Learning ecologies in the digital era: challenges for higher education

Ecologías de aprendizaje en la era digital: desafíos para la educación superior

数字时代的学习生态：高等教育的挑战

Экология обучения в цифровую эпоху: вызовы для высшего образования

Mercedes González-Sanmamed
Universidade da Coruña
mercedes@udc.es
https://orcid.org/0000-0002-3410-6810

Albert Sangrà
Universitat Oberta de Catalunya
asangra@uoc.edu
https://orcid.org/0000-0002-5144-9938

Alba Souto-Seijo
Universidade da Coruña
a.souto1@udc.es
https://orcid.org/0000-0002-9140-3184

Iris Estévez Blanco
Universidade da Coruña
iris.estevezb@udc.es
https://orcid.org/0000-0003-2821-5663

Abstract

The immersion of society in the digital age has decisively influenced people's ways of behaving, in the field of work, economy, entertainment and teaching. Higher education is undergoing a great transformation due to the technological development in which we are immersed, and these continuous changes have shown the need to keep us updated permanently, thus adopting the idea of life-long learning. Each person and each professional has a wide and diverse range of possibilities to be trained and to learn, which requires individuals to take more and more control over their own learning process. The concept of learning ecologies provides a framework of analysis to know how we learn, and what contexts and/ or elements we use to train ourselves, in order to provide us with new learning opportunities. Being aware of the elements and / or contexts that make up our learning ecologies can be a very useful strategy to help us update ourselves in a self-directed and effective way. This has led us to carry out a bibliographic study aimed at identifying some of the aspects that characterize the new ways in which we learn, which will allow us to understand the role that the university should play in today's society.

Keywords: higher education; learning ecologies; informal learning; lifelong learning; ubiquitous learning; self-directed learning

Resumen

La inmersión de la sociedad en la era digital ha influido de manera decisiva en las formas de comportarse de las personas, en el ámbito del trabajo, de la economía, del entretenimiento y de la enseñanza. La educación superior está sufriendo una gran transformación debido al desarrollo tecnológico en el que estamos sumergidos, y esos continuos cambios han evidenciado la necesidad de mantenernos actualizados de forma permanente, adoptando así la idea de aprendizaje a lo largo de la vida. Cada persona tiene un abanico de posibilidades, amplio y diverso para formarse y para aprender, lo que exige a los individuos tomar cada vez más el control de su propio proceso de aprendizaje. El concepto de ecologías de aprendizaje proporciona un marco de análisis para saber cómo aprendemos, y qué contextos y/o elementos empleamos para formarnos, con el fin de proporcionarnos nuevas oportunidades de aprendizaje. Ser conscientes de los elementos y/o contextos que configuran nuestras ecologías de aprendizaje puede ser una estrategia muy útil que nos ayude a actualizarnos de forma autodirigida y efectiva. Esto nos ha llevado a realizar un estudio bibliográfico dirigido a identificar algunos de los aspectos que caracterizan las nuevas formas en que aprendemos, lo cual nos permitirá comprender el papel que debe jugar la universidad en la sociedad actual.

Palabras clave: educación superior; ecologías de aprendizaje; aprendizaje informal; aprendizaje a lo largo de la vida; aprendizaje ubicuo; aprendizaje autodirigido

概要

在数字时代的社会沉浸已经对人们在工作，经济，娱乐和教学领域的行为方式产生了决定性的影响。高等教育正在经历着科技发展带来的巨大变革，而这些不断的变化证明了我们需要不断适应当前情况，采纳终身学习的理念。每个人都有各种各样的培训和学习机会，这要求个人越来越能够掌控自己的学习进程。学习生态的概念为分析我们如何学习以及我们运用什么背景和/或元素训练自己提供了一个框架，以便为我们提供新的学习机会。能够意识到影响我们学习生态的要素和/或情境可以是一个非常有用的策略来帮助我们以有效的自我指导跟上形势。由此，我们进行了一项参考书目研究，旨在确定表现我们学习新方法的某些方面，这将使我们能够了解大学在当今社会中应发挥的作用。

Аннотация

Погружение общества в цифровую эпоху оказало решающее влияние на то, как люди ведут себя в сфере труда, экономики, развлечений и образования. Высшее образование претерпевает большие изменения в связи с технологическим развитием, в которое мы погружаемся, и эти непрерывные изменения показали необходимость постоянного обновления, тем самым принимая идею обучения на протяжении всей жизни. У каждого человека есть широкий и разнообразный спектр возможностей для обучения и познания, что требует от него все большего контроля над собственным процессом обучения. Концепция учебной экологии обеспечивает рамки для анализа того, как мы учимся и какие условия и/или элементы мы используем для обучения, с тем чтобы предоставить нам новые возможности для обучения. Знание элементов и/или контекстов, которые формируют нашу обучающую среду, может быть очень полезной стратегией, которая помогает нам обновлять себя самонаправленным и эффективным образом. Это привело нас к проведению библиографического исследования направленного на выявление некоторых аспектов, характеризующих новые методы обучения, которые позволят нам понять ту роль, которую должен играть университет в современном обществе.

