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Digital Divide Characterization Matrix (DDCM)

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Abstract

The digital divide is a widely used concept that refers to the existing differences between different groups of users that either use —with diverse degrees of comfort— or do not use technology –either because they do not want to use it or because they do not have access to it–. The concept is so open that it allows the observer to focus on various aspects of the phenomenon, such as accessibility, appropriation, use or other defining characteristics such as country of residence or age range. This ambiguity of the concept allows the enhancement of its borders to observe wider scenarios; but at the same time, this openness complicates the understanding of its limits. Thus, a set of qualifiers aiming to characterize the digital divide would clarify the scope and intention of the concept.

In this article we present a framework for characterizing the concept of digital divide, depending on the consideration of its contextual factors (such as age, access, cognitive intentions, use and appropriation); and its comparison range (international, domestic and institutional range).

Key words: digital divide, higher education, qualifier, Information and Communication Technologies.

Resumen

La brecha digital es un concepto ampliamente utilizado en las últimas décadas para referirse principalmente a las diferencias existentes entre diversos grupos de usuarios y de no usuarios de TIC. No obstante, el concepto es tan abierto que permite al observador enfocarse en varios aspectos del fenómeno como accesibilidad, apropiación, uso u otras características definitorias de los usuarios como el rango de edad o su país de residencia. Si bien esta ambigüedad del concepto permite el ensanchamiento de sus fronteras para la observación de escenarios más amplios, al mismo tiempo complica el entendimiento de la intención del objeto y de su alcance que, mediante un conjunto de consideraciones, podrían servir para su delimitación. En este artículo presentamos un marco para la caracterización de la brecha digital dependiendo de la consideración de los factores contextuales como edad, acceso, uso y apropiación, y su rango geográfico de comparación.

Palabras Clave: brecha digital, educación superior, clasificación, tecnologías de información y comunicación.

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Introduction

The exponential development of Information and Communication Technologies (ICT) in everyday life has influenced an important amount of scientific improvements in the various fields where digital technology and society in global contexts converge and enhance communication, collaboration and development (Castells, 2002). In the educational context – at least in the Higher Education (HE) scenario, which is the one our research focuses on– the presence of ICT in everyday aspects of educators' and students´ academic and nonacademic duties has not only spread among the academic community, but it has also become so familiar to the users that they might not even notice its presence, just like the air in our everyday lives (Tapscott, 2008). ICT have become the *zeitgeist* of the modern era; and a *must* in a digitally driven society pursuing education to respond in a direct manner to innovation, information growth on the net, and to all the new sorts of channels, forms and means of communication.

In this day and age, the university assumes the responsibility to answer social demands (e.g. quality, access equality, greater coverage, labor and social matters among others) that HE is aimed to fulfill such as educating people to perform adult roles "for their performance in the working field" (cf. Brunner, 2003, p. 86). That is why HE institutions incorporate ICT and their rational use to their study programs with the aim of strengthening students' digital knowledge by expanding their action fields in many areas of social life in which they have to be creative and productive when performing their functions (Arras, Torres & Fierro, 2012, p. 8); and creating new research opportunities in various disciplines, ranging from chemistry to physics or medicine (Castells, 2002). These new functions that students must develop– and therefore educators must also- carry out implicitly a new set of skills for students and educators related to both: the appropriate use of basic instrumental computing – meaning the correct use of digital tools and web services for the purposes being–; and the information handling skills – related to how users search, filter, analyze and handle information– also known as computing skills and information literacy, respectively. This set of skills belongs to a mindset of a society where information and knowledge are to be treated as an important means for succeeding in its different fields, including the academic one. But identifying these skills has always brought prosperity and more opportunities for those who have them while bringing segregation and discrimination for those who do not have them. This trend creates two groups and a blurred line that arbitrarily divides those that are left behind from those that are part of an information driven society.

With their respective differences, the network society, information age, information society and knowledge society, are common ways to refer to this age where digital literacies are widely accepted and demanded. Each of the former terms explains aspects of the socio-technological paradigm that determine the social, laboural, entertainment and educational practices.

