The knowledge and information in the connectivism theory

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Abstract

On the context of technological development and society organized on network, appears the learning theory for the digital age, the connectivism. It is about of a Siemens and Downes proposed, in 2004, that highlights the knowledge as result of established connections on the networks, what allows the capacity of reflection, deciding and sharing. In this context, it objectifies with this article searching the theoretical panorama of thematic about connectivism and its relation with knowledge and information. There is a search of quality approach and of exploratory nature that comes out of a Systematic Review of Literature adapted of Cochran Center. As result, it was observed that, on the searched basis, the number of publications in the period of 2011 to 2017 had the balance in total occurrences compared to the types of documents, events articles and periodicals, with a higher incidence of publication in 2015. For the paucity of thematic it was observed that has discussions about what refers the legitimacy of a theory for the connectivism.

Keywords: connectivism; information; knowledge

1. Introduction

With the advent of web 2.0, it grows in a significant way the volume of information and, in the context of network, a renewing approach of learning makes itself necessary, as the important abilities of learning and innovation. For the XXI century abilities, the students need to learn to make easy its success in the future.

According to Mattar (16) learning is not a process entirely under control of individual. Knowledge is not being acquired with linear way, in addition, it is in others person's, organization or in a database. Those external connections empower what is can be learned, being more important than actual state of knowledge.

In this scenery, George Siemens and Steven Downes, in 2004, have submitted to the scientific

community, the connectivism that is known as digital age's theory, and of distributed knowledge. Given this fact, it was proposed in this article, investigate the theoretical panorama about connectivism and its relation with knowledge and information. With this propose, it was used as search method the Systematic Review of Literature (SRL). This article has as structure an introduction, followed by a theoretical part about the connectivism theory, the detailing of methodological procedures, the results of SRL and, at last, the final considerations.

2. The knowledge distributed: connectivism theory

For Siemens [3], the knowledge is distributed through an information network and can be stored on a variety of digital formats.

The author as early as 2004, put as assumptions, according to figure 1.

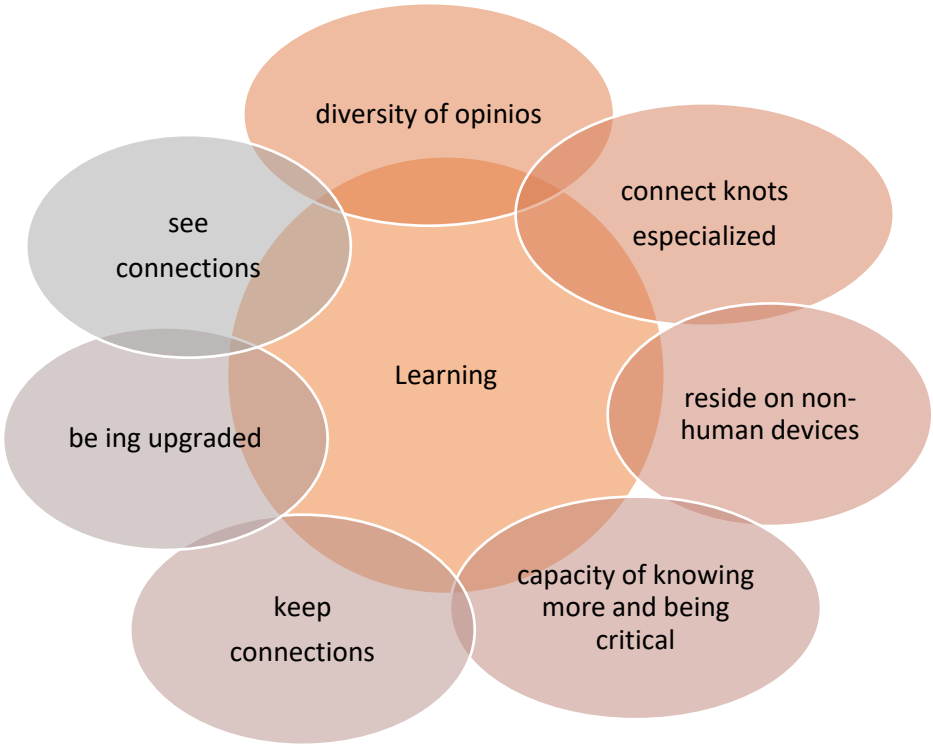

Figure 1. Assumptions of connectivism
Source: adapted from [3].

