

## IMPACT OF THE KNOWLEDGE SOCIETY IN THE UNIVERSITY AND IN SCIENTIFIC COMMUNICATION

### *[Impacto de la sociedad del conocimiento en la universidad y en la comunicación científica]*

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#### Abstract

Over the last two decades as a result of the introduction and intensive use of technologies for information and knowledge in general, from the internet in particular, the university is living in a process of complete transformation that affects its academic and organizational structures as well as the conception of educational methodology. The ICTs have demonstrated a need to establish coherent institutional strategies in their use and application along with the possibility to expand the sphere of institutional action in regards massive access to higher education. All of this shows an existing change from a model of education based on the transmission of knowledge, that was rather limited and under restricted access, to another that should fundamentally facilitate the competence to learn from people that live in the world in constant change, with open access to information and knowledge. In addition, all of this implies a transformation in the dynamics of communication and diffusion of scientific knowledge, that is now converted into something open and accessible which is subject to an analysis of knowledge social networks.

#### Keywords

Higher Education, Knowledge Society, e-learning, Open Acces, Open Science, Almetrics.

#### Resumen

A la largo de las dos últimas décadas y como resultado de la introducción y uso intensivo de las tecnologías de la información y del conocimiento en general y de internet en particular, la universidad esta viviendo un proceso de transformación complejo que afecta a sus estructuras académicas y organizativas así como también a su concepción de metodología docente. Las TIC han evidenciado la necesidad de establecer estrategias de coherencia institucional en su uso y aplicación, así como la posibilidad de ampliar los ámbitos de acción institucional y el acceso masivo a la formación superior. Y todo ello pone de manifiesto el cambio existente de un modelo de formación basado en la transmisión del conocimiento, que estaba bien delimitado y bajo acceso restringido, a otro que debe fundamentarse en facilitar la competencia de aprender a personas que viven en un mundo en cambio constante y con acceso abierto a la información y al conocimiento. Todo ello, además, conlleva a una transformación en las dinámicas de comunicación y difusión del conocimiento científico, que se convierte en abierto, accesible y sometido al análisis de las redes sociales de conocimiento.

#### Descriptores

Educación superior, sociedad del conocimiento, e-learning, acceso abierto, ciencia abierta, altmetric.

#### Technology, Management and pedagogy at university: balance and coherence

The university as a social institution has undergone important changes during the last decades as a result of the impact of the

Information Society, also known as the Knowledge Society or the Network Society. The internet is the material and technological base of the Network Society, which has generated new forms of social relationships

that, although they do not have their origin in the internet, they would not have grown without its potential (Castells, 2001). These new forms of social relationships have influenced all aspects of society and, particularly, the dynamics of communication and social connections.

Teaching and learning dynamics have also undergone changes since the introduction and intensive use of technology and, in particular, of the internet. Learning with the intensive use of technology (*e-learning*) has transformed the relationships between teacher and student, evidencing the importance of design and planning in the process of learning.

The most substantive changes that have occurred as a result of the introduction and use of the internet in the dynamics of educational institutions arise in three areas: the use of technology, the dynamics of educational organizations, and the educational paradigm. In the field of technology, few years have passed between the availability of technology in the classroom, and the classroom in your pocket. Although initially the introduction of technology consisted of equipping classrooms with computers that had educational programs adapted to the needs of the students, now, thanks to the development of new mobile devices (smart phones, tablets...), the reality is a connective and synchronized portable technology (Ally & Prieto-Blázquez, 2014).

In the field of educational organization we have observed the appearance of new professional profiles, often as a result of adaptation processes of professional profiles that already exist. One of the most evident cases of this is the transformation of university libraries, ancient repositories of static information, to resource centers for learning and investigation (CRAI) with dynamic, accessible and global documentation, involving changes and adaptations for professionals (Connaway, 2014). We are also able to highlight changes in academic administration and in the

information and visibility of university activity as a result of the use of the internet (Capshaw, 2012; McCaffery, 2010). In the educational field, the introduction and intensive use of technology has redefined teachers' and students' roles, as well as the sources of information and learning methodologies (Bates & Sangra, 2011).

