Analytical Assessment Process of E-learning; Research Domain between 1980 and 2014

Abstract:
Applying some methods to reduce the time and expenditures of training is inevitable in existing circumstances. Many educational organizations have realized the importance of Electronic Learning (E-learning) and tried to use this approach in leveraging their academic classes. As research in E-learning domain has become one of the most important and interesting subjects, observation in emerging and fading trends of E-learning is a need for the scholars and industry professionals who are interested to study and work in the field. This paper has triggered the investigation and depicting of scientific trends in E-learning by using two scientometric methods named burst detection and clustering analysis. By applying two mentioned methods, the hot topics were identified in the field of E-learning.

Keywords:
E-learning, Burst Detection Algorithm; Scientometrics, Text Mining.

1. Introduction

Although modern methods of teaching would never replace with traditional methods, presenting courses in a mere traditional way would not be completed unless along with some new technologies; as it facilitates knowledge transfer [1]. Modern technologies and globalization have created dramatic changes in all aspects of human life. Development in new knowledge and skills helps to apply information. Therefore, new knowledge of "quick and available tutorial" leads to new types of training [2]. In recent years, E-learning has experienced an increasing trend as an acceptable solution for effective and swift learning. E-learning has been defined as the use of internet technology to enhance the quality and quantity of learning [3]. E-learning has been defined as a part of educational process at different levels of education from primary to higher education as well

and can even be used in corporation environments in order to integrate entire staffs and reduce the time and expenses of training [4]. The benefits of this educational system increase the number of training programs in different fields (medical, management, engineering, medicine, information technology, electronics and telecommunications) [5]. On the other hand, all high expenditure of E-learning software, high initial capital and a lot of time to enter the market, lead to emergence of some approaches that attempt to reduce the disadvantages of e-earning through the combination of E-learning into other technologies. Among all these technologies cloud computing [6] and using mobile phone [7] have been used more than others to train. That is why research trends identification is a great help for researchers in this field to recognize emerging trends and choose the subject of future research as time goes on. In the following text it has been tried to review and analyze the published articles in the field of electronic learning in the most prestigious academic database in the world, Web of Science (WoS), by two methods called burst detection and clustering analysis to identify the hot topics in E-learning domain.

2. Literature Review

Due to the benefits and barriers associated with electronic learning in corporations, a lot of research have investigated these challenges, combining E-learning with other technologies and the growth of these technologies. These technologies are as follows: Training on social networks [8-11], E-learning implementation on cloud computing infrastructure [12-15] and Education via mobile phone [2, 16-20] which is a ubiquitous learning way[13, 21].

Chen and Lien [22] used an author co-citation analysis (ACA) which is an analytical method for identifying the intellectual structure of specific knowledge domains through the relationship between two similar authors, analyzed intellectual structure of E-learning from the perspective of management information systems (MIS). Lin and Hu [23] aimed to provide visualization of trends and research fronts in E-learning research from 2002 to 2013 through selecting five core journals from SSCI (British Journal of Educational Technology, Computers & Education, Education Technology & Society, International Journal of Computer-Supported Collaborative Learning, and Australasian Journal of Educational Technology). Harande and Ladan [24] studied development of E-learning literature in Nigeria; 1964-2008. They compiled a number of journal articles from ERIC database. Navalur, Balasubramani and Kumar [25] used Web of science Citation database for retrieving the publications' output in

E-learning during 2000-2011, which were 3070 publications. Chiang, Kuo and Yang [26] found that the quantity of recent research on E-learning is expanding remarkably; most research papers on E-learning are generated by multiple authorship; and applications of E-learning have most found in research areas such as Education & Educational Research, Information Science & Library Science, and Computer Science/Interdisciplinary Applications. Martin et al. [27] analyzed the technologies most likely to impact education in the near future, by looking at technology metatrends from 2004 to 2014. Maurer and Khan [28] analyzed five Social Science Citation Index (SSCI) journals (Journal of Computer Assisted Learning, Computers & Education, British Journal of Educational Technology, Innovations in Education and Teaching International and Educational Technology Research and Development) and two conferences (Educational Multimedia, Hypermedia & Telecommunications and IEEE International Conference on Advanced Learning Technologies). Cheng et al. [29] identified six research themes as result in the E-learning, which categorized into four dimensions: 1- integration of knowledge management with E-learning 2- E-learning for continuing education and professional development, 3- use of social media for E-learning and 4- E-learning in the healthcare sector. Kalmykova, Pustylnik and Razinkina [30] formed the model of information streams for the purpose of the choice of an optimal variant of network interaction when forming educational trajectories is offered. Aparicio, Bacao and Oliveira [31] identified 22 related E-learning terms used in literature and organized these concepts in a chronological way and then identified new concepts trends in E-learning and compared their publication growth rate with E-learning growth rate from 2010 to 2013.