The affirmation “The learning can reside on non-human devices” is corroborated with the argument of Mechlova and Malcik [4], in which the connectivism was introduced as the learning theory based on the assumption of which the knowledge exists in the world, instead of the head of an individual.

In contrast, Verhagen [7] presents a critic focused in three areas:

a) The connectivism is a learning theory or pedagogy?
b) The principles recommended by the connectivism are present in others learning theory?
c) The learning can reside on non-human mechanism?

On the other hand, Siemens [3] answers the questions presenting the table 1.

Table 1. Comparative table of learning theories.

Property	Behaviourism	Cognitivism	Constructivism	Connectivism
How does learning occur?	Black box—observable behaviour main focus	Structured, computational	Social, meaning created by each learner (personal)	Distributed within a network, social, technologically enhanced, recognizing and interpreting patterns
Influencing factors	Nature of reward, punishment, stimuli	Existing schema, previous experiences	Engagement, participation, social, cultural	Diversity of network
What is the role of memory?	Memory is the hardwiring of repeated experiences—where reward and punishment are most influential	Encoding, storage, retrieval	Prior knowledge remixed to current context	Adaptive patterns, representative of current state, existing in networks
How does transfer occur?	Stimulus, response	Duplicating knowledge constructs of "knower"	Socialization	Connecting to (adding) nodes
Types of learning best explained	Task-based learning	Reasoning, clear objectives, problem solving	Social, vague ("ill defined")	Complex learning, rapid changing core, diverse knowledge sources

Source: Siemens [3].

It should be noted as an answer of the author for the question "The connectivism is a theory of learning or a pedagogy?" Is has like a theory being compared with others prestigious theories.

Regarding with the question "the principles preached by connectivism are to be found on others theories of learning process" to list five characteristics listed on table 1 that differ the theories emphasizing your singularity.

Finally, with the question if "Learning could resist in not human's mechanisms?" It acts an affirmative

position in highlighting the possibility to be in connections, distributed in network and miscellaneous sources of knowledge.

Discussions about connectivism are being still founded on theoretical way about theme, which is correct due its recently source. Independent of theory which will be applied, it´s an author´s agreement mentioned the necessity of change what is actual learning refer.

3. Methodological Procedures

This research it's characterized as qualitative of exploratory nature and its delimitation consists on a Systematic Review of Literature (SRL), adapted to the procedures suggested by Cochrane Center [4].

The SRL it's about a schematically review and planned to respond to a specific question, using explicit and systematic methods to identify, select and evaluate critically the studies, besides collecting and analyzing the data of this study included in this review. "The systematic review uses all this structure to avoid bias in every one of its parts. [5]"

In this study, the SRL consists in 6 phases, according to figure 2.

