




## Contributions to the consolidation of connectivism as a pedagogical approach to the development of learning processes

*Aportes a la consolidación del conectivismo como enfoque pedagógico para el desarrollo de procesos de aprendizaje*

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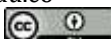
This article reflects on connectivism as a pedagogical approach for the development of learning processes that can be generated from information and communication technologies applied to education. It is presented as a pedagogical alternative that has gone through a series of epistemological debates about its theoretical character and pedagogical value to transform traditional educational practices. The methodology used was the documentary review and includes the main investigations on connectivism that have been carried out in Latin American countries, the United States and Spain, among others, and which are referenced in various databases, such as Redalyc, Dialnet, Springer and Scopus. In the results, the different theoretical and conceptual discussions about connectivism are presented, emphasizing the contributions that it has had to the consolidation of new pedagogical and educational currents for the development of learning processes.

### PALABRAS CLAVE

conectivismo,  
educación, enfoque  
pedagógico, procesos de  
aprendizaje.

Este artículo reflexiona sobre el conectivismo como un enfoque pedagógico para el desarrollo de procesos de aprendizaje que se pueden generar desde las tecnologías de la información y la comunicación aplicadas a la educación. Se presenta como una alternativa pedagógica que ha pasado por una serie de debates epistemológicos acerca de su carácter teórico y valor pedagógico para transformar las prácticas educativas tradicionales. La metodología que se utilizó fue la revisión documental y recoge las principales investigaciones acerca del conectivismo que se han realizado en países de latinoamérica, de Estados Unidos y de España entre otros, y que son referenciadas en diversas bases de datos, como Redalyc, Dialnet, Springer y Scopus. En los resultados se presentan las diferentes discusiones teóricas y conceptuales acerca del conectivismo haciendo énfasis en los aportes que ha tenido para la consolidación de nuevas corrientes pedagógicas y educativas, para el desarrollo de procesos de aprendizaje.

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## 1. INTRODUCTION

In 2004, George Siemens published a document entitled “Connectivism: A learning theory for the digital age”, in this he exposes an analysis about different learning approaches that have surrounded the development of instructional environments and, in other words, the education. This author starts from the idea that learning must be personal, and being impacted by technologies, it must create in the individual the “capacity to synthesize and recognize connections and patterns to learn” (Siemens, 2004, p. 5). In this sense, it can be said that in the midst of the rise of new technologies, the individual is immersed in a chaos of connections and patterns, on which he will have to make decisions and these decisions will become the basis of his knowledge.

For his part, Downes in 2005 refers to the fact that there are new forms of knowledge that are created through connected entities that have interactions and have distributed knowledge. In other words, Downes (2005) affirms that knowledge is not only quantitative, nor qualitative, knowledge is a new form of representation and interpretation of the sensations we receive from the world in relation to the distribution of knowledge. This reiterates the idea that knowledge does not come exclusively from the individual itself, this knowledge is connected by entities that are in chaos and that conform new patterns that must be understood by the individual when his perception in relation to the world changes.

### a. Connectivism as a pedagogical approach

Now, following Siemens (2004) and Downes (2006), to understand better connectivism it is necessary to take as reference different concepts that give rise to its relevance as a pedagogical approach, since from the understanding of these concepts it is possible to identify the epistemological discussions that have arisen around it and its contributions to improve the development of learning processes

#### ➤ Network

In the words of Siemens (2004), “A network can be defined simply as connections between entities. Computer networks, electric power meshes and social networks operate on the simple principle that people, groups, systems, nodes and entities can be connected to create an integrated whole ”(p. 6), without going beyond the definition itself, the network for Siemens (2004) is made

of connections and the points that unify those connections are called nodes (entities). However, for Downes (2006), what can be understood by network, must be inferred from what he defines as connective knowledge in which there are entities that have distributed knowledge, and between entities there are interactions (connections), that depend on the interpretation produced by emergent phenomena (See figure 1). In accordance with the above, connectivism establishes that there is no defined network that limits the flow of information between nodes and / or entities.

