Relation between U-Learning, Connective Learning, and Standard xAPI: A Systematic Review

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ABSTRACT

U-Learning is the educational process that is performed at any time, place, context and through any device. It is the application of omnipresence in education. The paper presents a systematic review of U-Learning related to the xAPI standard and connective learning. In the systematic review, 824 articles were found in 6 academic databases. According to the inclusion criteria, 54 papers were selected. This paper aims to find links between connective learning and the xAPI standard in the framework of U-Learning.

CCS CONCEPTS

• **Ubiquitous Learning** → **U-learning**; *Education*; • **xAPI** → standard; experience Learning

KEYWORDS

U-Learning, Experience Learning, xAPI, Connective Learning

1 INTRODUCTION

Initially, a systematic mapping review was carried out, this research focused on the educational models and methodologies integrated with Information and Communication Technologies (ICT), the results showed that there are no models or methodologies that integrate ICTs with education in a general way [16]. One of the conclusions indicates that one of the concepts that is closer to the definition of inclusion of education with ICTs is U-

Learning [20]. It was also found that the theory of connective learning is the evolution of learning theories and it supports the processes of education, making use of those concepts of networks in learning [19]. Also, the search allowed to find the standard of the learning experiences or xAPI [12], which defines a way to implement in the different technological tools the characteristic of the Ubiquity. It is important to clarify that the standard is the evolution of other standards such as SCORM and that is under construction and improvement, the xAPI has not yet been fully appropriated. According to this, the need for a systematic review focused on U-Learning, connective learning, and learning experiences were raised [14].

2 SYSTEMATIC REVIEW

2.1 Review Necessity

The evolution of information technology and communication have generated changes in the development of the activities of all people around the world. Education is one of the activities that have been most permeated by the evolution of ICTs [17], according to it becomes necessary to develop new ways to incorporate ICTs in education [24].

In this sense, it can be said that most of the activities that people do nowadays and in this particular case of education, different technological devices that involve hardware, software and communications are used [2]. Current education makes use of networks as a means of communication, especially Internet, software such as operating systems and applications and mobile devices such as smartphones and laptops [13], there are just some of the examples that can be named [6]. However, this evolution and permeation of ICTs in education have reached new levels [21].

Accordingly, there is always the possibility of including technological elements in education that allow the development of education in new scenarios [23]. U-Learning is a term that is influencing the evolution of the ICTs with the idea of developing educational processes at any time, place, context and through any device [8], it is an idea that is becoming reality little by little, this can be observed in the different studies and investigations.

2.2 Process of the Systematic Review

The systematic review (SR) process was carried out following the Kitchenham methodology [10]. According to the methodology, the steps were taken to perform the search of information in the academic databases and then manage the information to analyze the results and generate the conclusions. According to Kitchenham [11] a SR begins with a research question, then the initial definitions are made for the search, the keywords are defined, the databases, the search criteria, the inclusion and exclusion criteria. With these elements, the search process is carried out in each of the defined databases, then the information is managed for the extraction of the data and finally, the analysis of data and results is carried out, which allows obtaining the conclusions of the proposed systematic review.

2.3 Research Question

The purpose of this systematic review is focused on U-Learning and on the development of the pedagogical and technological components of the model that is planned to be developed. Accordingly, the relationship between connective learning and the user experience standard is sought Focused on discovering and generating a new dimension that allows the development of U-Learning. Consequently, the following question has been raised.

RQ1: How to develop a U-Learning model through integrating connective learning and user experiences xAPI?

2.4 Definitions

To have greater clarity in the terms used in the paper, a table of concepts definition was made. The concepts are related to the search strings used in the systematic review. Table 1 presents the concepts and their definitions.

Table 1: Definitions in the Systematic Review

Word	Definition
U-Learning	U-Learning is the ubiquitous learning process that can be performed at any time, place, device and context [3].
Connective Learning	Cognitive learning is the implementation and application of the concepts of networks in the learning process to generate knowledge [22].
xAPI	The Tin Can API (sometimes known as the Experience API or xAPI) is a brand-new specification for learning technology that makes it possible to collect data about the wide range of experiences a person has (online and offline [12].