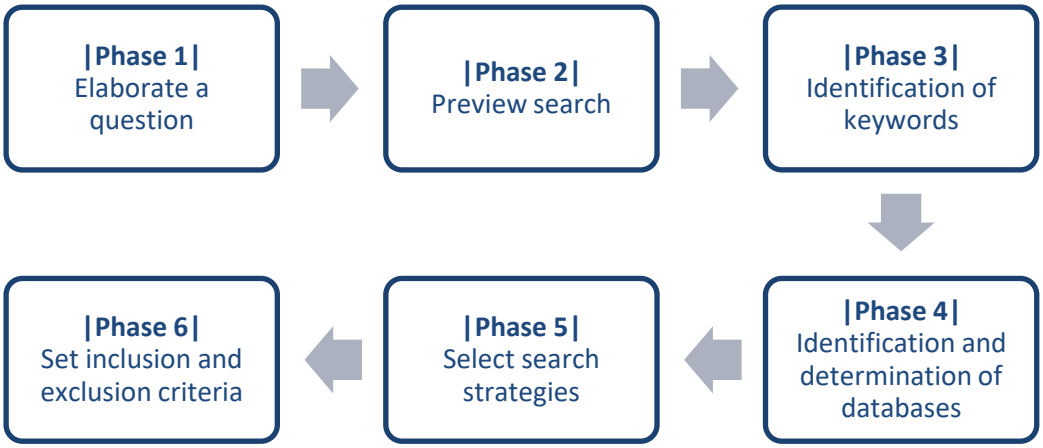

Figure 2. Search phases,
Source: Kuntz e Ulbricht [6].

On phase 1, the elaboration of the question to get the objective of investigates the theoretical panorama of thematic about connectivism and its relation with the knowledge and information came from the question: what is theoretical panorama that relates the connectivism of knowledge and information?

In a preview search, was initially selected the keywords as: learning theory, learning, connectivism, connectivism theory, information and knowledge. It was observed that, attributing the words learning theory and learning, the number of occurrences to analysis became unfeasible considering the research period. Assuming that has a question about the validate of the theory, highlighted by Verhagen [7], it was opted for the search with and without the words "learning theory" and "learning" to verify possible inconsequence.

With the criteria defined on phases 2 and 3, was determined the keywords: theory, connectivism,

information and knowledge, and was possible to relate, according to figure 3.

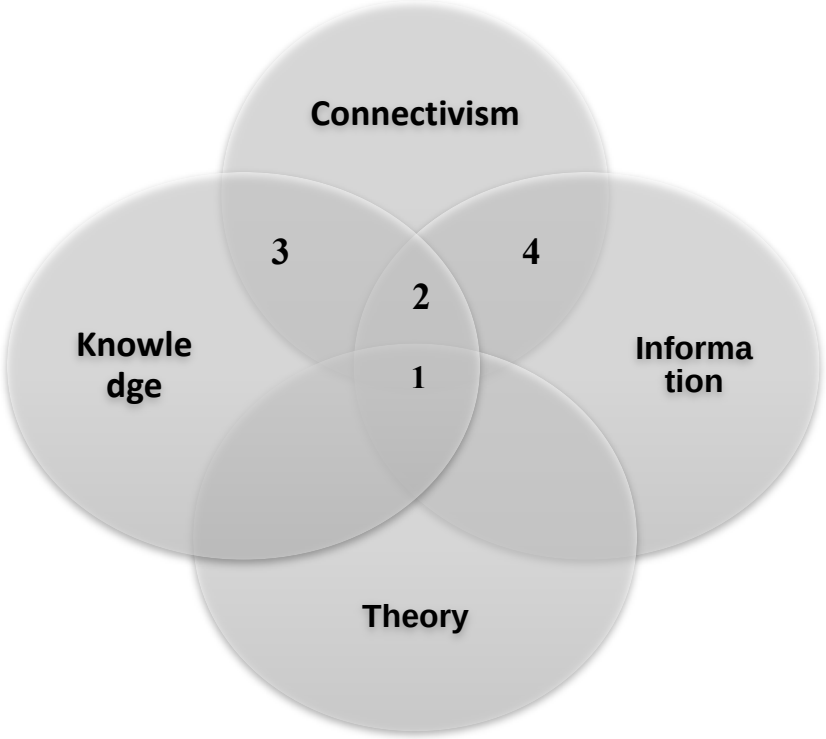

Figure 3. Relations of keywords

Therefore, the following combinations were searched:

a) 1 – connectivism + knowledge + information + theory
b) 2 – connectivism + knowledge + information
c) 3 – connectivism + knowledge
d) 4 – connectivism + information

On phase 4, of identification and selection of databases, it was decided to perform the search on the bases: Scopus, Scielo and Web of Science. Going to phase 5, with the select search strategies, it was identify that, when was searched the keywords in Portuguese, the results wasn't significant, therefore, it was selected just English language and the period from 2011 to 2017 was delimited.