The introduction of ICT in different social fields (Castells, 2002); and their respective activities (Crovi, 2009) have modified the international economy; the production processes and the organizational structure. They have transformed the types of work and working conditions and have also generated changes in the spaces and forms of communication. Brunner (2003) sees this phenomenon as a digital revolution where "a passage is being opened to a new social organization [...] based on the intense use of knowledge and technologies" (cf. Brunner, 2003, p. 45) which are oriented to both, basic computing skills and digital literacy. But these two sets of skills should not be equal to all kinds of users. On the contrary, there should be an expected knowledge level, but that level may be consistent with contextual factors, such as: the role discipline may play; the

moment students are in their curricula; or how seasoned educators are, just to mention three contextual factors.

Since the dawn of ICT, there has been a trend to compare the haves and have-nots of users of digital systems, and more recently this comparison has expanded to the observation of those who are connected and those who aren´t, also referred as the information rich and the information poor. Not everybody has neither the same type of access (hierarchy of access) to various forms of technology, nor the same context, level of engagement and consequences (Selwyn, 2004). That is, while there are people privileged with digital technology, there are others that are left behind and, in many common scenarios, cannot reach the level of the privileged ones. The differences between at least these two groups, may be evident by different lenses. For example, we could be comparing how nations, institutions or individuals access technological infrastructure. Or we could investigate the positive or negative impact that ICT might have on users depending on given factors such as the generational gaps, cognitive divides or access to appropriations of digital technology.

As previously stated, despite the chosen approach the observations are conducted in two groups: one that satisfies the observer's conditions, assumptions preconceptions or expectations; and the second one referring to the disadvantages made evident due to the idea that ICT are not always a symbol of prosperity, modernity and progress; mainly because physical or virtual artifacts can –to some extent– cause inequality scenarios at any level; the individual, the regional or the national one (Barrios, 2009, p. 266) and in various contexts, such as the monetary income from similar occupations, a different endowment of communication infrastructure and disparate educational opportunities (ALADI, 2003) generate a number of observable differences and social divisions.

The phenomenon of the existing difference between two or more groups of ICT users, is called the digital divide –or digital gap– and if not contextualized, it may be misunderstood because it may allude to different comparison criteria such as use, access or cognitive differences, or in a more precise and reflexive view it may refer to a "hierarchy of access to various forms of technology in various contexts, resulting in differing levels of engagement and consequences" (Selwyn, 2004, p. 351) In the context of this research, we consider that knowledge about access, use and appropriation of digital technology enables the social and economic development of a given society, because it allows the society to stay informed, seek solutions to its shortcomings, and simultaneously incorporate itself into the current social paradigm known as the information and knowledge society (Castells, 2002; Brunner, 2003)

What is Digital Divide?

The digital divide is not a static, completely bounded or universal concept. It is ill-defined, and when studied as a whole, it can be treated as a digital distance index "that may refer to the distance –either far or near– to what it is considered as an adequate amount of digital awareness to a given period of time or a society" (Hernán, 2011, p. 16). The concept of digital divide is binary in itself. It can be seen as a lag of interests or skills among people from two different generations (Prensky, 2001; Tapscott, 1998, Negroponte, 1995); as a disproportion among those who have Internet access and those who don't (Tapscott, 2008); or as an imbalance resulting from the global

inequality of the knowledge distribution (UNESCO, 2005). The term was earlier used as "part of a cybernetic metaphor to identify and sometimes quantify the differentiation, unevenness and separation among individuals, communities, countries and regions, according to their infrastructure endowments, hardware, and ICT services; or to the abilities and competencies of use" (cf. Lizarazo, 2011, p. 314). From a social perspective, the digital divide can be studied by its socio-cultural factors. A specific perspective could be the transposition of Bourdieu´s cultural capital (1987) into a technological driven context. In modern societies, ICT impact in everyday life, work and education has transformed the ways of understanding knowledge, and the degrees of appropriation tend to be associated to achievement, success and failure. The cultural capital in a technology driven context, referred by Casillas, Ramírez-Martinell, and Ortiz (2014) as Technological Capital, thus considers a set of knowledge and skills (savoir and savoir-faire) used in diverse social contexts such as the school and the workplace.

