Contemporary Educational Researches Journal

Volume 6, Issue 4, (2016) 173-185

http://sproc.org/ojs/index.php/cerj

Co-authorship networks and institutional collaboration in works about learning, teaching and education leadership

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Suggested Citation:
Haba, J, Haba, C. & Osca-Lluch, J. (2016). Co-authorship networks and institutional collaboration in works about learning, teaching and education leadership. *Contemporary Educational Researches Journal. 6*(4), 173-185.

Selection and peer review under responsibility of Assoc. Prof. Dr. Gulsun Atanur Baskan, Hacettepe University, Turkey.

Abstract

Bibliometric indicators, based on the statistical analysis of quantitative data from scientific literature, constitute, currently, an essential tool for the study of research activity. Collaboration is a characteristic feature of modern science and it is very difficult to measure this aspect. Nevertheless, it is widely accepted to count the combined signatures done by two or more authors, with the analysis of the institutional affiliation mentions and geographical provenance of these authors. To know the peculiarities of patterns of the institutional collaboration of researchers working on issues of learning, teaching and education leadership, we have analysed the institutions where these researchers have worked. Two types of collaboration have been distinguished: national collaboration and international collaboration, using as a source of information, the communications submitted at the World Conference on Learning, Teaching and Education Leadership included in the database Web of Science. The programs used to build collaborative networks were Pajek and Ucinet.

Keywords: Institutional collaboration, learning, teaching and education leadership, collaboration networks, scientific production.

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1. Introduction

Scientific and technological collaboration is considered a useful instrument for researchers in numerous scientific areas. Collaboration facilitates information flow and the contrast of criteria, possible technical improvements for researchers and it allows sharing costs and improving scientific activity efficiency.

One of the most tangible scientific cooperation shapes is co-authorship in scientific articles. The study of scientific collaboration networks based on co-authorship has a long trajectory in bibliometry, which has dealt extensively on the networks formed by citations within works (bibliography). The collaboration networks differ substantially in networks based on cites. In collaboration networks, nodes may represent authors, groups, institutions or countries and the links between them are cites.

The study of scientific collaboration network based on co-authorship of scientific works is a relatively recent focus. From the collaboration between authors or institutions emerges a relational structure that may help to understand, manage and predict the results of scientific production generated by groups of co-authors and organisations, define the position that deals in the network of subgroups and global structure, the knowledge and information flows and reciprocal influence relationships. The bibliometrical map obtained from a collaboration network permits to show in an easily and comprehensible form the relationships between authors or institutions and offers a clear visual impression of its structure and components.

An elevated number of connexions mean that the institutions are exposed to more information and more diverse. The institutions well connected may mobilise better its resources and dispose of different perspectives to resolve problems. The links of collaboration networks affect the access to resources, facilitates both the information transmission, as well as learning and create areas of influence. The relationships may help us to understand the diffusion, distribution, homogeneity or heterogeneity and scientific production in a country or region.

The causes that lead to scientists to work in teams are related to thematic specialisation and the necessity to face problems each time more complex and that make necessary the intervention of multidisciplinary teams. In general, the cooperation depends how open or close a scientific community is to participate in scientific projects with others from the same country or different, and with other specialities.

The objective of this work has been to describe and visualise the scientific collaboration network between the institutions where the works about learning, teaching and education leadership that have been presented to the *World Conference on Learning, Teaching & Educational Leadership*, and that have been included in the Web of Science (WoS), with the aim of knowing the collaboration patterns of institutions and countries that are interested in this theme.

2. Material and methods

Bibliometrical research was done in the Social Science Citation Index and Science Citation Index databases, in the platform WoS, produced by the company Thomson Reuters. The research was done in the field 'Congress', and the strategy used was 'Learning teaching and education leadership' or World Conference on Learning, Teaching & Educational Leadership (WCLTA). The research of these two databases was done by means of the platform WoS on 17 June 2015.

The analysis of the institutions proceeds from the information provided by the database Web of Science in the field 'Address' (address of researchers' institution) that allows the identification of the institutions of all of the works signing authors. This is one of the most advantageous characteristics of this database. It is interesting to study the institutions as productive entities of scientific research