The table below summarizes studies have used this method in E-learning process:

Table 1. Previous studies of E-learning

Study	Size	Period	Source	Method
Chen and Lien [22]	127 articles from 27 journals	1996 to 2009	Taiwan's NDLTD	ACA method
Lin & Hu [23]	4898 articles	2002-2013	The Social Science Citation Index (SSCI)	Burst Detection
Harande, Ladan [24]	Below 200	1964-2008	ERIC database	Bibliometrics
Navalur,	3070	2000-	Web of	Scintometrics

Balasubramani , Kumar [25]		2011	science	
Chiang, Kuo, Yang [26]	1944	1967-2009	SSCI	Bibliometric
Martin et al. [27]	NG	2004-2014	Google Scholar	Bibliometric
Maurer, Khan [28]	7759	2003-2008	5 SSCI journals & 2 conferences	Scientometric
Cheng et al.[29]	324	2000-2012	Scopus	Bibliometric
Aparicio et al. [31]	NG totally	1960-2013	ISI, Google Scholar, ACM, Scopus and AIS	Bibliometric

Generally, the application of bibliometrics methods can be seen conspicuously in so many disciplines and subject areas like e-business [32], informetics [33], Thesaurus construction [34], E-Government [35], and health information [36, 37]. Hasanagas, Styliadis and Papadopoulou [38] developed E-learning system in environmental science management is a challenging task in the area of forest and general rural development policy. They discussed the development of a GIS-based model which includes region-based scientometrics, regarding policy field communication by using VISONE software to recognize the most "important" in a network and is going to be applicable in E-learning for various target groups (e.g. students who are specialized in forest policy and rural policy analysis, lobbyists, policy makers). Breznik [39] used the social analysis to identify the most important research institutions in Slovenia, and reveal clusters of research organizations which collaborate.

In this article scientometrics method is used to assess investigations that has been done in this field. Scientometrics is an authentic research method that can be used to depict part of the information [40]. This algorithm is a quantitative method which can be used for an extensive study of academic publications [41]. Scientometrics objectives include: Providing a pictorial and graphical output to create a broad perspective in specific domain as well as structural details of this scope and its outstanding features by scrutinizing a large number of papers [40]. Considering too amount of information available in the scientific sphere, providing picture of

changes trend in academic disciplines enhance the information communication [42]. This article seeks to examine the issue of how E-learning course has changed between 1980 and 2014. To analyze the trends Burst Detection algorithm is used and data based on keywords, titles is categorized separately and both most and least are discussed. This study is used the VOSViewer [43] and Sci2 [44] applications. In this regard, upon presentation of clustering and burst detection algorithm, the results of the analysis are presented during the period.

3. Methodology

After accessing to Web of Science (WoS) core collection database, we have extracted the related papers to the field of E-learning. Next, we applied the Burst detection as well as clustering algorithm. We visualized both algorithms using visualization techniques by applying on the keywords and titles of E-learning papers. In the results section, we measured and visualized the outputs of the burst detection and clustering algorithms. The steps of the methodology that has been used in the paper is in figure 1.