Regarding of the origin of connectivism during the 2004, based in references, it´s noted the historic of fourteen years of possible publications, ending in 2017. A simple search for keyword "connectivism" in databased above it´s possible to be found the number of publications in each year, as seen at figure 4.

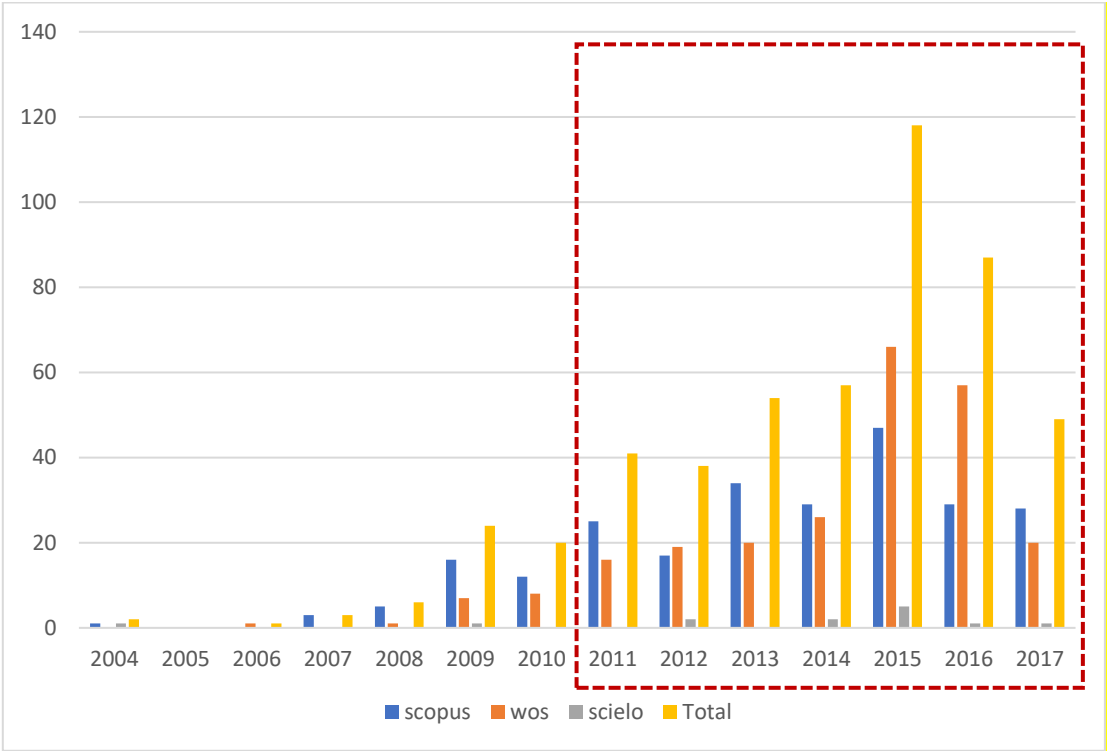

Figure 4. Publications about Connectivism (2004-2016)

It was found during the period of 2004 to 2017 that since from 2009 were obtaining over 20 occurrences, however, just from 2011, in the half period, it was found with more representativeness, approximately 40 occurrences, giving more progression during the last years, therefore, being used for this research.

For phase 6, it was defined that, as inclusion and exclusion criteria: the duplicated occurrences, the kind of publication (event articles and journals). As exclusion criteria, not being fully available, or being a payable access. The inclusion criterion on the next step corresponds to locate the words defined on phase 3 (connectivism, knowledge, information and theory) in the publication title and after analyze the abstract's theme relevance and also of the conclusions.

4. SRL results

With the procedures defined on preview item, the results were a total of 427 occurrences on the selected databases and defined keywords, according to table 2.