Talking about digital divide may include a wide variety of subjects (such as economics, infrastructure, education, business, and inclusion) and scales (such as global, nationwide, local, institutional or personal). Even trying to focalize the phenomenon in a given context, without the proper conceptual limitation, the digital divide –as a higher order concept– may refer either to economic aspects, software use, or differences in various fields, such as knowledge, gender or generational concerns. When talking about digital divide, studies tacitly orient its observation and findings to a given context with an ill-defined scale and the most suitable approach. The context, for example, can be described by its comparative perspectives (generational, cognitive intentions, access and appropriation); and the study scale bound by its geographical reach and limits (international, domestic); facilitating the selection of the most suitable approach and type of intervention either quantitative or –less common– a qualitative intervention.

It is important to consider the criteria used to observe –or measure– the digital divide in different settings, because it clarifies the contextual orientation of the study, delimits its reach and limits of by specifying a given geographical scope, and makes evident which research approach is more suitable to hold in the intervention. The approach, methods, methodology and instruments for data collection aimed to be used in the intervention, depend on the type of gap the researcher is to explore. Whether it is a generational, access, cognitive or appropriation digital divide study, the approach has to be coherent with the intention and cannot be the same to explore the concept of "digital divide" as wide as it might be understood. A study aiming to explore the technological differences at a large scale –with a span between communities, states or even countries– is more likely to use a quantitative methodology while a qualitative one may be used in a small scale study that focuses, for example, on the access differences between students and educators of a local institution.

After reading some articles about technology access (ALADI, 2003; Crovi, 2009, 2011; Lizarazo, 2011; Martínez, 2011; OECD, 2001; Serrano & Martínez, 2003), the generational aspect (Tapscott, 1998; 2008; Prensky, 2001; Barrios, 2009; Guzmán, 2008), technology use (Crovi, 2009, López, 2007; Guevara, 2010), digital technology appropriation differences (Crovi, 2009, 2011; Pisani, 2008) and about cultural capital (Bourdieu, 1987; Selwyn, 2004; Casillas, Ramírez-Martinell, Ortiz, 2014), and with the objective of framing the context with its contextual factors and its limits and reach of the phenomenon, we propose two markers that may help the term to be self explanatory and less ambiguous. These markers, referred to here onwards as qualifiers of the digital divide are: the contextual factors composed by three perspectives (generation, access, cognitive intentions); and the study scale composed by perspectives (international, domestic, institutional and referential).

Contextual factors

The first qualifier we propose to enmark the digital divide adverts the factors that outline the study group such as age range; access conditions to technology; knowledge, disposition and affinity to digital technology; as well as its appropriation and use.

Generational Perspective. One of the types of digital divide studies that are probably most frequently mentioned is the generational divide (Tapscott, 1998; 2008; Prensky, 2001; Barrios, 2009; Guzmán, 2008). Commonly found in a certain corpus of articles and as a common belief, it states the idea that there are technology users that are strangers, foreign or immigrants to the digital world (Prensky, 2001), and therefore they had to learn the language in formal, non-formal or informal educational settings while a second group who is native to the digital world, acquires the digital language in a more natural way.

Access Perspective. Another common type of digital gap is the access divide (OECD, 2001; Crovi, 2009, 2010; Lizarazo, 2011); which is characterized by technological infrastructure and adequate accessibility conditions –or lack of them– at different geographic and economic levels. The access perspective tends to be seen as a socio-economic drive, thus it may focus on the distinctions of the global differences (international divide) known as the "existing disparities in technology diffusion among countries that generate them and those that consume them" (cf. ALADI, 2003, p. 13); or the disparity among access people of the same country have (domestic divide). The access perspective of the digital divide among people –rather than countries– can be understood as a separation that exists between the "favored ones by ICT, that is, those who have infrastructure and connectivity; accessibility, skills and knowledge to use them properly" (cf. Martínez, 2011, p. 13); and "those who don't have access to ICT or even if they do, they opt not to use them" (cf. Serrano y Martínez, 2003, p. 8).