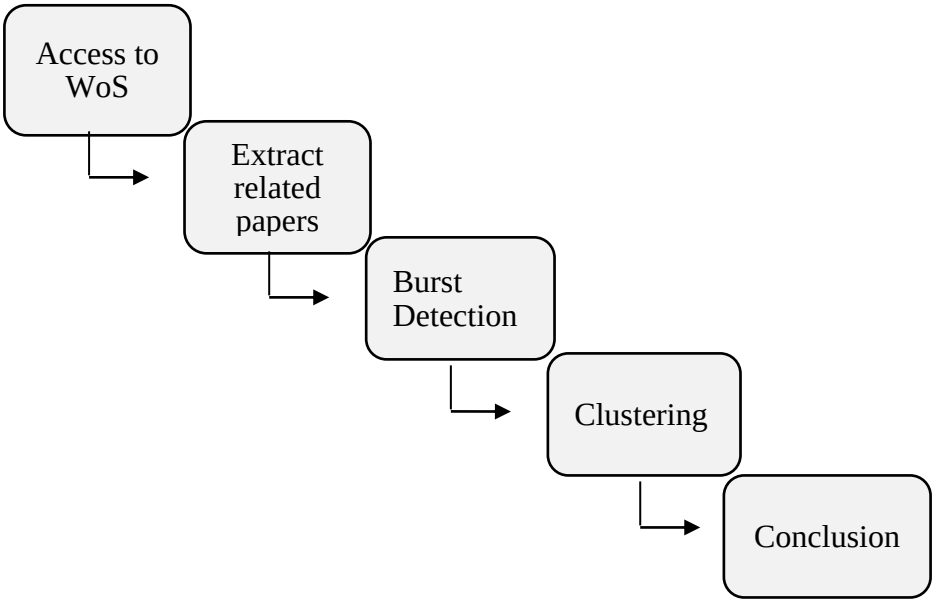

Figure 1. The methodology of current study

1.3. Data Gathering

The data used in this study, has been gathered from Web of Science (WoS). The word "E-learning" was applied on WoS search engine between 1980 and 2014 and 13895 articles were retrieved. A summary of the collected data is presented in the table 2.

Table 2. Year of publication, articles number and percentage of E-learning term in the WoS

Publication Year	Articles Number	Record percentage of 13895 articles
2014	1124	8.061
2013	1576	11.302
2012	1423	10.205
2011	1436	10.298
2010	1353	9.703
2009	1527	10.951
2008	1477	1.592
2007	1189	8.527
2006	787	5.644
2005	702	5.034
2004	676	4.848
2003	341	2.445
2002	154	1.104
2001	91	0.653
2000	39	0.280
1999	11	0.079
1998	6	0.043
1997	5	0.036
1996	2	0.014
1995	3	0.022
1994	4	0.029
1993	2	0.014
1992	7	0.050

What is observed from the above table, indicating that E-learning has experienced a significant increase in 2007 and 2008 and in the years leading up to 2014 has taken a downward trend. Current research has experienced the following methodology in figure 1.

2.3. Results

2.3.1 Burst Detection

The Burst Detection algorithm has been used for detecting the scientific emerging trends [45, 46], and was first used in 2003 by Kleinberg [47]. Keywords and titles of scientific papers are the important components of scientific papers that can express the theme of scientific trends. It should be noted that because of not adding any values to output results, we did not consider the term "E-learning" to neither of the steps of the analysis section. The results of burst detection algorithms are applied on the field of E-learning in the network of 20 keywords and titles as it is shown in Tables 3 and 4, respectively.

Table 3. First 20 obtained terms of burst detection on keywords

Term	Weight	Length	Begin	End
web	24.43671	5	2001	2005
object	24.38719	3	2004	2006
cloud	24.05329	3	2012	2014
leam	18.18986	7	2001	2007
scorm	15.51017	3	2004	2006
xml	14.39361	5	2002	2006
grid	13.82771	5	2004	2008
metadata	12.7317	5	2003	2007
base	11.65547	6	2000	2005

internet	11.46396	6	2001	2006
standard	9.943789	5	2003	2007
innov	9.748952	2	2010	2011
smart	7.820361	2	2013	2014
scienc	7.620019	1	2011	2011
im	7.369542	5	2004	2008
servic	7.306668	3	2003	2005
lom	7.229211	5	2005	2009
media	6.625228	1	2012	2012
multimedia	6.170715	6	2001	2006
organis	6.162919	3	2005	2007

Table 3 listed all of the top 20 emerging issues, sorted by their weights with respect to keywords. As it is indicated, the word *web* includes the highest repetition and subsequently has enjoyed the most weight among other keywords. Other top keywords are *object, cloud, leam, scorm, xml, grid and metadata*, addressing the important technologies and methods for constructing fundamentals of E-learning platforms.