Table 2. Number of search occurrences

Keywords	Databases		
	Scopus	Web of Science	Scielo
connectivism + knowledge + information + theory	18	20	3
connectivism + knowledge + information	32	36	4
connectivism + knowledge	80	90	7
connectivism + information	71	60	6
Total per base	**201**	**206**	**20**
General total	**427**		

Deleting the duplicates in each base, the result was 196 occurrences. However, eliminating duplicity between databases, termination was 160. About these occurrences, three was about the references of events and journals, a correspondence to a book's chapter and other to a book and another full journal.

Therefore, the result was 157 occurrences.

Before applying the rest of the search filters, it is relevant present an analysis about the frequency of the article by year and type of publication, according to figure 5.

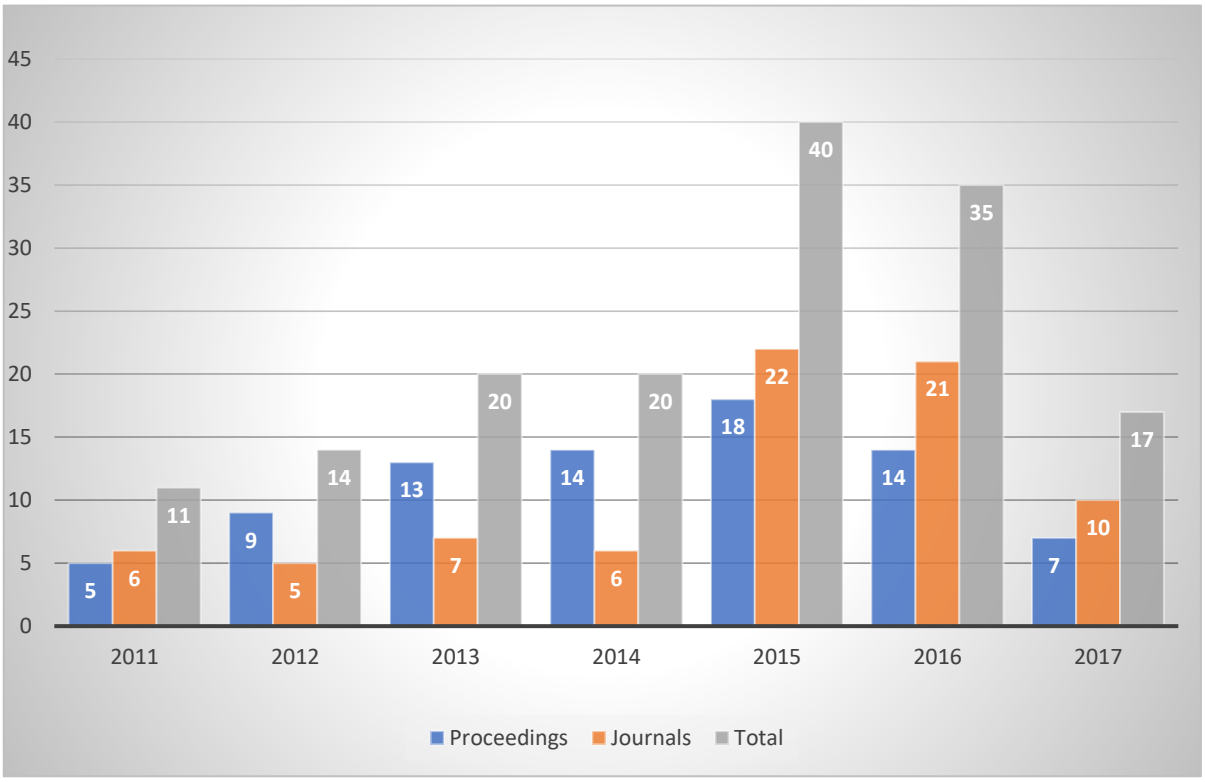

Fig.5. Occurrences of the article by year and type of publication.