Technology in general and the internet in particular, have been the motors of change in the world of higher education. Transformations have occurred rapidly and often with little planning. In the same manner, innovations in technology are constant and the growth in accessibility to the network has been increasing exponentially in such a way that we have modified the concept of digital gap from whether or not you have access to the network, to whether or not you have the competence to use it (Castaño-Muñoz, 2010). In the same manner, the basic elements of control in traditional university dynamics of costs, access, and quality, that comprise the so-called *Iron Triangle*, are disrupted by this use of technology. Educational administrators have habitually sought to maximize access and quality while trying to control costs, a complex balance that technology can help to maintain.

While the most apparent changes and transformations of the last decades have been technological and organizational, at the university level the challenge continues to be to adopt these changes in a coherent manner in order to define a transformative and adaptive learning model, suitable for the educational community and society in general. The learning model at the university level today must respond to the expectations and needs of those that form that current society, and in particular it must offer tools that facilitate the construction of competencies and adaptive skills. This is a complex challenge that can only be achieved by transforming the current institution and its educational dynamics, making it necessary to focus on the student, the person that learns.

The consistency between the use of a particular technology, the adoption of an educational administration, and the educational methodology employed, should be determined by the profile of the person that will learn: the student.

### **To Learn in the Network Society: “How” to Learn and Not “What” to Learn**

The traditional formative relationship between professor and student has been substantially modified as a result of the intensive use of the internet, affecting equally both actors in the educational process. On one hand, the student wants to be the protagonist of the learning process, it is to say, he desires to count with the necessary resources to be able to learn and interact not only with the professor, but also with the learning community. In addition, the student prefers to manage and plan his study pace and pursue a personalized educational model with the continued support of professors and/or experts. The educational model in the network society is based on the principles of interactivity, collaboration, personalization, and flexibility (Sangrà, 2002). Currently the educational challenges are situated in three levels of transformation: hybridization, feedback, and evaluation. Hybridization is the result of the integrated formative design of classroom learning and learning outside of the classroom, or online learning. Formative hybrid programs allow for the creation of a real continuous format, suitable of the dynamic of continuous and lifelong training (Osorio Gómez & Duart, 2011a, 2011b). The formative feedback is essential to the educational dynamic of the network society and the contended interaction that forms part of the teaching and learning process (Alvarez, Espasa, & Guasch, 2012). Evaluation systems integrated with the use of technology (e-assessment) are basic to support developed learning evidences in complex learning environments (Crisp, 2012).

The student in the network society is subjected to over-information as a result of

the easy and continued access to the stock of information in the network, hence the necessity of developing selection and administration of information competencies. The continuous and lifelong training is already and will be the usual pattern of learning in a continuously changing society. That is why it is fundamental to understand learning not only as a succession of events or formative milestones in life, but also as a continuum.

It is necessary to focus more on how to learn than on what to learn (Cobo & Moravec, 2011; Moravec, 2013). Teaching and learning systems in the network society need to overcome the conception that to educate is to transmit knowledge in order to advance in the preparation of competent people to learn. This is without a doubt the most important challenge that education encounters in the network society. The introduction and intensive use of technology, and the internet in particular, have changed educational relations and perceptions, and make evident that it is no longer possible to base on the transmission of knowledge that is already accessible and may have a high potential of obsolescence. What is important is having the competency to learn how to use the network in order to access knowledge and use it in an appropriate manner in our professional activity.

### **Internet in the University: New Models of Higher Education**

Today's university, after the incorporation and use of the internet in the educational and institutional dynamic, must sustain an adaptive and integrated educational model that allows for the acquisition and exercise of substantive skills for the current network society. For this reason, it is necessary to overcome traditional frameworks, but also learn from them. It is not necessary to start from scratch, significant experiences already exist inside many universities and it is important to know how to channel them and give them the necessary thrust to contribute to

institutional change (Bengoetxea, 2012; Weller, 2012).