Ключевые слова: высшее образование; экология обучения; неформальное обучение; обучение на протяжении всей жизни; всестороннее обучение обучение; самонаправленное обучение

Higher education in the current knowledge society

The university, like any social institution, is not immune to the various changes that have shaped humanity's evolution, which has gradually generated certain needs, with actions being promoted and decisions justified that expand, limit or question the role and purposes of higher education, both from the diachronic point of view and at a given historical juncture (Gibbs & Barnett, 2013). Hence, analyses must take into account this development and promote a critical vision of the various internal and external actions that have arisen in response to influences of the different types –cultural, philosophical, religious, economic, and/or political– that university institutions have had to face.

It is real the dual role of the university, as a receiver and promoter of change and social progress, must be recognised (Barnett, 2013; Morin, 2009). But it is also real that these two perspectives fluctuate depending on the context –both spatial and temporal– that is used, the subject or group conducting the study, the intentionality of the discourse, and also on the limitations underlying the theoretical frameworks employed, whether by academia, the business world, or the political sphere, to mention just a few examples.

Thus, universities, whether when they arose in the Middle Ages, or during their expansion throughout the Modern and Contemporary eras, through their organisation, functions and purposes, as well as their members' requirements, obligations and privileges, reflect a certain social context, promote certain values, justify certain presumptions, and legitimise certain knowledge (Barnett, 2008; Sosa, 2011). They also illustrate

the interests of certain groups concerned with protecting their functions, upholding their roles and generating a framework for action that is recognised and recognisable by the various bodies exercising power and making far-reaching decisions for society and, ultimately, regulating or implementing actions, relationships and expectations aimed at scientific, technical and artistic development (Barnett, 2010; Strain, Barnett & Jarvis, 2009).

As a result of all this, undertaking an analysis of university institutions requires recognising the changing role that has been assigned to them, the different optics with which they have been viewed, and, above all, perceiving the intricate relationships between the implicit and explicit contexts in which all human action takes place. In particular the work of organisations that have played important roles due to their impact on the course of peoples' histories, by promoting new ways of thinking, behaving and being, thanks to individual and collective intellectual development and, ultimately, by contributing to cultural, social and economic progress (Barnett, 2009).

Any consideration of the university today entails a) evaluating its system of operation and governance; b) reconsidering its structure; c) reviewing its contributions; and d) identifying the expectations it generates and the achievements demanded of it in an era marked by uncertainty and distrust. In short, any examination means revealing the features that make this institution a bulwark of culture, knowledge and science despite the successive questionings of it, and the deep challenges it has had to face. These last ones now, perhaps more than ever, call into question its principles, processes and results.

The limitations of this article do not allow us to delve into the aforementioned diachronic vision. This perspective would allow for a better understanding of the evolution of some of the aspects that have generated the greatest controversy, and would surely help us to better understand the actions that were undertaken in order to reconsider endorse and/or adapt the meaning, expectations and actions of university institutions. Thus, while recognising previous influences, and being aware of the impact they undoubtedly exert on the conformation of higher education systems, we choose to focus our analysis on the present time. The aim is to outline some of the extrinsic and intrinsic aspects that characterise the university, shape its functions and determine the role that it is expected to play in society in this twenty-first century. Especially, with a view to fulfilling one of its purposes with a significant impact on society: the education and preparation of future professionals in the various branches of professional activity.

From an internal perspective, there are two decisive elements when it comes to reviewing and evaluating the university's future. On the one hand, attention should be paid to the characteristics of students, their expectations and needs, as an important criterion for determining the university's role and its contributions at this time. At the same time, the role of university professors also merits reflection, the demands they have to meet, and the implications, with regards to training and professionalization that all this entails.