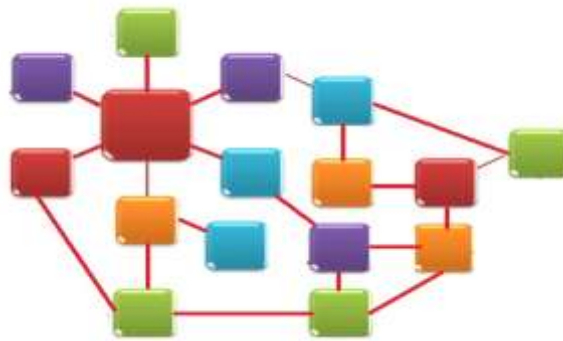


Figure 1 Network, connections and entities  
(Source: Own elaboration)

### ➤ Nodes

Siemens (2004) defines the nodes from the network science theory, he explains that the nodes “always compete for connections, because the links represent survival in an interconnected world” (Barabasi, 2002, p.106). To clarify it further, Barabasi (2013) says that nodes exist before networks and that once there is a link connecting the node to the network, it will integrate it. In this sense, Downes (2006) takes the same concept of node and link from network science theory.

In practical terms, the nodes can be considered learning communities, which are made up of the individuals who participate in the community and the information they have; These nodes can also vary in their strength to impact the network depending on the number of individuals participating and the amount of information they have. And in the event that a node wants to integrate into the network, the same network will make its connection possible, or if, on the contrary, a node isolates itself from the network, it will form a smaller network, but in the same way it will continue to be a net. Following a graph that exemplifies this option.

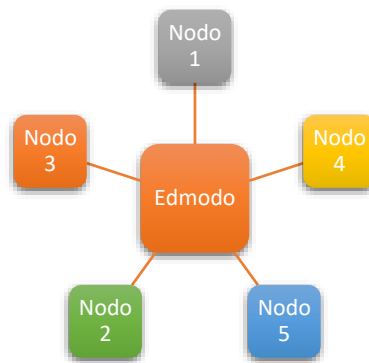


Figure 2 Construction of a network  
(Source: Own elaboration)

Although the previous one is a simple network, five nodes that configure it can be seen; the nodes revolve around a larger node that in this case can be exemplified on the web, with platforms such as Edmodo, which constitutes an educational social network, which offers teachers, students, parents and educational communities in general, the Option to connect your members among themselves and with members of other learning communities, to share information, strategies, activities, evaluations and learning experiences. which will become a form of connective knowledge, this term has as its principle the recognition of patterns that allow individuals, in this case of educational communities, to have a certain configuration of what they know (Leal, 2012).

### ➤ Self-organization

Siemens (2004) clarifies that his theory of connectivism starts from "the integration of principles explored by the theories of chaos, networks, complexity and self-organization" (p. 6), for this reason he takes the concept of self-organization. That is why it articulates the conception of learning to concepts such as network and node; But as evidenced in relation to the previous concepts, the network and the nodes act interconnectedly and since a network can have a large number of nodes, these nodes are connected by competition, so it is necessary to speak of self-organization.

The concept of self-organization Siemens (2004) adopts it from Rocha (1998), where it is said that "self-organization is the spontaneous formation of well-organized behaviors, structures and patterns, based on random initial conditions" (p. 3). However, in the case of Downes (2005), the concept of self-organization would become the possibility of understanding, what does it mean to know? Because this is the quintessential representation of learning, since "learning is based on organization and connectivity in the brain" (Downes, 2005, p. 21), which consequently implies

that the perception of Downes (2005), about learning is not static, although it depends on how learning environments arise that are located in the network and that are explored by connective knowledge, which transcends the qualitative and the quantitative.

### ➤ **Learning**

Finally, with regard to the concept of learning, it could be said that at this point one enters the coldest and most elusive part of connectivism as a learning approach, since Siemens (2004) refers to learning as “a process that occurs when interior of diffuse environments of changing central elements - which are not entirely under the control of the individual ”(p. 6). He also explains that learning "is focused on connecting specialized information sets, and the connections that allow us to learn are more important than our current state of knowledge" (Siemens, 2004, p. 6), with which the individual is involved as Part of a network, in which you must make decisions and those decisions will be the basis of a necessary competence for the digital age, in which access to information is almost unlimited.

For his part, Downes (2005) does not speak as such of learning, he makes a clear description of the way in which knowledge is given or created. Which, it could be said, differs from a conception of learning, but at the same time it contributes to connectivism; Downes explains that knowledge is connective and depends on the interpretation of an emergent phenomenon (signals) involving different entities (nodes), which interact (connect) from interpretation patterns established by physical qualities that are associated through connections with what already known, thus creating networks.