It is possible to analyze on the graphic more concentration of publications in 2015 and 2016, in the two years preceding report a linearity of twenty publications, and it is worth highlighting that in 2017 doesn´t

has it´s totality of publications, because of the research published had done in November,2017.

In that corresponds to periodical articles, in 2015 have more concentration, with 22 of 40 articles. For an overall average of type of publication it seems to be a match with 80 occurrences to event articles and 77 to periodical articles.

The table of occurrences also allows verifying the consistency of author's publications. With more than one occurrence related to main authors, regarding of table 3.

Table 3. Consistency of author's publications

Authors	**Publishing quantity**
Bali M.	2
Belahcen A.	2
Cabero Almenara J.	2
Cerny, M.	**3**
Cruz-Benito, J.	2
Belahcen A.	2
Klement, M.	2
Kultawanich, K.	2
Melo Fiallos	2
Molnar G.	2
Siemsen S.	2
Sobrino Morras, A.	2
Steffens, K.	2
Walinski J.	2

It is noted that this survey was made only with the first authors of publications, resulting in fourteen authors with the frequency of two articles, and just author Cerny,M with three articles.

It follows that this linearity and lack of authors with high level of publications in area must be noted with the recently origin about topic already discussed.

In that corresponds to frequency of publications, it have more than one occurrence the events and periodicals that are highlighted on table 4.

Table 4. Frequency of publications

Event/Journal	**Publishing type**	**Frequency of publication**
Advances in Intelligent Systems and Computing	Journal	2
Communications in Computer and Information Science	Journal	2
Dilemas contemporaneos-educacion politica y valores	Journal	2
Red-revista de educacion a distancia	journal	2
Revista Lasallista de Investigación	Journal	2
RUSC Universities and Knowledge Society Journal	**journal**	**3**
Turkish Online Journal of Distance Education	**journal**	**3**
10th International Technology, Education and Development Conference (INTED)	**Proceeding**	**3**
11th International Scientific Conference on eLearning and Software for Education (eLSE)	Proceeding	2
5th International Conference on Education and New Learning Technologies (EDULEARN)	Proceeding	2
5th International Conference on New Horizons in Education (INTE)	Proceeding	2
8th International Conference of Education, Research and Innovation (ICERI)	Proceeding	2
8th International Conference on Education and New Learning Technologies (EDULEARN)	Proceeding	2
8th International Technology, Education and Development Conference (INTED)	Proceeding	2
ACM International Conference Proceeding Series	Proceeding	2
Proceedings of the European Conference on e-Learning	Proceeding	2

According with the frequency, it was noted that of the sixteen selected, thirteen have two publications related with the topic, and three (two journals and one proceeding) with three publications.

It´s also noted that nine are articles of events by proceedings.

To improve a higher quality result of cloud tag, it´s was necessary first, apply filter on title of publications using four keywords (connectivism, knowledge, information, theory). The result was sixty publications.

At fifteen articles was not possible identify the keywords because of three reasons: Structure of this articles does not contain this content, the article wasn´t founded or was a condition with restricted access.

From the keywords of occurrences the result obtained was a cloud with the highlighting common words, as seen at figure 6.

Figure 6. Keywords with more frequency

The words with more prominently are learning and connectivism; on a second level are the words: social, education, e-learning, online and open. It is still possible see with certain relevance the words: information, education, theory, knowledge and open.

Faced with these occurrences, applying the access criteria, it identified 11 pay access and 10 publications with broken access links, resulting on 39 occurrences.

With the reading of these publications abstract and conclusion, it analyzed as the relevance, it obtained 10 publications that appears on table 5.