Cognitive Perspective. Another type of divide found in the mainstream literature is the cognitive divide or knowledge divide and it "is linked to the skills and knowledge that an individual should have to properly take in the new media and the ICT" (cf. Crovi, 2009, p. 43). This kind of digital divide considers the knowledge, skills and intent of use. In Mexico, for instance, researches in the field have explored how much individuals know about ICT (López, 2007) and the habitus or disposition of use that individuals have towards them (Guevara, 2010).

Use and Appropriation Perspectives. Last but not least, the use and appropriation views of the digital divide are those that focus on how people use ICT, the type of digital services they use, their skills while using the digital artifacts and the level of empowerment and endowment users have (Pisani, 2008). This perspective explores the differences among the over-informed users with access to different media and ICT that apply their expertise in academic, social and civic context and those that due to conviction, lack of information or limited access to information and technology are not using ICT as part of their everyday lives (Crovi, 2009).

Study Scale

The second qualifier of the digital divide is the scale of the study; its reach and limits. A digital divide study can be conducted at different geographical levels, such as international, institutional or at a more local one; but we consider, it can also be performed between an existing group with

a constructed referent. In any case, this qualifier has to be accompanied by the contextual factors in order to delimit the type of comparison in both dimensions. With those qualifiers defining the concept, the observer will be able to recognize the type of study with ease; knowing de facto that a study is not as ambiguous as the concept of "digital divide" is, but about the comparisons, for instance, between two groups of people from different countries and their accessibility patterns, if we state it as follows: international access digital divide.

International Digital Divide: These differences are clear when we see the studies that international organisms such as OECD, UNESCO, World Bank have conducted, which have made evident some differences of technology access among countries and have highlighted in most of their studies that the use of ICT –or lack of it– affects the countries' economic development and impacts either positively or negatively in certain areas such as culture, education and society, among others. Nevertheless, a limitation in these measurements is, that the criteria for observing the divide is the same for all the countries, and does not take into account the context each country has.

Domestic Digital Divide: This digital gap contemplates the inequality among the groups of citizens within a given society. The domestic view allows the researcher to concentrate on the existence of diverse digital gaps within a country. This type of exploration has been performed within a country, mainly to conduct diagnoses of the differences of access and technology use at national level that may allow policy makers to effectively address needs of those who have the least access to the ICTs, or to establish action plans to acquire infrastructure or to train people to take advantage of the ICTs for specific purposes and contexts (such as, educational, commercial, cultural, etc.).

Institutional Digital Divide: This lense of the digital divide focuses on a range of people from the same organization, establishment or academic institution. By means of the intra-institutional digital divide the researcher can analyze two types of stakeholders. In the case of an academic context, the differences among students and educators can be the center of the study. The intra-institutional view is ideal for institutional audits that aim to identify areas of opportunity either for training educators, expanding their technological infrastructure or restructuring curricula.

Referential Digital Divide: This type of approach is employed when abysses or inequalities are found when comparing what a person or group of people –from a determined background or context (e.g. an institution, organization, region)– do, have or know about ICT with what –according to international standards such as those proposed by ISTE, UNESCO, ECDL or OECD among others– they should do, have or know about ICT. There can be two sides to this scope; one that shows the differences that the standards establish, and one more about noticing the lack of local considerations of global standards.