And it is in this different conception of learning between Siemens and Downes that many variables have been given to understand the contributions of connectivism in the pedagogical and educational field, which is the subject of this reflection document.

## **2. METHOD**

The purpose of this reflection article was to analyze the contributions to the consolidation of connectivism as a pedagogical approach to the development of learning processes, based on the theory of Siemens (2004) and Downes (2006), for this reason the article compiles different pedagogical conceptions in which connectivism has been inserted since 2004. The document contains a total of 50 bibliographic references, between research articles and book chapters, these analyze the main epistemological debates of connectivism:

- ✓ Connectivism as a pedagogical vision
- ✓ Connectivism as a theoretical framework to understand learning
- ✓ Connectivism, network learning and learning networks
- ✓ Connectivism and Personal Learning Environments (PLE)
- ✓ Connectivism as a basis for the design of instructional models of learning

In order to present a wide spectrum of the consolidation of connectivism in the pedagogical field, its theoretical bases and the pedagogical axes that define them are presented. The methodology used was the documentary review and includes the main investigations on connectivism that have been carried out in Latin American countries, the United States of Spain, among others, and which are referenced in various databases, such as Redalyc, Dialnet, Springer, Scopus and google academic. The documentary review was carried out by means of access to said databases, since they deal with themes around the subject of the immersion of information and communication technology in education.

### **3. RESULTS AND DISCUSSIONS**

#### **a. Connectivism as a pedagogical vision**

Various authors, since 2008, Kop & Hill (2008), Ravenscroft (2011), Şahin & Abu Safieh (2012), Adell (2013), Morras (2014), Steffens, et al (2015), Bair & Stafford (2016 ) among others, they have highlighted the work of Verhagen (2006), as one of the main alternatives to the understanding of connectivism, because it indicates that connectivism as such is not a learning theory, that it is a pedagogical vision It can be adjusted to the study plans because they are concerned with what is learned and why?

So, the learning principles that Siemens (2004) postulates, according to Verhagen (2006), can be grouped in four bases for the development of a study plan that understands the learning demands of the digital age.

- ✓ The ability to see connections between fields, ideas and concepts should be promoted.
- ✓ The necessary connections must be nurtured and maintained to facilitate continuous learning.
- ✓ The ability to choose what to learn and the meaning of the information seen through the lens of a changing reality should be promoted.
- ✓ Learning can reside in non-human devices.

Otherwise, the principles of Siemens (2004) do not go beyond being postulated. They cannot be verifiable in practice, which takes away the connectivism character of learning theory. even Duke, B., Harper, G., & Johnston (2013) state that “If connectivism is considered a theory of learning rather than a theory of simple connection, there should be a transfer and promotion of student understanding” (P. 8), with which it can be shown that Vergahen's (2006) critique of connectivism has been studied and revised, in light of its possibilities to determine the role of the student in learning.

Regarding the subject of learning, Verhagen (2006) explains that Siemens (2004) understands it as a result but not as a process, and that is why he states that learning can reside in non-human devices, which implies that the Siemens theory does not differentiate between the learning of people and the learning objects; This is questionable in terms of understanding human learning activities, which are related to reasoning and understanding. In other words, Verhagen (2006) affirms that the postulates of Siemens can be adjusted to topics related to the learning of algorithmically programmed machines, but in no case this form of learning by algorithms can explain how human learning occurs.

Vergahen's (2006) critique can be considered one of the clearest in relation to the way connectivism is taken as a learning theory; since, Siemens (2004), based on chaos theory, network science and the parameters of self-organization. It is referring to learning as something given and that, by residing in non-human devices, as if it were something finished. It should be clarified in this case that Verhagen's (2006) criticism, in the midst of being valid, is not taking into account Downes (2005) postulates on connective knowledge, which could solve this crisis of connectivism around what it is conceived as learning.

Now, Verhagen's (2006) critique has been taken as a basis to talk about connectivism from other learning contexts, which include the topic of pedagogy as an essential part to improve educational processes; which has given way to new ways of understanding connectivism. For example, Morras (2014), quotes that “Some authors (Verhagen, 2006; Kop and Hill, 2008; Bell, 2011) doubt that connectivism can be considered as a theory of learning; in any case, it would constitute a pedagogical proposal in accordance with the new realities derived from web 2.0” (p. 40).