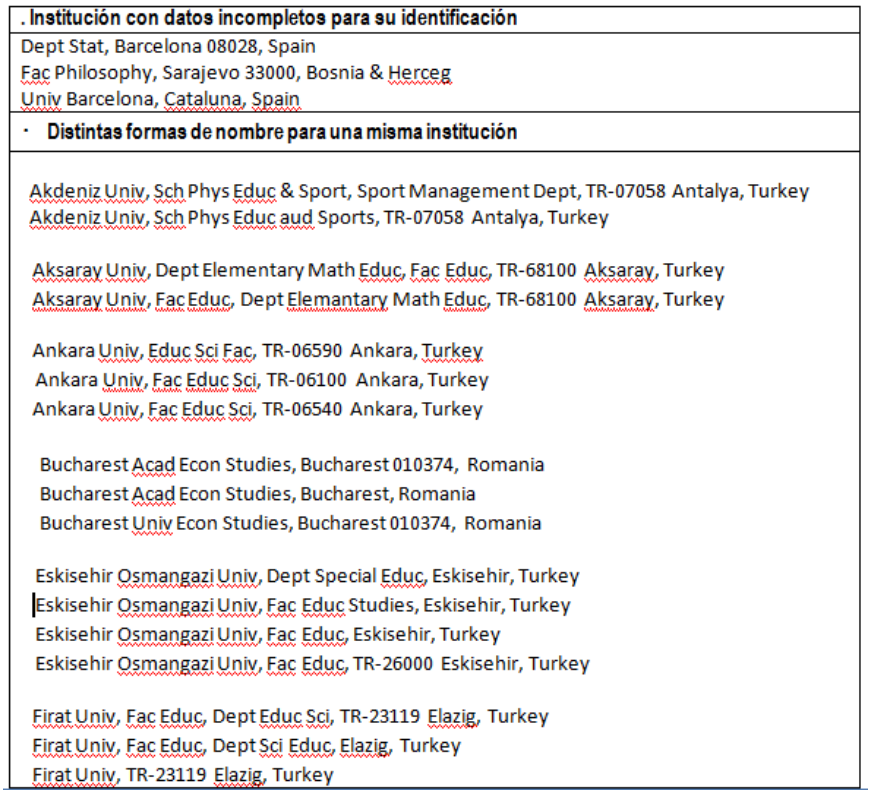
works to highlight, which are more relevant, productive, geographical distribution and collaboration guidelines.

For each recovered work, we registered the next variables: year of publication, title, authors, institutional filiation, congress data, language, theme category and number of cites received. The data obtained and selected from each single research strategy phase were included in a single relational database, with the aim of facilitating the treatment and normalisation of the different variants of the institution denominations. The data and information of the analysed institutions in this work proceed from the information collected by means of the WoS database in the field 'Address' that gather the information of the institution of the authors as they appear in the source document. The variants of the names of the institutions in the works were unified with a single denomination. This process allowed attributing the works analysed to all the institutions referred according to the method of total assignation. Under this method, the works are associated with all the signing centres, which allow analysing the collaboration between institutions and countries. Nevertheless, the association of a single document in more than one centre originates directly counting the documents by institutions and countries to avoid being added and creating an unreal total. Implicitly, the works signed by more than an institution are considered the product of collaboration between works, and analogically by countries.

To understand the normalisation task has been necessary to do, in Figure 1, we present some real examples of data of some institutions, as they appear gathered in the works. In some works, data are incomplete, and others exist different variants in the name of the same institution and, lately, there are also some cases in which some works have no data of a single institution.

After the normalisation of the names of the institutions, we proceeded to obtain different indicators of productivity and collaboration. For each of the works selected, it has been identified the total number of institutions and countries of the different authors that have collaborated in the realisation of the works and we proceeded to unify the different variants of the institution signatures, with the aim of obtaining information about scientific productivity of each single one of them. Scientific production of each institution and the collaboration between them was analysed, by means of the index of signatures per work (the average of the number of institutions signing each work). To obtain the indicators, we used a total counting system, assigning the same value to each of the institutions that have participated in the work.

From the works signed by different institutions, we have located the collaboration index and the identification of collaboration networks has been done. The global characterisation of the collaboration between the institutions has been executed from the collaboration or co-authorship index and the number of works signed in collaboration has been determined. From the identification of the main collaboration networks, different networks and visual representations of the collaboration between countries and institutions have been built. The construction of the networks and graphical representations have been done using the programs Pajek and Ucinet. The size of the nodes represents the weight of each institution or country that has in the net, the thickness of the lines indicates the intensity of the relationship. For a better visualisation of the structure of the institutions network, it has been represented only those institutions that have more works, added to the institutions which they collaborate, since a network with an excessive quantity of nodes and relationships presents serious interpretation difficulties.



. Institución con datos incompletos para su identificación
Dept Stat, Barcelona 08028, Spain Fac Philosophy, Sarajevo 33000, Bosnia & Herceg Univ Barcelona, Cataluna, Spain
· Distintas formas de nombre para una misma institución
Akdeniz Univ, Sch Phys Educ & Sport, Sport Management Dept, TR-07058 Antalya, Turkey Akdeniz Univ, Sch Phys Educ aud Sports, TR-07058 Antalya, Turkey
Aksaray Univ, Dept Elementary Math Educ, Fac Educ, TR-68100 Aksaray, Turkey Aksaray Univ, Fac Educ, Dept Elemantary Math Educ, TR-68100 Aksaray, Turkey
Ankara Univ, Educ Sci Fac, TR-06590 Ankara, Turkey Ankara Univ, Fac Educ Sci, TR-06100 Ankara, Turkey Ankara Univ, Fac Educ Sci, TR-06540 Ankara, Turkey
Bucharest Acad Econ Studies, Bucharest 010374, Romania Bucharest Acad Econ Studies, Bucharest, Romania Bucharest Univ Econ Studies, Bucharest 010374, Romania
Eskisehir Osmangazi Univ, Dept Special Educ, Eskisehir, Turkey Eskisehir Osmangazi Univ, Fac Educ Studies, Eskisehir, Turkey Eskisehir Osmangazi Univ, Fac Educ, Eskisehir, Turkey Eskisehir Osmangazi Univ, Fac Educ, TR-26000 Eskisehir, Turkey
Firat Univ, Fac Educ, Dept Educ Sci, TR-23119 Elazig, Turkey Firat Univ, Fac Educ, Dept Sci Educ, Elazig, Turkey Firat Univ, TR-23119 Elazig, Turkey