Both quantitatively and qualitatively, students attending institutions of higher education are completely different from those filling university classrooms only a few decades ago. On the one hand, the university faces a problem of overcrowding, which makes it difficult to maintain the desired levels of quality and the personalised attention that is required. Young people, who have grown up in an environment very different from that of previous generations, reflect totally different cultural formats in their

behaviours, relationships and expectations, which undoubtedly has a direct impact on their way of attending, participating and learning at university (Escofet, García & Gros, 2011). In addition, we are faced with a new socio-labour reality characterized by the instability of professions and the obsolescence of knowledge. With this challenging the purpose, contents and methods of learning; generating uncertainty and permanent questioning at the macro level (threatening the foundations and functions of universities) and at the micro level (challenging the contributions of certain courses of study and content in favour of more instrumental and exchangeable knowledge in the professional field). Universities, therefore, play a fundamental role here, as they must train people capable of developing their own knowledge autonomously, furnishing students with the tools (cognitive and conceptual) that help them process the most important information, and strengthening their ability to learn to learn.

Professors are one of the linchpins determining quality of higher education institutions, and, particularly, the relevance and value of university education. As the roles of faculty in the 21st century change in response to society's evolution, training becomes an element key to teaching professional development. Thus, university teachers must acquire a series of skills that enable them to design new educational scenarios and itineraries allowing them to satisfy the demands of an educational paradigm centred on learning and individual learners (Aguilar, 2016; Mas &Tejada, 2013; Montes & Suárez, 2016; Torra et al., 2012).

In addition, when considering the extrinsic aspects that affect the functioning of universities, it is necessary to take into consideration two closely related factors having a clear influence at every level during this age: globalisation, as a defining characteristic of today's society; and dizzying technological development (Sangrà & González-Sanmamed, 2004), as an element key to analysing modes of production, relationships, and life, from both private and public points of view. The confluence of both aspects constitutes one of the defining features of what has been called the "knowledge society", a term denoting not only the value of knowledge in itself, but also its prominence in every context (personal, family, professional...) affecting people, and the interdependence that occurs with other elements of the dynamics shaping the development of social organisations today.

Globalisation can, indeed, be regarded as one of the most characteristic aspects of the current civilisation: it affects the entire planet, which is transforming into a global village (McLuhan, 1971), and permeates every sphere (economic, political, social, business, financial, legal, military, cultural, educational, leisure...) affecting individuals lives, the development of communities, and the actions of organisations, regardless of their status. It is a dynamic process whose development and expansion have been multiplied by the availability of more accessible, secure and effective technologies that make possible connections, liberalise and democratise exchanges, and facilitate interactions on various scales. The expansion of the use of Information and Communication Technologies (ICT) –in particular the Internet and, more recently, Web 2.0 applications– has spawned an extraordinary circulation of information, which is also created and shared autonomously and openly. Thereby empowering people and endowing them with a great capacity to manoeuvre, as they have at their disposal the means to move from consumer to producer, express their positions, and cope with the imposition of hegemonic thoughts and behaviours. The technological and digital revolution has given rise to "Network Society" (Castells, 2006, 2009), which is articulated into a continuously connected, decentralised and open social structure that transcends territorial boundaries, overcomes physical and temporal barriers, and dramatically

expands possibilities for mobilisation, intervention and resistance. All of this thanks to the multiple nodes in which a person, group or organisation can situate itself, or through which they can interact.

These revolutions have shaken up every sphere of human activity; particularly, affecting those institutions involved in the education of citizens to facilitate their insertion into a changing, technologically complex and highly competitive world. In this reality, it is necessary to know and master new forms of discourse, the latest codes, and the most sophisticated tools in order not to suffer some exclusion gaps that have emerged in this extremely heterogeneous and unequal society.

The creation, systematisation and dissemination of knowledge as pillars and hallmarks of universities, from their advent down to the present day, have also been controversial, and can be taken as an example of the transformations that the institution has undergone over its more than eight centuries of existence (Didriksson, 2007; Gibbons et al., 2007; Innerarity, 2012). Indeed, knowledge plays a crucial role in the dynamics of our society, such that it becomes one of its main hallmarks (Sacristán, 2013).

Given these phenomena of change in our society, it is necessary to undertake actions, from the different spheres of social reality, including and highlighting Education, to overcome the challenges that individuals and organisations face. Education is being challenged to respond to the demands made by society's transformation (Maina & Garcia, 2016); particularly, by taking advantage of, integrating and promoting new forms of learning and opportunities open to all citizens.

The metamorphosis of learning: new perspectives for analysis

ICT have played a decisive role in changing people's behaviour in the fields of work, economics, entertainment and, of course, education, for more than two decades (Saadatmand & Kumpulainen, 2012). In Fenwick's words (2001), "the information technology revolution has transformed modes of doing business, the nature of services and products, the meaning of time in work, and the processes of learning" (p.4). Beyond ways of teaching, its greatest contribution is how it has engendered new possibilities for learning, as there has been a genuine metamorphosis in the ways we learn due to the new opportunities that have arisen.