Besides, by taking a closer look at other top keywords, we can conclude that new technologies such as cloud computing (understood from the term *cloud*) is in an upswing technology in the field of E-learning. The other keywords such as standard, smart, media and multimedia paid to important characteristics of E-learning domain. For instance, multimedia has been effectively utilized in E-learning and its advantages for classroom learning are well designed. Figure 2 shows graphical view of the output of burst detection algorithm on the E-learning keywords, obtained from table 3. The horizontal axis indicates the time span of keywords and the vertical axis indicates the weights of keywords. This figure also indicates that start of important E-learning articles is from the year 2000 by looking at the keywords of the articles.

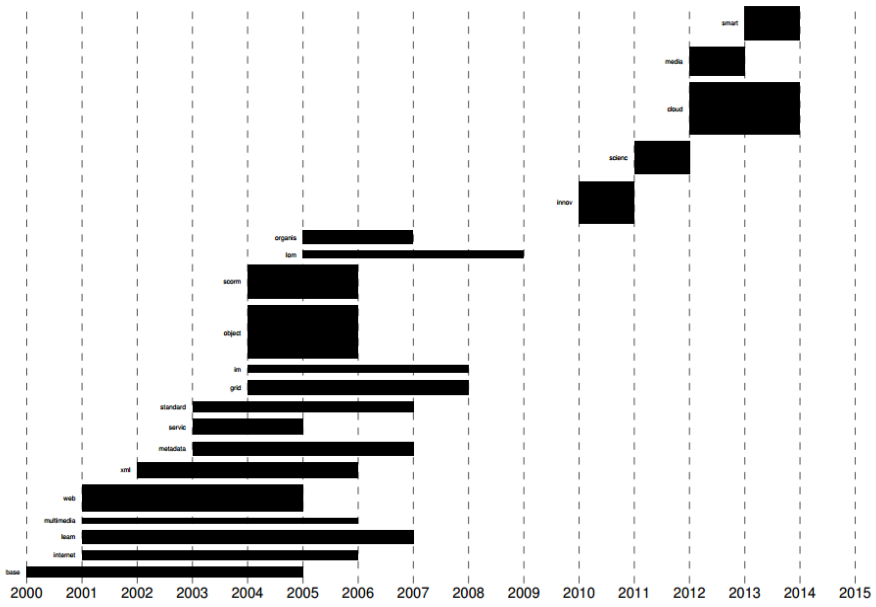

Figure 2. The diagram of top 20 terms in E-learning by burst detection on keywords

Also, in table four, the burst detection algorithm has been performed on the network of the titles of the E-learning articles.

Table 4. First 20 obtained terms of burst detection on keywords

Term	Weight	Length	Begin	End
cloud	30.70448	3	2012	2014
web	19.60832	4	2002	2005
grid	16.64846	5	2004	2008
agent	15.147	5	2002	2006
metadata	11.86874	7	2001	2007
higher	10.66432	1	2010	2010
servic	10.21461	3	2003	2005
distribut	9.908474	6	2001	2006
semant	9.660242	2	2005	2006
trial	8.65457	3	2012	2014
scorm	8.517835	3	2004	2006
onlin	8.407294	1	2014	2014
librari	7.979327	4	2003	2006
xml	7.823294	5	2001	2005

qualiti	7.734712	1	2012	2012
social	6.710419	4	2011	2014
interfac	6.637954	2	2006	2007
scienc	6.457969	1	2011	2011
assur	6.203103	1	2012	2012
video	6.02806	1	2006	2006

As the table above indicates, *cloud* technologies have a remarkable place among other titles of E-learning articles. We can also infer that the terms such as *web, grid, agent, metadata, servic, distribut and semant* enjoyed the most weights among other titles. For instance, these terms show the importance of technological advances and applications of semantic web, web 2.0 and Distribution systems in E- learning area.

Figure 3 illustrates the table 4 by applying title terms of E-learning in a time-span from 2001 to 2015. This figure also indicates that beginning of important E-learning articles is from the year 2001.