At the institutional level of universities, there are transformative dynamics that are making a great impact. We can mention four of different natures, but with wide relevancy: open educational resources (OER) and massive open online courses (MOOC), the use of data in order to analyze students' and professors' behaviors (*Learning Analytics*), and globalization and multiculturalism. The open movement begins with Learning Objects and the necessity to find a standardized system in order to be able to share learning content (Downes, 2001). Subsequently, *Open Educational Resources* (Caswell, Henson, Jensen, & Wiley, 2008) are launched and universities in the occidental world begin to allow open network access to some of their educational resources. This opens up a debate about the existing business model behind this decision, which without a doubt also helped the appearance of the *Creative Commons* open edition license. The next steps are *Massive Open Online Courses* (MOOC) that raise new educational dynamics (Mengual-Andrés, 2013; Roig, Mengual-Andrés & Suárez, 2014), among the relationships between professor, student, and community, as well as new systems of evaluation (Martin, 2012), and studies about whether this movement in general and the MOOC in particular are going to change the university model (Anderson, Boyles, & Rainie, 2012). Learning Management Systems, known generically as Virtual Campus, offer the possibility of collecting and processing large quantities of data about the behavior of the members of the academic community. Educational data mining has moved to Learning Analytics during a time of effervescence in the Big Data Movement. The data analysis provides information to assess relationship dynamics and to establish predictive guidelines in order to act on behaviors, like in the case of university dropout (Carnoy, Rabling, Castaño-Muñoz, Duart, & Sancho-Vinuesa, 2011). This open dynamic of global

interaction highlights the need for university construction of global knowledge networks. These networks and their participants show that resources and courses are selected taking into account the reputation and prestige of the author or publisher, the rigour of the content, and the flexibility of the program. In this manner the new learners decide their own learning and complete their continuous training (Pedró, 2006).

In the new higher education models, challenges exist in learning and teaching dynamics. Looking at the latest edition of the *Horizon Report* of Higher Education (NMC, 2014) it is evident that the most strategic elements of the future correspond to learning and teaching practices and evaluation systems, while areas such as technological infrastructure and organization, that were relevant in previous reports, now lose force. Now is the time to focus on learning methods, specifically how one learns, and the new educational organizations must respond to these new forms of learning. Nevertheless, today's academic structures and university organization do not facilitate change. The university of tomorrow will be different, and above all, diverse. A single model to replicate does no longer exist.

### **The Redefinition of the Role of the University in the Diffusion of Knowledge and Open Science**

We can confirm that the impact of ICTs has changed the speed of production and distribution of knowledge. A clear example is the recent growth in the publication of scientific documents derived from *e-journaling* and the repositories of open access scientific information. In this respect new technologies have challenged the institution of Higher Education around the world (Guri-Rosenblit, 2009), forcing them to rethink not only their educational models, but also their purpose as agents of scientific dissemination and social responsibility.

Universities are complex organizations, their inherent functions include promoting

significant change when an important pressure exists, new models appear, or when there is a group of people that demand its participation (Toffler, 1985). Thus, higher education institutions are obliged (intrinsic to a greater extent) to contribute and give support to a society in constant change, where technology is an evolutionary and transformer agent (Pittinsky, 2006) and the university must position itself as the “connected tower” breaking the metaphor of the “ivory tower” (De Pablos, 2010).

In short, higher education organizations and centers are important beneficiaries of the contributions from ICTs (Parker & Burnie, 2009) since the impact of these contributions is not only visible in their management, educational models, and their politics, but also in other important areas of university life, such as scientific publications (Guri-Rosenblit, 2009). From a global economic perspective, it is evident that the economic downturn that many countries are experiencing has begun to influence investments in technology, evidencing certain effects of deregulation and a lack of planning (Anglada, 2014). The role of universities in scientific contribution and productivity is undeniable. Science and technology contribute to the growth of welfare states (Finch, 2012), producing economic benefits that can be redistributed socially; thus it is purported that open access science generates more and better science (Anglada, 2014). Therefore, it is not surprising that these benefits, in terms of scientific productivity, should be identified, evaluated, and measured.