There have been many changes, but we can identify at least four fundamental catalysts of this transformation. First, the connectivity of networks, which permit a level of peer interaction never seen before. Secondly, the empowerment of the student, who is able to make decisions about his own learning, deciding what and how he/she wishes to learn. Thirdly, the overcoming of spatial and temporal barriers, which also allows us to decide when and where to learn, without further limitations. And fourthly, the assumption that there is, sometimes, an unnoticed, informal, invisible, silent learning that, nevertheless, allows us to acquire fundamental skills.

Connected learning

Castells (2005) indicates, in the foreword to one of the many books published in the mid-2000s on the Information and Knowledge Society (Tubella & Vilaseca, 2005), that

our current society is organised through networks, with this representing a change in our social morphology. He then defines what a network is: a set of interconnected nodes.

These nodes interact with each other, generate new structures, exchange information, and form a very dynamic and flexible social structure that is constantly moving and, therefore, ever-changing. Past analyses are becoming less and less able to explain the state of things today, what we do, how our institutions are organised, and what their purpose is. Change, although not always easily accepted, is the common thread of a way of life that finds in inter-node interaction our society's models of analysis and development (Castells, 2005, p.11) underscores that:

The network society's processes of social transformation also profoundly affect culture, broadly understood, and power. The ICT-centred technology system has made possible the emergence of a new economy, a new form of management, with respect to both businesses and public services, a new media system, a new culture, and new forms of organisation and political and administrative participation.

In this context, education in general, and higher education, in particular, are not an isolated phenomenon. The idea of interconnected nodes, which explains these new economic, cultural and organisational models, is also applicable to higher education. Siemens (2004) is the first to suggest that, although until recently behaviourism, cognitivism and constructivism were the main theories that sought to explain how learning occurs, the social upheaval resulting from globalisation and the information and knowledge society render these theories insufficient.

Martí-Vilar, Palma, Martí and De los Ángeles (2013) state that the aforementioned theories are based on the principle of internalised knowledge, focused only on the individual. Siemens (2006) argues that these theories do not take into account learning that occurs outside individuals; that is, learning stored and manipulated by technology, and learning that occurs in organisations; and that nor do they contribute to the value judgements that must be made in knowledge environments.

As a result of this process of critically assessing the most notable theories of learning, Siemens (2004) contributes a new standpoint in the form of an emerging theory: that of Connectivism. In his own words, "Connectivism is the integration of principles explored by chaos, network, and complexity and self-organisation theories". (p. 4)

Connectivism is based on the following principles:

- Learning and knowledge rests in diversity of opinions.
- Learning is a process of connecting specialized nodes or information sources.
- Learning may reside in non-human appliances.
- Capacity to know more is more critical than what is currently known.
- Nurturing and maintaining connections is needed to facilitate continual learning.
- Ability to see connections between fields, ideas, and concepts is a core skill.
- Decision-making is itself a learning process.
- Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality.

Advocates for the idea of Connectivism consider learning to be a process that occurs within a nebulous environment of changing elements not entirely under the individual's control. Thus, learning can take place in different scenarios, as it is "a process of creating a personal knowledge network, an idea consistent with the way people teach and learn on the Web 2.0" (Sobrino, 2011, p.117).

Siemens (2006) indicates that learning is related to creating connections between information nodes and pattern recognition. Nodes are external entities that can be used to form a network. The influence of Castells' concept of the Network Society (2006) seems, therefore, evident. Nodes can be people, organisations, libraries, web pages, books, magazines, databases, or any other source of information.

Although it cannot be concluded that this is a truly new theory of learning, the truth is that it is proving highly influential today (Bell, 2011). This approach, which posits that a very significant part of learning takes place due to connections and exchanges of information between nodes, has generated new interesting ideas and models.

Deleuze and Guattari (1972), for example, employ the botanical metaphor of the rhizome –an underground stem that grows horizontally and from which different shoots are born independently of each other– to this philosophy. They assert that a rhizomatic model has no centre, and that the conception of any element from its structure is generated regardless of reciprocity by any other element. Cormier (2008), meanwhile, applies it to learning. In a rhizomatic learning model, the curriculum is not generated by the contributions of experts. Rather, it is constructed and negotiated in real time through the contributions of those involved in the learning process. As you can see, its elements have clear "connectivist" connotations.