## **b. Connectivism as a theoretical framework to understand learning**

Kop & Hill (2008) add a different variable to the criticism of connectivism that started with Verhagen (2006). Kop & Hill pose the following question: is connectivism a new learning theory for the future or is it instead a holdover from the learning theories of the past? Or yes on the other hand, can connectivism be erected as a theoretical framework to understand learning in the 21st century?

To answer this, Kop & Hill (2008), start from the definition of the concept of theory, establishing that it must meet specific criteria that allow it to constitute itself as such. In this sense, a theory “must be within the domain of scientific research, use scientific methods and be based on studies. It must be logically constructed and verifiable through tests ”.

In this regard, it should be clarified that connectivism is part of scientific research, but that it is not related to the field of learning research, these theories are framed in sciences different from it, such as network science and chaos theory. When the theory was raised in 2004, by Siemens, it did not have tests and / or applied research that allowed determining the veracity of its postulates, because connectivism is based on the experiences of Mooc courses, which according to Downes (2013 ) begin in 2008. Therefore it can be deduced that connectivism does not meet the condition of being a theory.

In view of this lack of connectivism, Kop & Hill (2008) highlight that there are theories of development, which can be considered as emerging theories and that these "can lead to empirical research that validates or refutes the formal hypotheses postulated in the framework of the scientific method ”. With which connectivism could be understood, not as a theory of learning, but as an emerging theory of learning. In this regard, a key element that reiterates this idea is that only four years later, Siemens (2008) will begin to integrate categories of understanding of learning based on the theoretical principles of objectivism, pragmatism and interpretation; which allowed connectivism to offer a different and alternative conceptual basis for learning, highlighting that it starts from a reality that is external to the mind and that there is a negotiation between the reflection, experience and research that occur through socialization and the signals generated by distributed knowledge.



### **c. Connectivism, network learning and learning networks**

The network learning is a phenomenon that is beginning to consolidate as an essential part of the way in which individuals learn in relation to the emergence of new information and communication technologies in the 21st century, and although there are antecedents that can speak of network learning at the pedagogical level, it could be said that it acquires all its epistemological and conceptual weight in relation to connectivism as a theoretical framework (Kop & Hill, 2008), which allows defining the principles of action of network learning.

In this sense, studies such as that of Duke, et al, (2013) appear, which will talk about learning communities with connectivist forms of socialization; This study highlights that connectivism:

"It is characterized as a reflection of our society that is rapidly changing to a society that is more complex, socially and globally connected, and mediated by increasing advances in technology, so that learning involves the orchestration of a complex disorganization of ideas networked to form information sets "(Duke, et al, 2013, p. 6).

Therefore, it could be established that connectivism constitutes the theoretical base that gives rise to the understanding of the way in which network learning occurs; because it specifies the way in which society and the school operate and react in front of the transformations resulting from technology, and therefore contributes to the creation of guidelines that guide the understanding of changes in learning, as a structural part of this society. According to Duke, et al, (2013) "connectivism is undoubtedly an important school of thought directly applicable to the use of technology in the classroom today". And it offers a "network configuration that can help new generations collaborate to find solutions to answer a large number of questions" (p. 9).

In this regard, studies on online learning and learning networks share with connectivism key concepts such as the information society, the knowledge society, the digital age and skills for the 21st century. They also cite, among others, the work of Siemens (2004, 2008, 2010), as a benchmark that gives rise to the concept of online learning, placing it as a bet for the reformulation of the educational system and the promotion of skills throughout life, for children, for adolescents, and for professionals (Sloep & Berlanga, 2011).

From another perspective, Bartolome's study (2011) is one of the most representative that makes direct reference to the theoretical correspondence between connectivism, online learning



and learning networks, because, according to this study, learning can be understood as “a process of connecting and generating information in the context of a learning community ”(Bartolomé, 2011, p. 71), highlighting that there cannot be only one way of understanding how learning occurs or is generated, then, any attempt to understand learning must respond to the different approaches that it has studied, such as constructivism and cognitivism, thus taking up the postulates of Kop & Hill (2008).