The measurement of scientific activity today is centralized in two major indexes: The Journal Citation Report (JCR) and the SCImage Journal & Country Ranking (SJR). These lists allow institutions, centers, or states to not only classify the importance of the impact of its participating agents, but also allows them to make decisions respecting the lines of intervention on scientific policy. Recent reports show the connection

between the scientific productivity of a country (measured through its presence in JCR) and the growth or downturn of its GDP. The strategies of the main world economies, specifically the members of G-20, have been revealed, and they envision the regulation of the world economy (Thomson Reuters, 2014). The Thomson Reuters report shows the expansion of worldwide research capability in the last ten years and the loss of competitiveness among leaders (until now) compared to emerging economies. Indicating this change is the increase in the number of papers in WOS, including 145% increase in Brazil, 115% increase in India, a 373% increase in Saudi Arabia. Additionally, a 900% increase in the number of patents in China and a decrease of 3% of the European presence in JCR (Thomson Reuters, 2014). These statistics not only reflect the relationship between development, science, and innovation, but also describe the strategies of specific countries (especially those with emerging economies) in respect to scientific policies. This trend is not surprising, considering science is a fundamental element for an industrialized society, and a point of attention to be reached by peripheral countries; in short, it is a question of survival (Salager-Meyer, 2008). Triad science, technology, and publication form part of the generation of wealth, which is the base of true independence, and the emergence of the balance of duties among countries of the world today (Salager-Meyer, 2008).

In this context, and that of an increasingly competitive world, there are many authors that question a measurement system that prioritizes (to a greater extent) the “global” rather than the “local-peripheral,” and whose products (made by companies) only seek the maximization of profits and audiences. It is also not surprising that numerous countries (e.g., Japan) develop policy initiatives aimed at commercializing their academic science, restraining publication in order to protect the value of its patents; this situation adversely

affects open science (Walsh & Huang, 2014) and significantly impacts on social welfare. This system is creating a series of impostures, imbalances and contradictions that lead researchers to question their participation in this type of publication, and more than this, their scientific contribution to society.

The aforementioned example should make us reflect on the true role of the university in the world of science. Timothy Gowers, professor at the University of Cambridge, recently led the movement “the cost of knowledge” and in little time more than 10,000 researchers around the world had joined. But perhaps the project of Nobel Prize winner Randy Schekman demonstrates this ideal more clearly. Schekman created the journal *eLife* which has been renowned as a clear example of free, open science of great quality, with no commercialization and outside the impact indexes of “traditional science”. It is a journal designed for the current times and reveals the business of big publishing houses and the problems of revision processes (Schekman, Watt & Weigel, 2013a). The paradox of a scientific project of social contribution has done just that, without request, it has been included in JCR and WOS; not for the benefit of *eLife*, but for the benefit of the rest of the editors of such listings whom are now able to witness the increase in the number of citations of those papers in their articles. The journal *eLife* is not an isolated case, *Plos* also has achieved the same success; both reflect Open Access (OA) initiatives of science that contribute to society in a responsible manner. We should recall that the impact factor was never meant to measure the quality of individual research, but rather a tool of comparison among journals (Schekman, Watt & Weigel, 2013b); thus it is important to consider the systems of measurement, evaluation, and classification that we have built around these indexes.

The OA movement brings extra value to universities (Aliaga, 2014), not only is it driving a science of social commitment, but

also contributing to the improvement of the visibility of international science that it is being developed in countries least present in selective international indexes (Alperin, Babini & Fischman, 2014; Guo, Chue & Li, 2014). The strategies of open science for the disclosure of the impact of I+D entail the development of business innovation, demonstrating the positive effect of university collaboration in these movements (Jong & Slavova, 2014). This discourse, closest to the responsibility of universities with OA and their social contribution, is important enough for higher education institutions to move away from the debate that wants to feed off of the benefits of OA in the metrics of citation (McCabe & Snyder, 2014; Craig, Plume, McVeight, Pringle & Amin, 2007).