2.5 Key Words

For the systematic review, the search of 6 keywords in English, Spanish and Portuguese was defined to have a large number of results from the searches and that allows having a complete revision in the databases Table 2.

Table 2: Key Words of the Systematic Review

English	Portugues	Spanish
xAPI	xAPI	xAPI
User Experience API	Experiência de usuario API	API de Experiencia de Usuario
U-Learning Ubiquitous Learning	U-Learning Aprendizagem ubíqua	U-Learning Aprendizaje Ubicuo
Connective Learning	Aprendizagem Conectiva	Aprendizaje Conectivo

2.6 Databases

Six (6) databases were used to perform the information search according to the systematic review. We chose these databases because they are the most internationally recognized in the area of engineering, computing, and education. The database are used IEEE Xplore, SCOPUS, Science Direct, ACM, Web of Science and Google Scholar.

2.7 Inclusion and Exclusion Criteria

The inclusion and exclusion criteria of the systematic review were defined according to the indicated keywords and the research question defined for the search.

The inclusion criteria are: 1) Articles published between the years 2013-2017, 2) Articles published in congresses, congresses, journals and chapters of books, 3) Papers written in English, Portuguese and Spanish, 4) Papers found in the databases detailed in the database table, and 5) Papers related to higher education, virtual education, models and methodologies integrated with information and communication technologies.

The exclusion criteria are 1) Document not available for download, 2) Articles in languages other than English, Spanish or Portuguese, 3) Articles that do not focus on the U-Learning, Connective Learning and Experience Learning xAPI, And 4) grey literature.

2.8 Query Search

It was defined to perform the search by keyword terms in each of the databases, the definition of a general query with all the words was made but no results were found with the three keywords, a chain was made with two keywords and neither were found Results, this is why it was defined to perform searches by words each of the keywords. Table 3 presents the words strings used in the search.

Table 3: Words strings used in the Systematic Review

Search	Word 1	Word 2	Word 3
Strings	(("xAPI" OR "Tin	(("U-Learning"	(("Conne

Can API" OR "User Experience API"))	OR "Ubiquitous Learning"))	ctive Learning"))

The general chain used in the search for systematic review is the following:

(("xAPI" OR "Tin Can API" OR "User Experience API") AND (("U-Learning" OR "Ubiquitous Learning") AND (("Connective Learning"))

2.9 Search Process

The search process is done by accessing in each of the databases, the individual search terms were defined to perform advanced searches, defined keywords and search criteria. No other studies or databases were considered for the search. Once the results were obtained in each one of the databases, the data gathered were organized in a spreadsheet where the following data was retrieved: code, title, abstract, link, conclusions.

The information to organize the obtained information was the following: a) search date, b) database code, c) database, d) search string, e) title and f) abstract.

2.10 Data Extraction

Once all the information of the searches in the databases was unified in the spreadsheet, 824 studies were found in the databases. A general review was carried out to find the papers, the chapter of books, etc.

Then a review of the titles, summary and the conclusions of the works was carried out. This review took into account the inclusion and exclusion criteria, all information relevant to the intended search and that could help to answer the question initially posed. The general summary is detailed in figure 1.
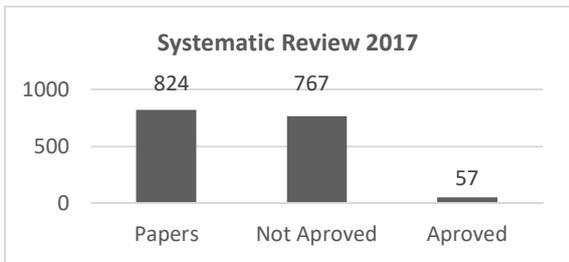

Figure 1: Accepted Papers in Systematic Review.