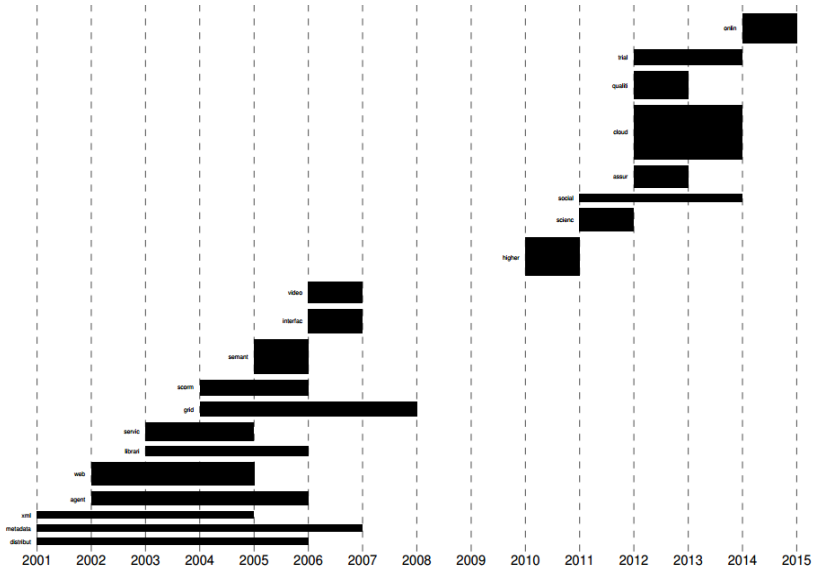

Figure 3. The diagram of top 20 terms in E-learning by burst detection on titles

The figure above also shows words such as metadata, agent, librari and interface have lasted for seven, five, four and two years respectively. On the other hand, the terms such as, *cloud, social, online* and *trial* are the hot topics because they ended in the year 2014.

4. Clustering

Clustering analysis is a powerful and useful tool for analysis of information flow [48]. Clustering Method is used for searching scientific literature, scientific issues, identifying leading researchers and classic papers, the birth of a new scientific process, track the evolution of each discipline, recognizing the "points of growth", analysis and improvement of scientific activities in scientific historical research communities. We applied clustering algorithm on the network of keywords and titles, indicated in table 5 and table 6, respectively. Besides, the clustering network of keywords and titles of E-learning articles have been visualized in the figure 4 and 5, respectively. A summary of the results of clustered keywords has been shown in the table 5. We indicated the most significant clusters and their related keywords in the table 5.

Table 5. Clustering table frequent keywords

Cluster	Keywords
Cluster 1	Education, information, knowledge, training
Cluster 2	behavior policy, benchmarking
Cluster 3	learning model, learning activity, machine learning, neural network, text mining, web mining
Cluster 4	cloud, education technology, education tool, learning systems, remote learning, virtual laboratory.

Among 23 top words, we clustered them into four groups. Words such as Education at the first cluster, behavior in the second cluster, machine learning, neural network, text mining in the third cluster and cloud, remote learning in the fourth cluster are recognized as outstanding keywords among other keywords .

Figure 4 shows a schematic view of table 5. It should be noted that the keywords with the same color are considered in a same cluster.