Bartolomé (2011) points out that learning from a connectivist perspective implies increasing the knowledge of an individual. In other words, “if we have accepted that knowledge does not reside in the individual or even in the group, it resides in the interactions in the group, it will be necessary to accept that learning is not the enrichment of the individual, it is the process by which these interactions increase ”(Bartolomé, 2011, p. 73), and this is what has become known as online learning. The peculiarity in relation to connectivism is that the network is not only the space or the medium in which learning occurs, it is also an entity to which learning is reversed. From another perspective, Steffens, et al (2015) highlights that connectivism talks about what network learning implies, while the application of the theory of Siemens (2004) and Downes (2005) was reflected in the creation and design of massive open and online courses (MOOCs), which were intended to provide a framework for how connectivism operates.

In the case of studies on learning networks, it can be highlighted that they are characterized by presenting learning networks as “online learning environments that help participants develop their skills by collaborating and sharing information” (Sloep & Berlanga, 2011, p. 56), so that they can share experiences, work collaboratively on projects, create working groups, offer and receive support from other users of the learning network and evaluate themselves as learning communities with specific purposes oriented towards improvement and educational change. Murillo (2009) cites that learning networks can be grouped according to their focus of educational transformation in:

- ✓ Networks seeking innovation in the classroom through the application of shared experiences of teachers who have similar academic and disciplinary interests.
- ✓ Networks that seek to improve schools, through groups of teachers who share the organization and common structures of their schools in order to generate knowledge that allows them to transform their educational environments.
- ✓ Networks that seek to impact and contribute to the transformation of education in general, from research and development to educational innovation (Murillo, 2009).

In summary, from the perspective of connectivism in relation to online learning according to Duke, et al, (2013), it can be said that “there is no doubt that online learning is a direct technological response to learning from different cultures, methods and inspirations ”; Thus, “anyone can participate and perform various functions: for example, students, teachers, 'coaches', mentors, curious onlookers, individuals seeking support, etc.” (Sloep & Berlanga, 2011, p. 57), as long as they exist common purposes that imply working collectively with collaboration and commitment to generate and acquire knowledge, from negotiation and autonomy.

#### **d. Connectivism and Personal Learning Environments (PLE)**

The concept of PLE (Personal Learning Environment), arises in 2004 in the development of the NIMLE project, cited by Adell & Castañeda (2013), however it is Álvarez (2014), who specifies that in the framework of the NIMLE project, in the which is developed by the JISC (Joint Information Systems Committee) congress, is where the concept of PLE appears, because in that congress, “they expose the need, and possibility, of developing platforms for learning management (LMS) less focused on needs of control of the organizations and with more possibilities of personalization for the student ”(Álvarez, 2014, p. 15). Which leads us to establish the direct connection that exists between connectivism and PLEs, because both are based on the development of LMS, from a pedagogical approach.

In this sense, the importance of personal learning environments in relation to the rise of connectivism, comes from the fact that the sources from which individuals learn have varied and consolidated on the Internet, making the educational elements of the school traditionally, they conflict with goals they must achieve to promote learning. In this way, the postulates on personal learning environments following Adell, et al, (2013), can be associated with the principles of connectivism, based on the following premises:

- ✓ Teachers are not now the only source of specialized information.
- ✓ The standard assessment leaves out personal learning.
- ✓ The belief that knowledge resides in people's heads leaves aside the fact that knowledge depends on external resources with which we establish relationships,
- ✓ Knowledge is on digital media or online.

Now, in Webinar # 4: Personal learning environments, the work carried out by Adell & Castañeda (2010) is cited, where the personal learning environment is defined, as a “set of tools, sources of information, connections and activities that each person assiduously uses to learn”.

On the other hand, Adell (2014) refers to the fact that a vital element for the good development of a personal learning environment through the network should be the selection of information, under the fact that “the Knowledge is not “localized”, it is not accumulative, that our greatest cognitive capital is not what we “have in mind”. The networks of connections between information and the relationships that form those connections are capital. Those networks and connections are organized and evidenced thanks to our PLE. ” (Adell, et al, 2013, p. 32).

In another sense, Gros (2015) affirms that the school is no longer the space-center of knowledge, but has become a space-node of knowledge, which implies that said school in the information society no longer It is the center, the school constitutes one more node of the network, in addition "mobile technologies allow students of all ages to operate through different contexts." (Gros, 2015, p. 61). This position brings connectivism's postulates even closer to the principles that underlie personal learning environments, in fact, in general terms, it can be established that, according to Gros (2015), personal learning environments represent the setting where the learning of connective form. Consequently, a “PLE can be seen as a platform based on social networks, focused on the learner and designed to allow sharing, collaborating and producing resources and content through distributed participation processes.” (Gros, 2015, p. 62).

