is complete, users can disregard the judgements of the source, when the objectivity of information is valued.

It is also possible to create referents that are indistinguishable from the real ones. They promote "virtual worlds" designed for escapism. They can be used to replace or manipulate the existing referents. This is how cognitive dynamics are mobilised: distinctions between reality/fiction; creativity/objectivity; imagination development / reduction. The use of referents to falsify information once again makes the objectivity/manipulation dynamic insecure.

Table 8. (Co1) Dynamics of knowledge related to the control of referents

<table>
<tr><td colspan="4">ICT allow the control of information / communication referents. They enable:</td></tr>
<tr><td colspan="3">THE CREATION OF REFERENTS</td><td>THE VIRTUAL ACCESS TO REAL REFERENTS</td></tr>
<tr><td colspan="3">- WITH THE CREATION OF THE REFERENT:</td><td>- WITH THE VIRTUAL ACCESS TO REAL REFERENTS:</td></tr>
<tr><td>Virtual "worlds" can be built and displayed</td><td rowspan="2">The real referent can be substituted by a fictitious one</td><td rowspan="2">The real referent can be manipulated</td><td>Can display referents of events</td></tr>
<tr><td rowspan="2">Dynamic of escapism to fictitious experiences / fulfilment in real life</td><td>Access to what already exists or is happening allows for objective verification</td></tr>
<tr><td colspan="3">Objectivity / manipulation dynamic</td></tr>
<tr><td colspan="3">Reality / fiction dynamic</td><td rowspan="3">Dynamic of judgement based on reality / reputation</td></tr>
<tr><td colspan="3">Creativity / objectivity dynamic</td></tr>
<tr><td colspan="3">Imagination development / reduction dynamic</td></tr>
</table>

Source: Authors' own creation.

(Co2) Dynamics of knowledge related to the use of index narratives

Index narratives reproduce the form, appearance and eventually the movement and sounds of the referents. This isomorphism facilitates understanding. In addition, the narrative develops in real time, to the rhythm of the current events. Exposure to index narratives accelerates mental processes. However, it may be the case that the speed with which information is presented exceeds people's understanding and memory capacity.

In any case, indexes make it easier for each receiver to base the verification of the account of the events on observation. Such autonomy makes users' interpretations to be more varied, which promotes dissidence more than consensus.

Index analyses are linked with Martín-Serrano's studies of *Social Mediation*.

Table 9. (Co2) Dynamics of knowledge related to the use of index narratives

INDEX NARRATIVES HAVE TWO CHARACTERISTICS:		
1: they use images that come from the objects of reference	2: they are synchronous with the current events	
They can facilitate intelligibility	They can prevent intelligibility	They tend to accelerate the pace of thought

As a consequence:

The use of index narratives affects:
- the ability to understand
- memory
The objective presentation of events in index narratives facilitates:
- the verification based on reality, instead of personal judgements
- users' autonomy, rather than dependence on mediators, to interpret what is being narrated
- autonomy of the interpretations, which promotes more dissidence than consensus about what is presented and what is happening

Source: Authors' own creation.

(Co3) Dynamics of knowledge related to innovations in expressive processes

The applications that integrate texts, images, and sounds in the same narrative and those that digitise them, developed cognitive capabilities that are involved in the encoding and decoding of messages and the construction of narratives. Virtualisation also has an impact on these capabilities, but in the opposite direction. It provides intuitive routines that require less complex mental operations.

The integration of messages, digitisation and virtualisation develop expressive capabilities.

Table 10. (Co3) Dynamics of knowledge related to innovations in expressive processes

They are related to expressive skills needed for:		
LANGUAGES INTEGRATION	DIGITISATION	VIRTUALISATION
For example: in materials including text + images + sounds	When it incorporates new symbols	When it includes intuitive aids and routines
The integration and digitisation of languages require the cognitive processes to operate with new guidelines:		Virtualisation requires less complex mental operations,
- for the encoding / decoding of messages		for the interpretation of messages
- for the construction of narratives, stories		
They develop understanding skills		Disables abstraction skills
They develop expressive skills		

Source: Authors' own creation.

(Co4) Dynamics of knowledge related to web navigation

Search engines and hypertexts expand the available sources of knowledge. Search engines select and present the information requested by users, based on internal criteria. On the other hand, hypertext-based navigation occurs in non-preconfigured paths, which respond to user's criteria. Therefore, search engines structure knowledge while hypertexts de-structure it.

They remit to McLuhan's paradigms. They quote De Kerckhove and Levy.

Table 11. (Co4) Dynamics of knowledge related to web navigation

Internet search engines and hypertexts expand the repertoire of available sources of knowledge	
THE USE OF INTERNET SEARCH ENGINES	HYPERTEXT-BASED NAVIGATION
provides information according to criteria predetermined by the search engine	provides information according to criteria determined by the user
these criteria structure the organisation of knowledge	these criteria de-structure the organisation of knowledge
This configures the dynamic: development / reduction of the cognitive skills for knowledge organisation	

Source: Authors' own creation.