The systematic incorporation of technologies, in general, and social networks, in particular, has generated the attempt (historically pursued by traditional distance learning) to establish crowd learning models (Dron & Anderson, 2010). On the one hand, these models aim to solve problems of an economic nature by reducing the costs of learning and making them scalable. However, on the other hand, they operate from the conviction that they are developing models of collective knowledge (Downes, 2010).

As García Aretio (2012) points out, the good thing about any knowledge or any learning is being able to exploit it when a situation requires it. However, as this is not always possible, "the ability to know how to locate the sources in which to find what we need, and connect with them, is a vital skill today" (p. 370).

Hence, the importance of establishing these connections in our knowledge networks, as stressed by those upholding the concept of Connectivism. These networks will help us remain up to date in this very dynamic society, in which most people will work in different areas over the course of their lives; and, because the life of knowledge is short, we must attach more importance to the knowledge networks we establish than to knowledge itself.

Decisions about what and how to learn

Living in a society undergoing constant and increasingly accelerated change has made the need to learn throughout life, and constantly remain up to date, a common place (Jiménez-Frías et al., 2010). Lifelong learning occurs in a wide variety of formal and informal contexts, where learning is sometimes intentional, and sometimes a chance.

This phenomena requires individuals to take ownership of their own learning processes (Alexander, Kernohan, & McCullagh, 2004).This internal need to take charge of one's learning and efficacy has given rise to suggestions that self-directed learning should be used to promote lifelong learning skills in students (Boyer et al., 2014).

Self-directed learning, according to Knowles (1975), "is a process by which people seize the initiative, without help from others, to diagnose their learning needs, formulate goals, identify human and material resources, and evaluate learning outcomes" (p.18).

Karakas and Manisaligil (2012) update this definition when they place it in the context of the digital age. In that context, emerging technologies applied to the educational arena give rise to a set of tools, or Web 2.0 ecosystem, and allow global connectivity and technological convergence to enhance substantial and underlying decision-making in self-directed learning, complemented by virtual collaboration, online communities, and digital creativity.

Based on these definitions, and with contributions from researchers, such as Brookfield (2009), Fischer and Sugimoto (2006), and Hiemstra (1994), the following are the main characteristics of self-directed learning:

- It is initiated by students themselves, who are increasingly responsible for making decisions about their own learning.

- Some of these decisions are related to answering these questions: how and what to learn, where and when, and how to access the different resources.

- This means that students learn at whatever pace they decide and by solving the problems, they are given.

- The fact that the learning is self-directed, by the student, does not mean that he is alone. In fact, in many cases this learning is in groups, and the teacher has his own role as one who engages in dialogues with his students, facilitates their acquisition of resources, and encourages their critical thinking.

- Students carrying out self-directed learning will be able to transfer their learning, in terms of knowledge and study ability, from one situation to another.

In the context of the digital age, self-directed learning takes on particular importance, as the technologies available to citizens allow them to take the initiative and captain their own learning processes, thereby making it a much more creative (Karakas & Manisaligil, 2012) than reactive process. Collins (2006) emphasises that, since interest is what prompts one to decide to learn for oneself, and thus, become more involved in one's own process, self-directed learning is a strategy that should be encouraged.

Some of the strategies that students can employ to stay current are: searching for text-based information sources, browsing websites, searching for formal or structured learning opportunities, creating new informal contexts, and developing knowledge networks, such as mentoring relationships, among others (Barron, 2006a). This learning is of great importance to professional development, as it will make it possible to expand knowledge and, consequently, improve the quality of professional practice (Shen, Chen, & Hu, 2014).

The relevance of self-directed learning means that, from models based on educational decisions made by institutions (where individuals were passive subjects), we are shifting to models where the individual makes his own decisions about his learning trajectories. In *Do-It-Yourself University; Edupunks, Edupreneurs and the Coming Transfor-*

mation of Higher Education, Kamenetz (2010) writes that students taking the initiative and making decisions regarding their learning processes is a trend that is bound to transform higher education institutions.

Options on where and when to learn

If individuals' commandeering of the learning process, and decision-making about what and how to learn is a fundamental aspect of the metamorphosis we are witnessing, so is the overcoming of spatial/temporal barriers to learning; that is, when and where.

The advent of the Internet and related technologies in our society has dramatically changed the way information is accessed. Knowledge has been relocated, and there are no longer just a few repositories for it. Rather, it is now accessible from multiple locations, at any time, and in distributed form.