Table 5. publications to be analyzed about the content

#	Title	Year	Author(s)
	Proceso de enseñanza-aprendizaje y web 2.0: Valoración del conectivismo como teoría de aprendizaje post-constructivista	2011	MORRÁS, A.S.
	Connectivism as a framework for creative productivity in instructional technology	2011	CLINTON, G., LEE, E., LOGAN, R.
	Dialogue and Connectivism: A New Approach to Understanding and Promoting Dialogue-Rich Networked Learning	2011	RAVENSCROFT, A.
	ICT in changes of learning theories	2012	MECHLOVA, E., MALCIK, M.
	Teachers' Competence in Using Information and Educational Internet Resources in the Education Process	2012	SMYRNOVA-TRYBULSKA, E
	La conectividad: Dogmatismo o nuevo referente paradigmático para el docente de vanguardia	2012	PADRÓN, J.; ORTEGA, A
	Development of Instructional Model Based on Connectivism Learning Theory to Enhance Problem-solving Skill in ICT for Daily Life of Higher Education Students	2013	SITTI, S.; SOPEERAK, S.; SOMPONG, N
	Knowledge construction in the Connectivist Learning Environment - CLE	2013	BELAHCEN, A. ABIK, M. ,

#	Title	Year	Author(s)
			AJHOUN, R.
	Aportaciones del conectivismo como modelo pedagógico post-constructivista	2014	MORRAS, A. S.
	Competences, Learning Theories and MOOCs: Recent Developments in Lifelong Learning	2015	STEFFENS, K

On the article 1, Morras [1] proposes to evaluate the connectivism as it concerns the strengths and weaknesses to improve teach and learn. As results, highlights that, although incomplete, declarations of connectivism as a learning theory can defy pedagogy to give a renewed answer. The author quotes Downes [8] when he relates knowledge and information on the sentence: the knowledge is constituted by formation of connections between the knots of information, as isolate content or entire networks, and the learning is just the ability of to build and move through these networks [8].

To Clinton, Lee and Logan [9] article 2, it has as objective, explore ways where connectivism could explain how its professionals of technology must manage the rapid changes, improving the working environment and productivity on a creative way. The relation brought by the authors with information and knowledge is on the rapid change, life time and accuracy.

The article three deals a discussion about the theory of connectivism, emphasizing the evaluation and development of connections with persons and resources by dialogue. The goal is propose some social constructivist approach based in dialectical and dialogical dimensions which could act as the key lever to implementation of connectivism learning and demonstrated that through a private tool called Interloc. The relationship between information, knowledge and connectivism Ravenscroft [17] offer tolls to immediately exchange and also to built knowledge as way to encourage critical thought and reasoned dialogue.

Mechlova and Malcik [10], article 4, discuss the impact in the relation of technology with learning theories behaviorism, cognitivism, constructivism and connectivism on school practical. The authors present as a result an example of use of the ITC on education based on investigation. The relation with knowledge and information is highlighted on the sentence: “Learning (defined as actionable knowledge) can reside out ourselves (inside a organization or a database) is focused in connect sets of specialized information.

Smyrnova-Trybulska [11], discuss in article 5, the levels of competency of the professors on using information and Internet as resource on the process of education, that are very important to contemporary professors. The author quotes the connectivism as example and methodological base to implement these abilities to practice on school. The relation with information is related to the use to promote the professors competences in which can be incorporated the knowledge, abilities and attitude.

On the article 6, Padrón and Ortega [12] reflect about the epistemology of connectivity on a learning environment, obtaining critical consideration about the authors, analysis and evaluations of classic learning theories in relation with connectivism. They discuss about the knowledge that can be conceive out the human mind through the using of devices able to process the information digitally given.

Sitti, Sopeerak and Sompong [2], article 7, proposed to explore the teaching model based on the

connectivism theory to improve the ability of problems resolution. Learning Based on Problems (LBP), on ITC for university students, obtaining a satisfactory response. The knowledge, in this case, for resolution ability of student's problems. Besides, the results can be the information to support systems to policy of higher education.

Conceive e implement connectivism learning environment is the goal of article 8, by Belahcen, Abik and Ajhoun [13]. The objective is adopting connectivism as a pedagogic approach, to build the knowledge through the collaboration between heterogenic community composed by human beings and intelligent objects. The authors highlights the acquisition of information by knots already notify to building of knowledge.