(Co5) Dynamics of knowledge related to participation in social networks

It is argued that part of the face-to-face relations is transferred to the Internet. As a result the influence of membership groups (like peer, family and friendship groups) weakens to the benefit of the virtual membership groups (like "followers"). This transference of influence affects the identity signs with which people recognise and acknowledge others. Therefore, it mobilises self-assessment and self-recognition skills. Moreover, it also establishes criteria that group members have to take into account in order to be accepted by and remain in the group.

It is believed that the participation of people on social networks intervenes in the homogenisation/differentiation of beliefs and worldviews. In this case, in the sense of homogenisation.

These ideas have precedents in the "critiques of mass culture" of the 1960s.

Table 12. (Co5) Dynamics of knowledge related to participation in social networks

Participation in social networks	
- weakens the influence of users' (real) membership groups (for example, their family)	- strengthens the influence of the (virtual) membership groups (for example, "followers")
These changes also have an impact:	
In the individual signs of identity	
In the membership criteria of groups	

Therefore, participation in social networks affect:

The development / reduction of self-assessment and self-recognition skills
The participation / exclusion dynamic
The homogenisation / differentiation dynamic of beliefs and worldviews

Source: Authors' own creation.

3.4. Results related to the fourth hypothesis

The scientific and academic production about the links between technology, culture, and knowledge in the era of globalisation, are systems of representation guided by scientific paradigms.

* "The representation system of cultural dynamics", which is reproduced in table 2 contains analogies with a communication-based ideas-transmission model, which has been used since 1948 as a paradigm of the social applications of the media: Lasswell's paradigm (1948), which was inspired, according to its author, by the psychoanalyst conception of the production of culture. This correspondence is represented in table 13:

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Table 13. Similarities between the model of cultural dynamics and Lasswell's

Model describing the ICT applications that generate cultural dynamics						
PARTICIPATION (Cu3)	→	DETERRITORIALISA-TION (Cu2)	→	DIGITISATION (Cu4)	→	APPROPRIATION (Cu1)
Equivalences with Lasswell's communication model:						
Who communicates	→	What message and to whom	→	In which channel or form	→	With what effects

Source: Authors' own creation.

* The model that reflects "the dynamics of the knowledge representation system" (table 7) has obvious similarities with another paradigmatic model used in semiology to describe how languages work, when knowledge is used to interpret in certain sense the information provided in discourses. See Table 14:

Table 14. Similarities between the knowledge dynamics model and the semiology model

Descriptive model of the ICT applications that generate dynamics of knowledge								
CONTROL OF REFERENTS (Co1)	→	INDEX NARRA-TIVES (Co2)	→	EXPRESSIVE PRO-CESSES (Co3)	→	EXPLORATIONS (Co4)	→	PARTICIPATION IN SOCIAL NET-WORKS (Co5)
Equivalences with the semiology language analysis model:								
SEMANTICS *analyses meanings* Exposes the relationships between signs and the objects they refer to				SYNTACTICS *analyses meanings* Builds the "structu-res of language" that describe the ways in which signs relate		PRAGMATICS *analyses behaviours* Studies the use of linguistic resources by communicators		

Source: Authors' own creation.

4. Conclusions

*The reason to carry out this study

This study was motivated by the transformation that culture and knowledge are experiencing, as a result of the social uses of new ICT. Such transformations originate historical changes that affect our existence. This is a scientific and technological revolution, which emerges on top of other revolutions that started since the beginning of industrialisation. As expected, the scientific and academic literature resumes the analyses that predict the changes and consequences. This material contains specialists' visions of the future in terms of culture and knowledge in the globalisation era. The systematic study of these sources had not been done so far and now is the occasion to know the content of these interpretations. In addition, this study offered the opportunity to follow up on the process of production of scientific knowledge. This is an analysis that shows the validity and

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transformation of the paradigms that underlie the sciences of culture and knowledge, when society becomes globalised.

*** Main conclusions**

The results that have been obtained and described are consistent with the research hypotheses:

• Scientific and academic publications consider that large part of the historic changes related to the social uses of ICT concerns to culture or knowledge. To be precise, one in every five references.

• Generally, these publications contain divergent interpretations on the meaning that such transformations will have. They describe dynamics of cultural and cognitive changes. Such dynamics could be identified and have been identified by means of content analysis.

• Descriptions contained in these sources about the social uses of ICT are very structured:

- There are four types of social applications of ICT, which generate 12 different types of dynamics of culture. They systematise the 271 different descriptions included in the sample.

- There are five types of social applications of ICT, which generate 18 different kinds of dynamics of knowledge. They systematise a corpus of 180 sentences.