The concept of distance (the place or time separating two things) is all but obsolete, as the time period that elapses between the creation of knowledge and its diffusion –or, rather, awareness of its existence– can be almost nil. Thanks to technology, we are witnessing the irrelevance of remoteness, as anything that can happen many miles away can be experienced as if it had just happened right next to us (Sangrà, 2008). In addition to our aforementioned ability to decide what to learn, and how, now we also have the capacity to decide when to do so, and from where. Learning has become ubiquitous.

Cope and Kalantzis (2010) stress this when they explain that ubiquitous learning is associated with a new educational paradigm that ICT have made possible. Due to the spread of portable devices and wireless networks providing the means to learn wherever and whenever needed, learning is being integrated into the flow of everyday human activity (Burbules, 2012).

Learning, then, can occur not only in the classroom, but also at home, in the workplace, at a playground, library, museum, park, and in everyday interactions with others. Ubiquitous learning calls on us to rethink how learning occurs, and to reflect on all the possibilities that ICTs offer. As Arenas (2015) points out, it is necessary to study the benefits of learning approaches more focused on students, since they have different skills to learn and different preferences regarding the use of the myriad of learning technologies at their disposal and the opportunities they offer.

Not all learning will or should take place through digital devices, nor should original learning media be ignored when they are available, but it must be borne in mind that the ubiquitous perspective reformulates the environment where learning occurs. According to Burbules (2012), educators must assume roles as, in addition to pedagogues, designers, directors and apprentices, since they themselves are in the midst of "a stream of learning opportunities and experiences, and, from this position, their growth and development may be continuous" (2012, p.12). In addition, new interactive, multimedia and expanded forms of learning are being generated featuring a high level of involvement by citizens in their access to and production and exchange of knowledge, as predicted by Nonaka and Takeuchi (1995), as well as the acquisition of new skills of an instrumental, cognitive/intellectual, socio/communicative, emotional and digital nature (Rendueles, 2016). The result of all this is that the technological tools used facilitate informal and incidental learning in face-to-face and virtual spaces

that transcend the traditional classroom, generating ubiquitous processes anywhere and at any time (Díez-Gutiérrez & Díaz-Nafría, 2018).

(Non-) conscious learning

The iceberg metaphor is valuable to illustrate what happens with learning, especially, but not only, when technology mediation offers us multiple opportunities, in a "ubiquitous" context, as we have seen before.

When we attend a course that is integrated into a certain curriculum, we are aware that we do so because we want to learn something specific and, when we finish it, we can identify what we have learned, and what we have not. In the same way, there is a part of our learning that we do not perceive, which remains "invisible" to us. It is this distinction what characterises formal, non-formal and informal learning.

Taking into consideration some definitions (Coombs, Prosser, & Ahmed, 1973; Conner, 2009; Cobo & Moravec, 2011; Sangrá & Wheeler, 2013; CEDEFOP, 2014), it can be stated that *formal education* refers to regulated programmes that take place in different organised and structured environments. They are characterised by a specific duration and objectives, which, once achieved, entail obtaining certification. *Non-formal education*, on the other hand, refers to activities organised by different institutions, with these actions not being regulated, and not necessarily leading to the issuance of a certificate. Some authors also refer to this as organised informal education (Livingstone, 2001). Finally, *informal education* corresponds to day-to-day learning that occurs in everyday situations (with family, friends, co-workers...). It is not organised, and may occur by pure chance, in which case it is termed "incidental".

Although there have been some efforts to categorise these three types of learning, as defined, the truth is that this is extremely difficult. Some authors, such as Fernández-Enguita (2013) avoid talking about both informal and invisible learning, instead choosing the label of "diffuse" learning, also alluding to a blurred sphere where it is difficult to establish sharp subsets. An interesting proposal is that of Van Noy, James and Bedley (2016), who suggest a continuum between the formal and informal extremes, on which we can identify different degrees of informality in learning.

Cobo and Moravec (2011), meanwhile, address this "invisible learning", emphasising that a distinctive feature of the "invisible" is, precisely, the impossibility of recognising it visually. That is, on the one hand we have explicit knowledge, which is simple to encode or verbalize, and even observe in books, databases, programming manuals, musical scores, etc. Moreover, on the other hand, there is another type of knowledge, called tacit, which is personal or experiential, and much more difficult, or impossible, in some cases, to export, systematize or even verbalize.

Taking into account the impact of technological advances and the transformations of formal, non-formal and informal education, in addition to those intermediate (continuous) meta-spaces, these same authors set out to explore a range of options for the development of future scenarios relevant to current education, proposing a theory that seeks to integrate different ideas and perspectives. This perspective aims to spawn ideas on how to bring about a more relevant education; capable of narrowing the gap between what is taught in formal education and what is demanded by the working world.