The article 9, by Morras [14], with the goal to evaluate the last contributions of connectivism to improve the teaching process, not as much as theory, but as pedagogical approach of gamification and of Massive Open Online Course (MOOC). Concerning to information, it highlights the excessive and points out that the student's learning process must be rethinking by the professor to transform the information in knowledge.

Steffens [15], on article 10, talks about the connectivism theories and generativism, that for the author goes to explain the collaborative learning on virtual learning environment. Concerning to information and knowledge, the connectivism, for the author, creates a knots external network, where we're connected and creates the information and knowledge source. To the generativism, the information is transformed on metadata, going through knowledge, resulting on learning, and the learning through metadata generates meaning.

On the figure 7 a resume of publications with structured form.

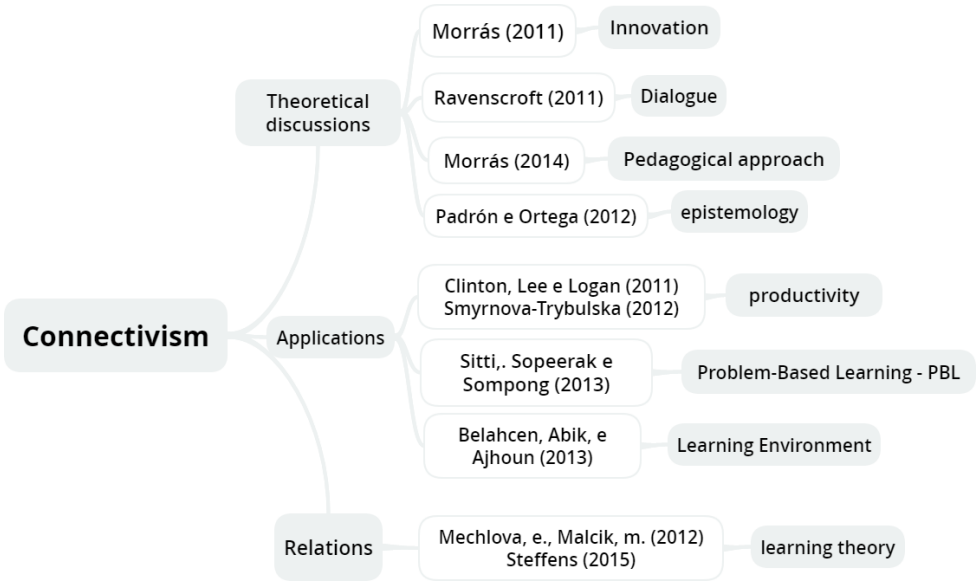

Figure 7. Resume of Publications

All of publications deal with connectivism, however it is possible to rate in:

a) Theoretical discussion: Morras (2011) about innovation;Ravenscroft(2011) about dialogue;

Morras(2014) about pedagogical approach; Padrón and Ortega (2012) about epistemology.

b) Applications: Clinton, Lee and Logan (2011), and Smyrnova-Trybulska (2012) about productivity; Sitti,. Sopeerak e Sompong (2013) about Problem Based Learning (PBL).
c) Relations: Mechlova e Malcik (2012) and Steffens (2015) about learning theory.

5. Final considerations

The found discussions about connectivism are still on theoretical field, what make sense since this was recently discovered. Regardless of the theory to be applied is a consensus of the mentioned author the need for change in terms of learning.

On the Systematic Review of Literature, the search with keywords in Portuguese didn't presents relevant results, being inconsiderate in this research. Although it doesn't be considered Spanish initially, it was obtained three publications at the end.

Also was possible to observe, for example, that on the search for keywords, when the word "theory" was insert on the Scopus and Web of Science base, it was obtained, respectively, eight and five occurrences. With the absence of this term the return was eighteen and twenty occurrences. It can be inferred that this discrepancy is due to debate created around the legitimacy of connectivism be a learning theory.

6. Acknowledgement

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