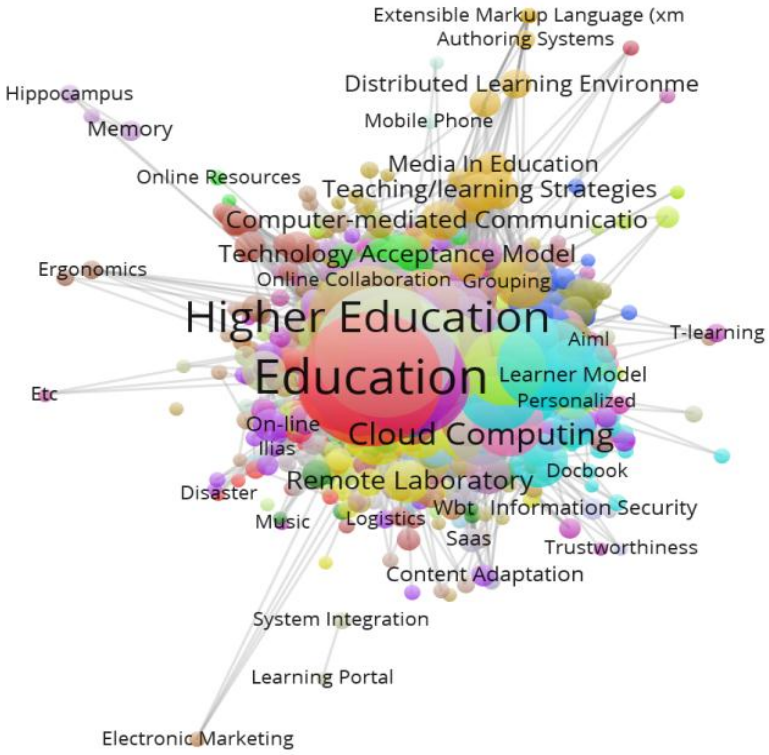

Figure 4. Clustering based on keywords

Cluster 1 covers the subjects such as Education, information, knowledge, training; which are the basic and fundamental subjects in E-learning area. Cluster 2 devotes to behavioral aspects of E-learning area. Cluster 2 is devoted to learning approaches in E-learning domain such as text mining and web mining. Cluster 4 indicates significant tools for providing the structure of E-learning frameworks.

We also applied clustering techniques to titles of E-learning articles which top frequent keywords have been clustered in table 6.

Table 6. Clustering table frequent titles

Cluster	Titles
Cluster 1	data mining, mobile learning, social software, mobile technology
Cluster 2	virtual university, virtual

	classroom, E-learning application, cloud, E-learning service
Cluster 3	taxonomy, web service, online learning, E-learning technology
Cluster 4	semantic web, student learning, E-learning content, intelligent E-learning system

For showing the important clusters, we selected 15 top terms. Cluster 1 indicates the learning process and the technologies for constructing a successful E-learning platform. Cluster 2 indicates the basic platforms and services such as virtual classes and E-learning applications. Cluster 3 contains the words such as taxonomy which is a base for providing the online learning classes. The terms such as semantic web and learning contents in cluster 4 represents the importance of these terms in intelligent E-learning systems.

We also visualized the whole clustered network of titles of E-learning domain in figure 5.

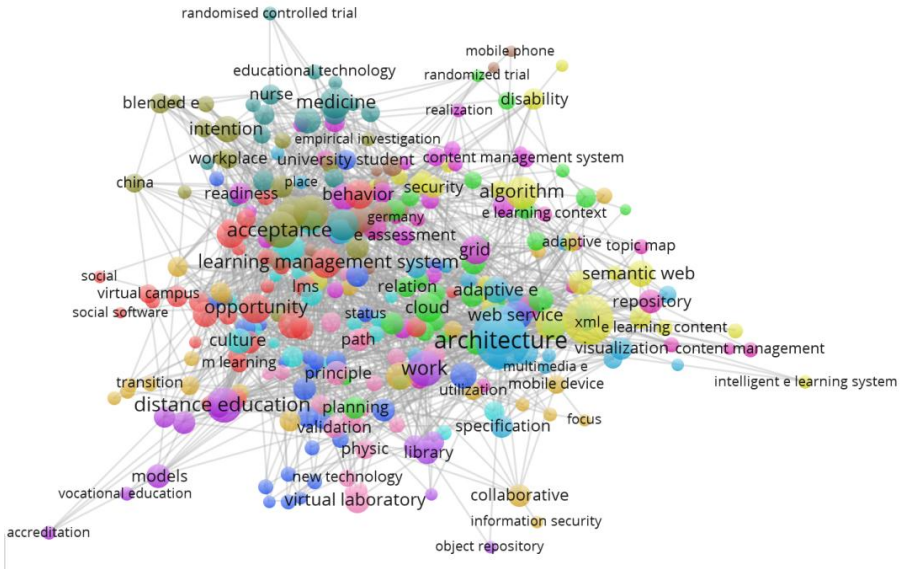

Figure 5. Clustering based on titles

5. Conclusion

In this study, we applied scinetometrics methods such as clustering and burst detection over titles and keywords of E-learning domain. The results of burst detection algorithm, represent the emergence and disappearance themes through academic studies in the field of E-learning. By applying clustering analysis, it was inferred that the main current research directions in the field and by segmenting them into number of clusters, the important hot topics were identified. The findings indicated the current research direction for the scholars who were willing to understand the emerging and fading themes in the field of E-learning. The results also make evidence using remote access to E-learning frameworks. Web of Science database were used in this study. It is suggested that in the future research, more data from several databases such as Scopus and ProQuest databases have been studied and the results were compared with the current study.

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