The adoption of this perspective requires a series of transformations, and great flexibility, as it calls for a change in tools, pedagogies and practices, all with a view to educate "nomadic" students who tomorrow will be adaptable experts. For instance, in terms of the tools used to facilitate learning, the more ubiquitous and diverse the use of ICT is, the more likely it is that new skills and learning will be developed that are invisible or ignored by traditional knowledge measurement tools (questionnaires, parameterized tests, multiple-choice tests, etc.). Likewise, Fernández-Enguita (2013) indicates that "at the pole of diffusivity relations between people prevail, in all their facets; at the pole of specificity, relationships between roles do, restricted to the definition of these in the context" (p.153), which is also important in terms of the analyses that can be carried out of informal, invisible, or "silent" learning.

Learning ecologies as an integrative perspective

As we can derive from the above, higher education is undergoing a major transformation due to the technological development currently surrounding us. Zabalza (2008) states that the university initiates the educational process for many adult individuals, but, given the features of today's society, it cannot complete it. In line with reflections on ubiquitous learning and invisible or informal learning, (Fischer, 2000, p.3) explains that "learning can no longer be dichotomized into a place and time to acquire knowledge (school) and a place and time to *apply* knowledge (the workplace)". Therefore, we must become people able to learn to learn (Rocosa, Sangrà, & Cabrera, 2018), to continue doing so throughout our lives and to deal with the large volume of information that we are forced to process every day (Mas & Tejada, 2013). Tabuenca, Ternier and Specht (2013) state that continuing permanent education and lifelong learning encompass the different contexts in which individuals operate. These contexts include both formal, non-formal and informal education.

Today's learning theories must account for the rich, dynamic, interconnected and complex systems in which knowledge is created and shared; hence the emergence of concepts such as learning ecologies. "An ecology is basically an open, complex, adaptive system comprising elements that are dynamic and interdependent. One of the things that makes an ecology so powerful and adaptable to new environments is its diversity" (Brown, 2000, p.19). As Looi (2001) states, the ecological metaphor favours a broader perspective on learning, as it seeks to respect all those ways in which it can occur. According to Siemens (2007), this metaphor lays the foundation for future educational models, more in line with the context and characteristics of current knowledge: chaotic, interdisciplinary and emerging. Barron (2004) defines learning ecologies as "The accessed set of contexts, comprised of configurations of activities, material resources and relationships, found in co-located physical or virtual spaces that provide opportunities for learning" (p.6).

Likewise, more recently, Jackson (2013) determine that "An individual's learning ecology comprises their process and set of contexts and interactions that provides them with opportunities and resources for learning, development and achievement" (p.2).

From all this, we can conclude that the concept of learning ecologies (Sangrà, González-Sanmamed, & Guitert, 2013) stresses the possibilities of having an analytical framework to appreciate how we learn, and what contexts and/or elements we use to

educate ourselves, in order to enjoy new learning opportunities. Being aware of the elements and/or contexts that make up our learning ecologies can be a very useful strategy, helping us to stay up to date, both personally and professionally (Maina & García, 2016). As Barron (2006b) states, the purpose of developing a framework of learning ecologies is to help us think about the dynamics of learning over time and in different settings. Sangrà, Guitert, Pérez-Mateo and Ernest (2011) state that learning ecologies provide us with a framework to interpret the multiple learning opportunities offered by the current complex digital landscape, in which issues such as the integration of formal, informal and non-formal opportunities, and some intermediate meta-spaces that lead to invisible learning, can be consistent with improving lifelong learning and career development.

The concept of learning ecologies arises, then, as a perspective integrating the catalysts of the learning metamorphosis to which we referred above: a) the generation and maintenance of learning networks where collective knowledge is created; b) the initiative of individuals who seize the reins of their own learning process, and decide which opportunities they will pursue, and which they will not; c) in a context where the parameters of space and time are not limiting; and d) where learning is both visible (formal) and invisible (informal), based on activities, resources, relationships and interactions (Barron, 2004) taking place in different contexts and processes (Jackson, 2013).