#### **e. Connectivism as a basis for the design of instructional models of learning**

Instructional models of learning constitute a new scenario in which the postulates of connectivism begin to be mixed with the applied principles of online learning, taking into account the ubiquity of digital technologies. "It is on this last aspect that instructional design is mainly based, which is based on identifying which methods should be used in the design of the instructional process, and also determining in which situations these methods should be used" (Fernández, et al, 2017, p.1).

For his part, Zapata-Ros (2012) exposes the bases for the construction of a theoretical model of learning and the elaboration of knowledge from connected learning environments. Zapata-Ros (2012), part of which learning “is the process or set of processes through which or of which ideas, abilities, skills, behaviors or values are acquired or modified, as a result or with the contest from study, experience, instruction, reasoning or observation”(p. 5), this means that knowledge has meaning, value, is operative in different contexts and can be represented and transmitted to other individuals.



Now, Bair, R. & Stafford, T. (2016) present the discussion between multimedia design theory and connectivism, establishing that web 2.0 has drastically changed the possibilities of designers to create models of learning instruction, due to that web 2.0 "has enabled students to locate, assemble, modify, and transfer documents and other files worldwide" (Bair, et al, 2016, p. 129).

From this perspective, connectivism can represent a way out of the new models, because such connectivism understood as a theory "will lead to the consideration of the amalgam of e-learning and mobile learning technologies and, therefore, may forge a path towards a more ubiquitous format that allows instructors greater autonomy "(Bair, et al, 2016, p. 130). As Downes (2008) did, through his massive open online courses (MOOC), according to Morras (2014), highlighting that "in parallel to this new theory of connectivism learning, new instructional models emerge, such as , the concept of e-learning 2.0 coined by Stephen Downes to symbolize the application of Web 2.0 tools in education "(p. 40).

According to what has been said about connectivism, in the first decade of the 21st century it could be considered that it went from being identified as a theory for learning, to a frame of reference to understand learning. And so far in the second decade of the 21st century it has come to be understood as a network learning model and / or as a method for designing instructional learning models, among other interpretations.

Molina (2016) in this sense highlights that:

"Within the connectivist pedagogical model, there is a type of learning that has been called in multiple ways: ubiquitous learning, invisible learning, situated learning, interactive learning, digital learning, among others. All these learning proposals have a common element: the ubiquity of Information and Communication Technologies, in our daily life and particularly in educational processes. (Molina, 2016)

Thus, connectivism seen as an emergent learning theory or as an emergent pedagogy, provides an approach to interpreting learning different from that proposed by traditional pedagogies, where the student turned out to be a receptacle of information obtained by repetition. Now we are talking about discovery learning, ubiquitous learning, meaningful learning, etc. As well as learning environments and ecologies that favor skills in 21st century students.

#### 4. CONCLUSIONS

The connectivism proposed by Siemens since its appearance in 2004 as a pedagogical theory has made significant contributions to the development of new conceptions about learning and the way in which it must be understood in the 21st century, therefore it is possible to show the changes and challenges that the education you are facing. Changes that urgently require new pedagogical and educational perspectives that facilitate the articulation between information and communication technology and education.

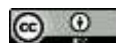
Connectivism can be conceived as a process of connecting information that, regardless of its source or the node that provides it, has the possibility of generating different types of learning, which can be applied inside and outside the classroom, which leads to its consolidation as a pedagogical strategy to improve learning processes and this is reflected in the broad theoretical transition it has had during the first and second decades of the 21st century.

Connectivism understood as a pedagogical approach to understand learning has generated a very enriching debate at the educational level that has allowed it to transcend theory and insert itself in classrooms as an instructional model of learning, thus delocalizing traditional pedagogies to offer new models of learning, such as PLEs, which today contribute to the consolidation of articulation strategies of information and communication technologies in traditional schools, offering a wide range of learning possibilities for students, who are recognized as the part central to these learning processes.

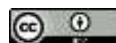
Connectivism as an emergent learning theory or as an emergent pedagogy still has challenges to face as long as it can identify and develop knowledge acquisition processes that can be used that beyond being instructional and constitute a true guide for the promotion and improvement of learning methods that make it easier for students to “learn to learn” to identify networks, nodes and to self-organize their learning around not only personal interests. Also to own contents of the academic curricula.

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