The papers included in the systematic review were 57, that is, 6.92% of the total papers, which met the inclusion criteria and are relevant to answer the initial question of the systematic review. These documents belong to the defined databases. The general summary of the documents accepted and rejected by the databases is detailed in figure 2.
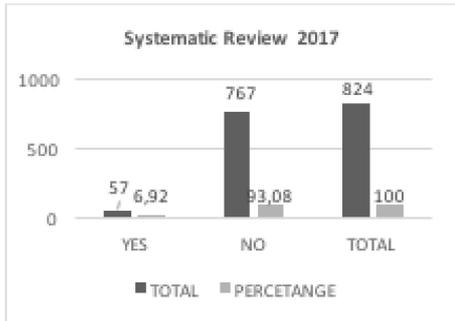

Figure 2: Accepted Papers in Systematic Review. Number of papers and percentage accepted in systematic review

3 DATA ANALYSIS AND RESULTS

3.2 Results of the Systematic Review

Based on the 57 documents accepted in the systematic review, most of the papers were found in Google Scholar, Scopus, Web of Science and IEEE databases, the 95% of the accepted documents are found in these databases. In the other databases (ACM and Science Direct) is the remaining 5% of the systematic review.
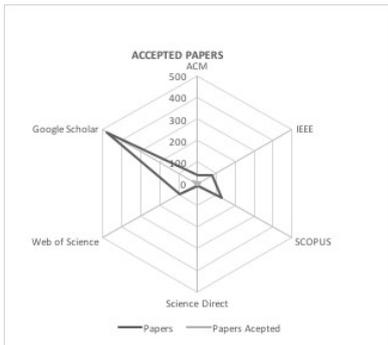

Figure 3: Papers accepted in the systematic review

3.2 Answer of the Research Question

RQ1: The papers found present the relationships between U-Learning and different concepts and technologies, have developed ontologies related to U-Learning, have implemented U-Learning measurement models in different institutions, research has been developed to implement the Standard with the LMS, research has been carried out that mix pedagogical strategies with U-Learning [3].

It has been proposed the connective learning as one of the theoretical bases of U-Learning, philosophical, ethical and legal discussions about data are generated with the U-Learning and the xAPI standard [22].

In the systematic review the book of the future of the Ubiquitous Learning was found, where it is necessary to update the pedagogical ones and to apply the new technologies in the

education so that the U-Learning can be realized in a better form [9].

The papers selected as the most important are those that contain the definitions, characteristics, and applications of the terms U-Learning, Connective Learning and xAPI. In each of the papers, the elements of the functioning and the application of the concepts in the educational processes are established [22].

With the results obtained it is possible to conclude that a case study should be developed that will allow to carry out the tests and validations, as it is observed in most of the papers reviewed and selected. In this order of ideas, it is necessary to propose the conceptualization and characterization of the concepts of U-Learning and connective learning [6] and Experience Learning.

The documents such as papers and books that have allowed for more clarity in the systematic revision are in relation to U-Learning, the book the future of ubiquitous learning, which explains from the conceptualization, to the tendencies and possibilities that exist with the Implementation of U-Learning in education, passed by the evolution of pedagogy and the implementation of ICTs in education. With regard to connective learning, the paper Connectivism: A Learning Theory for the Digital Age was found, which explains all the conceptualization and application of connective learning [4]. Finally, the paper Semantic description of the experience API or xAPI was hidden [1]. Performs the description of the standard and possible applications of the same to develop U-Learning with different tools of ICTs applied in education.

4   CONCLUSIONS

The systematic review allowed the discovery of documents and papers related to U-Learning, which allows generating a framework of knowledge of the state of the art of ubiquitous learning.

U-Learning is not a new concept but has not yet been fully developed. This is why research is conducted with applications in different processes and levels of education.

Connective learning is the theoretical framework of education that is developed through ICTs, comprises the whole conceptual framework to develop learning making the concepts of networks in learning, is the evolution of different Theories of learning that precede it.

The standard of learning experiences or xAPI is a standard that has been developed for some years but has not been adopted completely by the academic and technological community, must continue to develop developments in the application and use of the standard So that it is more used, and thus its benefits improve the educational and learning processes.

The final conclusion is that there are no published papers in which the relationship between U-Learning, connective learning, and the xAPI standard is realized Accordingly, it is possible to develop a U-Learning model that allows relating the connective learning and the standard of learning experiences or xAPI, developing a state of the art and conceptual framework of these concepts and the subsequent design of the model and Validation

of the same through a case study focused on the educational processes of education mediated through ICTs.

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