This capacity for integration makes ecologies a valuable framework for analysing the ways and patterns in which different individuals and groups learn. Evidence of this is provided by the different research projects that have already been undertaken based on this concept. Whether it has been to analyse the way doctoral students learn (Esposito, Sangrà, & Maina, 2015), or teachers (González Sanmamed, 2017; González-Sanmamed, Santos, & Muñoz-Carril, 2016; Hernández-Selles, González-Sanmamed, & Muñoz-Carril, 2015; Van den Beemt, & Diepstraten, 2015), homeless people (Strohmayer, Comber, & Balaam, 2015), or entrepreneurial mothers in Canada (Christen, Sangrà, & González-Sanmamed, 2016). As can be seen, it is possible to apply the learning ecologies analysis framework to a wide range of different groups.

Learning and teaching at the university: a learning ecologies perspective

In addition to the internal organisational and governance challenges currently facing universities, they are also dealing with a profound change in society that is already influencing them and that will continue to do so in the immediate future.

Bauman's reflections (2005) on education in "liquid modernity" point to some of the issues that today's university will have to face. What he calls "impatience syndrome" refers to the impulse to minimise any effort related to education, the obsolescence of knowledge, whose lasting value ceases to be a positive attribute and instead becomes a burden. Also the desire or need of each individual to have access to a unique education that is substantially different from another, so as to be able to better compete by "not being like others" (Bauman, 2005, p.40).

Universities, from core to node

One of the effects, which we just put forward, is the fact, already accepted, that universities some time ago lost their monopoly on knowledge (Laurillard, 2002) and are unable to manage it in its entirety.

In addition, as we have already seen, society is beginning to be structured into much more flexible and adaptable networks, which can be created, eliminated and recreated very readily. In this reticular society, there are "switches" that can be used as reference elements (Castells, 2003). From this perspective, we should understand that universities have gone from having a core function to being a node that must play a qualitative role in that network. Thus, they become one of those switches to which Castells alludes, and that changes the way people learn. In other words "it is no longer about how the person assumes and assimilates knowledge from outside to inside, but rather how he is able to make information interconnections through the group with the support of technological tools" (Martí-Vilar, Palma, Martí, & De los Ángeles, 2013, p.136). It is true, however, that this means the loss of some control over and the power to manage learning, in so far as various influences and multiple purposes will motivate learning activities (Burbules, 2012), and that is the great challenge that universities are facing.

Co-creating knowledge

Cope and Kalantzis (2010) point out that another major challenge is the blurring of traditional education's institutional, spatial and temporal boundaries. Haythornthwaite (2009) concurs, stating that the differences between professors, as generators of knowledge, and students, as users of it, are now indistinct. The borders become diffuse, such that this author believes that we are dealing with a "new relational order". At issue is the emergence of the co-creation of knowledge and the participatory designing of higher and lifelong education. The result: authority will no longer be generated through regulatory control, but rather through competition. In the words of Fernández-Enguita (2013) "not only is learning decentralized, but also, on the other side, so is teaching" (p.155).

The danger of glorifying credentials

The potential of informal learning is evident to higher education institutions, and some universities have even discerned that they can monetize its recognition, given the value it can have in professional and social life (Cobo & Moravec, 2011). As lifelong knowledge is increasingly valued, however, we are less likely to be able to certify all our learning by means of diplomas or other official documents.

Diversified sources of learning

As Burbules (2012) explains, the possibilities of ubiquitous learning offer us an opportunity to commence a dialogue on the shared responsibility to create and sustain a society of learning by engaging formal institutions and other entities that share their knowledge.

However, they also allow for the emergence of new forms of organisation, as Kamenetz (2010) suggests when she proposes that everyone create their own university (Do-It-Yourself University). There is no doubt that higher education institutions may see this as a threat, as unfair interference in their own educational mission. However, they would do well to consider how to work together from different perspectives.

On this point Fernández Enguita (2013) provides an interesting explanation of the education development at school, which has gone from something very broad and open, to something very specific and closed, as the result of an industrial society model. Now shifted again towards the challenge of a more open, broad, and amplified model: "the specific in the face of the diffuse" (p.151).

"It should be stated, in general, that wherever a relevant area of non-formal education –non-regulated teaching or education– has been identified, sooner or later schools have tried to absorb it, with varying degrees of success" (Fernández-Enguita, 2013, p. 153). In the current discussion, it seems interesting to see whether higher education institutions carry out this absorption successfully, and whether this is the right strategy; that is, formalising the informal (Sangrà & Wheeler, 2013).

The concept of learning ecologies includes the impact of the four above-mentioned catalysts on the ways in which we acquire knowledge. An approach based on learning ecologies can provide universities with a better understanding of how their professors really stay up to date. Also a deeper comprehension about how their current and future students (those who will trust them for their lifelong learning process) learn, in such a way that they are able to structure appropriate responses to their needs in an environment as dynamic as the one we live in today.

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