The ICTs, social changes, citizens’ demands, the need to work for a more equal society, and the role of higher education institutions have influenced a new way of understanding “Science 2.0” and, as such, they provoke discussion and studies about new ways of establishing the impact factors of this new type of science (e.g., Hoffman, Lutz & Meckel, 2014; Konkiel, Piwowar & Priem, 2014) and comparisons about its effectiveness with respect to traditional forms (Brown, 2014; Thelwall, Haustein, Larviere & Sugimoto, 2013). More so, the debates about these new *Article Level Metrics (ALM)*, emerging forms of evaluation about the impact (or presence) of research derived from the possibilities of the social web, is very present today in the international scientific literature.

Drawing comparisons is a way to address the debate, but it is also possible to be more reflective: (a) to present these indicators as new forms of scientific communication (Torres, Cabeza & Jiménez, 2013), (b) to propose alternatives to measurements based on the social network (Keita, 2012), (c) to analyze the change in measurement roles, techniques, and methods (Mehraban & Mansourian, 2014) or (d) to recognize their complementarity (Mounce, 2013) and the

potential of ALMs in the researchers' curriculum vitae as well as its compensating role in traditional metrics (Piwowar & Priem, 2013).

## Conclusion

The university, as a social institution, is in the process of transformation. Its academic structures and organizations are adapting to the new communicative dynamics of access to information and knowledge and of social relationship. But the great transformation is derived from the paradigm shift in educational methodology, i.e. the passing from an academic culture based on the transmission of knowledge to another focused on promoting the learning competence and process. The technologies of information and knowledge, especially the internet, are accelerating many institutional transformation processes facilitating the access to information and knowledge. However, institutions have not lost their essence, they transform and adapt themselves responding to new demands and new professional profiles.

It is not an easy debate to speak about scientific communication and the new formulas of measurement that loom over academic publication. Accepting one or another position depends on the conception that one has about science, research and the role that adopts as a citizen. Nevertheless, it is not only taking place the new forms of impact measurement, but also the benefits of Open Data are indisputable and open the horizons of science (Boulton, 2014). This new way of "doing" science allows the availability of open data, the availability of an open code, supports the replication of results, the refinement of theories, laws... and, in sum, offers tools to improve education (Light, Polley & Börner, 2014). The ALM implies, simply, a representation of the social impact of academic works, a complementary, necessary and representative information.

All of this, in short, reveals emerging forms of understanding and doing science that begin to

move away from the traditional gears. It is, finally, the intersection of a social and a technological layer of a network society that demands a greater social commitment from scientific institutions.

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<b>Abstract / Resumen</b>	<p><i>Over the last two decades as a result of the introduction and intensive use of technologies for information and knowledge in general, from the internet in particular, the university is living in a process of complete transformation that affects its academic and organizational structures as well as the conception of educational methodology. The ICTs have demonstrated a need to establish coherent institutional strategies in their use and application along with the possibility to expand the sphere of institutional action in regards massive access to higher education. All of this shows an existing change from a model of education based on the transmission of knowledge, that was rather limited and under restricted access, to another that should fundamentally facilitate the competence to learn from people that live in the world in constant change, with open access to information and knowledge. In addition, all of this implies a transformation in the dynamics of communication and diffusion of scientific knowledge, that is now converted into something open and accessible which is subject to an analysis of knowledge social networks.</i></p> <p>A la largo de las dos últimas décadas y como resultado de la introducción y uso intensivo de las tecnologías de la información y del conocimiento en general y de internet en particular, la universidad esta viviendo un proceso de transformación complejo que afecta a sus estructuras académicas y organizativas así como también a su concepción de metodología docente. Las TIC han evidenciado la necesidad de establecer estrategias de coherencia institucional en su uso y aplicación, así como la posibilidad de ampliar los ámbitos de acción institucional y el acceso masivo a la formación superior. Y todo ello pone de manifiesto el cambio existente de un modelo de formación basado en la transmisión del conocimiento, que estaba bien delimitado y bajo acceso restringido, a otro que debe fundamentarse en facilitar la competencia de aprender a personas que viven en un mundo en cambio constante y con acceso abierto a la información y al conocimiento. Todo ello, además, conlleva a una transformación en las dinámicas de comunicación y difusión del conocimiento científico, que se convierte en abierto, accesible y sometido al análisis de las redes sociales de conocimiento.</p>
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