It can be concluded that there are, explicit and implicit, patterns that prioritise the themes, sources and formats on which the consideration and publication of a text as scientific depends in these fields. These are the criteria that regulate the "agenda" of the authors.

• From the point of view of the production of knowledge, altogether the scientists and academics who have published these texts function as a group:

- The approaches of a source or an author of reference on the subject are quickly reproduced through citations and are used widely, if they are deemed innovative or topical.

- In addition, the capital of representations of culture and knowledge, which is considered relevant, is used to connect the current analyses with the previous ones. They are linked, mainly, with theories that, during the 1960s and 1970s, explained the cultural, cognitive and social effects of mass culture in general and of audiovisual culture in particular.

• In our view, the most relevant conclusions from the perspective of the history of ideas are as the following:

- There is a paradigm, the one formulated by Lasswell in the 1940s, to study the production of mediated culture as a social practice. This paradigm prevails, updated, in the model that describes the dynamics of culture generated by the social uses of technologies.

- The model that describes the dynamics of knowledge related to the social uses of technologies is a recreation of the semiology models, which relate the social signs with interpretation. As it is known, this model dates back to Ferdinand de Saussure's linguistic structuralism and, previously, to the philosophical pragmatism of Charles Sanders Peirce.

Finally, it should be pointed out that nobody has planned, a priori, the organisation of these 451 representations so that they can be used to configure models that correspond to certain paradigms. However, this organisation exists and we have been able to identify it. This confirms that there are epistemological constrictions in operation which regulate the social production of knowledge, as Thomas S. Kuhn pointed out. And in the specific field of the production of stories, which are disseminated by the cultural contents shared by members of a community, we confirmed the relevance of another paradigmatic reference: the structural anthropology of Claude Lévi-Strauss.

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5. Notes

[1] The first scientist who linked the social applications of knowledge and technologies with social and historical changes was Auguste Comte (1842). Since then, the Sociologies of Progress, Change, and Cultural History have given continuity to these analyses. A review of this abundant production is offered by Elias (1939) and Mumford (1934). The epistemology discusses the paradigms underlying the interpretation of the socio-historical changes. The reference generally quoted is that of Kuhn (1962). The most important precedent works on the effects of technologies in culture and knowledge are mentioned in Geertz (1973) and Inglehart (1990).

[2] In the 1970s, Professor Manuel Martín-Serrano analysed the socio-historical transformations related to the social uses of television which culminated the "audiovisual era". Since 1990, he and other researchers who shared his school of thought have carried out similar studies on the virtualisation and shared use of information in communicative/informative systems. These studies revealed that: "Because there are laws that regulate the ways in which the social formations incorporate the communicative innovations, there can exist a social science of communication. Its objective is to explain how public communication takes part in the reproduction and transformation of societies" (Martín-Serrano, 2014b: 43).

The work of reference is *La producción social de comunicación* (Martín-Serrano, 2004). This publication and *La mediación social* (Martín-Serrano, 1977) are at the top of the selection titled

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"Basic books in the history of Ibero-American communication studies" ("Libros básicos en la historia del campo iberoamericano de estudios en comunicación"), developed by the journal *Razón y Palabra* in 2011. Several communication journals have dedicated issues to this topic.

The most complete review has been offered by the International Centre for Advanced Communication Studies for Latin American (CIESPAL) under the title *Manuel Martín Serrano y sus aportes a la comunicación* (*Chasqui*, 2011, nº 114/115). The digital edition is available: http://repositorio.ciespal.org:8080/jspui/handle/123456789/432. This monograph includes relevant analyses for this article: "Presentación de *La teoría social de la comunicación*" by R. Fuentes, "Las relaciones entre las mutaciones sociales y los cambios en las representaciones", by J. González; "La comunicación pública y los cambios socioculturales", by F. Sierra, "Mediaciones tecnológicas en la comunicación", by J. Esteinou; and "La contribución estratégica de Manuel Martín Serrano al pensamiento transformador latinoamericano", by A. E. Maldonado.

[3] The reasoning developed in a sentence is elaborated with claims and connectives. See the following example: claims appear in the table's right column, between quotation marks; while the connective words are underlined:

Social application of the benefit:	"Users' access to digital networks (is an innovation that) makes it possible to replace face-to-face interactions with virtual ones";
The dynamic:	Therefore "the use of this provision allows participation in multicultural groups";
The socio-historical effect:	As a result, "digital networks develop multicultural exchanges".

The claims suggest an idea that is, or will be, either true or false; connective indicate the relationship between claims. There are many manuals that describe these logical techniques. For their application to content analysis we recommend the work of Badesa, Jane & Jansana (1998).

[4] The "snowball" sample selection is a technique suitable to work with sources, which is also suitable to obtain information in communities (see: Almarcha & González, 2011).

[5] The computer application has been developed by Dr. Javier Martin, member of the "Social identities and communication" research group of the Complutense University of Madrid.

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