Digital Divide Characterization Matrix

With the sole objective of understanding the reach, limits and types of digital gaps that there might exist, we propose a Digital Divide Characterization Matrix (DDCM), in which we aim to locate the types of gaps depending on the contextual factors and their reach and limits. To construct it, we considered each and every component of these two qualifiers to ease the analysis and

comprehension of this multifactorial phenomenon. The DDCM is an original proposal aiming to clarify the scope and main objective of an exploration regarding disparities on either access, use or appropriation of digital technologies among groups of people that –for the sake of the study– belong to either a country, an organization or a more confined setting.

The contextual factors and the scope of the study formerly explained can be structured in a two entry table composed by values concerning to the contextual factors accommodated in the columns and the reach and limits of the study depicted in rows of the DDCM. This matrix is of use for researchers and observers to map a given digital divide. The DDCM is intended to allow the description of the following combination of studies.

1 Domestic generational digital divide;
2 domestic cognitive digital divide;
3 domestic access digital divide;
4 domestic appropriation digital divide;
5 international generational digital divide;
6 international cognitive digital divide;
7 international access, digital divide;
8 international appropriation digital divide;
9 institutional generational digital divide;
10 institutional cognitive digital divide;
11 institutional access, digital divide;
12 institutional appropriation digital divide;
13 referential generational digital divide;
14 referential cognitive digital divide;
15 referential access, digital divide;
16 referential appropriation digital divide.

It would be meaningless and time consuming to explain each of the former type of studies, but it is clear enough to say that a referential appropriation digital divide –to explain the last study of the list– is the comparison of how a group of people make sense of technology in their everyday lives compared to an expected profile built out of former observations or outlined by an international accredited organism pursuing to regulate technology appropriation.

For example, A) if we use this DDCM to characterize a study about the differences of connectivity and equipment Finnish students have access to, with what Mexican students have at their schools and homes we could use the DDCM to refer to the study as an International Access Digital Divide; or B) for a situation where the aim of the study is to explore the differences of ICT appropriation between pre-service teacher and students, instead of only saying digital divide it may be less am-

biguous and more precise to refer to the study as "Institutional, appropriation Digital Divide" (See examples A and B in Table 1).

TABLE 1. DIGITAL DIVIDE CHARACTERIZATION MATRIX

Reach and limits	Contextual factors		
(International / Domestic / Intra-institutional / Referential)	Generational	Cognitive	Access
Domestic			
International			**A**
Institutional			
Referential			

Source: Prepared by the authors.

The categorization of a possible digital divide between university actors according to their discipline or region as well as an establishment of a minimal dimension that portrays the digital knowledge that any student or educator of a given discipline must have to be fluent with technology in their area of expertise, will allow us to propose the institution a starting point for future institutional innovation projects, curricular update, infrastructure acquisition; subscription to paid digital services; and ICT update programs according to a given discipline.

Conclusions and further work

The use of the concept "Digital Divide" as it is, may refer to different perspectives or even various types of gaps. Comparing the privileged ones with those that are not benefited by digital technology can be made –and clarified with the DDCM– depending on what the observer wants to make evident. Not knowing whether the focus of the study is a generational analysis between students and educators of a rural school; or the access differences between two developing countries; may not lead to the understanding of the phenomenon in the terms expected by whomever is conducting the observation.

The concept of digital divide is a complex and multifactorial observation, and using it as it is may not be self explanatory. For example, a generational difference aiming –in most of the cases– to portray the young ones as the owners of more advanced or natural digital skills against the old ones that are –almost by default– conceived as unfamiliar and eskeptic with technology driven solutions, is a completely different study from that aiming to analyze how people from two different parts of the world access technology. And although they are clearly different studies, with no qualifier, they both are considered digital divide interventions.

The qualifiers presented in this article, may not be exhaustive. We are sure other factors may also be of certain interest to other researchers aiming to focus on gender observations (Arras, Torres & Fierro, 2012); users' attitude towards content that locates them as digital content consumer or producer, or other perspectives. For those and other factors the DDCM can be adapted with ease.

To keep track of the development of the project framing the DDCM, we encourage the kind reader to visit the research blog http://www.uv.mx/blogs/brechadigital or to follow the hashtag #brechadigitaluv.

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