Figure 1. Examples of institution normalisation problems

Bibliometric indicators, as well as the analysis of social networks applied to the analysis of the collaboration in scientific publications, allow identifying the main groups and working networks that are generating an active scientific production in a knowledge area, more than the existent formal cooperative structures, which allows the characterisation of a scientific activity. The comprehension of the methodology used requires assuming certain basic premises: the groups or collaboration networks are defined in terms of co-authorship, this is, by those authors or, as in this case, institutions, that sign together an important percentage of their production, but that do not correspond necessarily with a determined institutional or administrative structure. Collaboration networks have been built from the countries and most productive institutions only in the period and discipline studied.

3. Results

3.1. Country productivity

The total number of works presented at the WCLTA that have been gathered by the ISI WoS databases up till the month of June 2014 have been 1,115. These works have been done by a total of 1,929 authors that work in institutions from 65 countries. The participation of researchers according to the country of provenance at the WCLTA is very uneven.

When analysing the authors' provenance countries that presented works at the WCLTA gathered at the WoS, it is observed that works presented by five countries that have collaborating when producing more than 66% of all the scientific production analysed predominates (Turkey, Iran, Malaysia, Romania and Spain).

Turkey is the country that has participated in the realisation of a greater number of works (353), with a 29.56% in total. In the second and third position are Iran with 130 works (18.89%) and Malaysia with 120 (10.05%), followed by Romania with 112 (9.38%) and Spain with 75 works (6.28%), occupy the fourth and fifth position, respectively.

When we analyse per years, the distribution of number of countries that have presented works in different WCLTA congresses gathered by the WoS, it is observed that this participation is very variable throughout time (see Figure 2), being the World Conference on Learning, Teaching and Educational Leadership celebrated in Brussels (Belgium) and Barcelona (Spain), which are the ones that had the greater number of different countries participation, being 49 and 44, respectively. (The year corresponds to the publishing year of works and not the date of the Congress.)

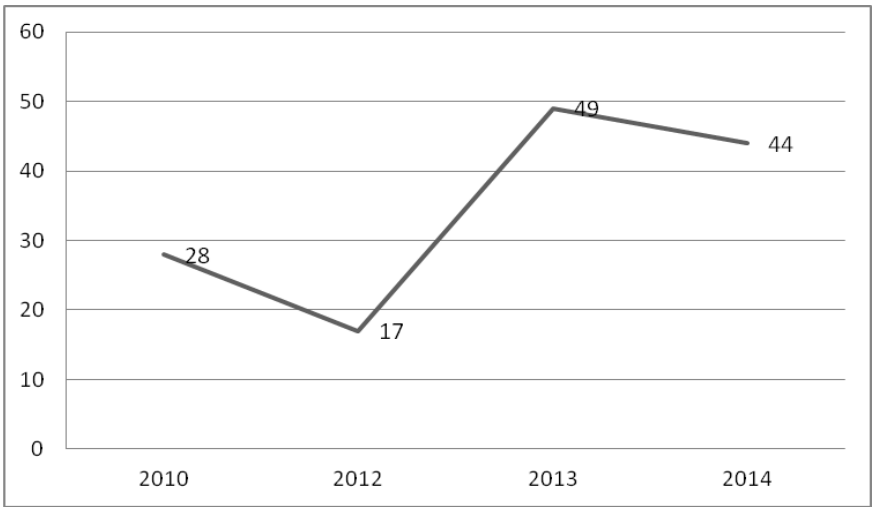


Figure 2. Distribution of the participation of number of countries per year

When a more detailed analysis is done to the distribution of works per years and countries (see Table 1), it is observed that only 10 countries have participated in absolutely all of the WCLTA editions (Turkey, Iran, Malaysia, Romania, Czech Republic, USA, Greece, Singapore, England and Saudi Arabia). In the other extreme of the distribution, we find 13 countries that have participated on one single occasion (Botswana, Brazil, Chile, Israel, Latvia, Montenegro, New Zealand, Peru, Philippines, Slovenia, Sweden, Ukraine and Wales).

Table 1. Alphabetic relationship of the countries with the number of works per year

Countries	2010	2012	2013	2014	Total	%
Algeria		4		2	6	0.50
Argentina			2		2	0.17
Australia		1	3	6	10	0.84
Belgium			2		2	0.17
Bosnia & Herceg			1	1	2	0.17
Botswana	1				1	0.08
Brazil			1		1	0.08
Bulgaria			3		3	0.25
Canada	2		3	1	6	0.50
Chile				1	1	0.08
Cyprus	10	2		12	24	2.01
Czech Republic	5	5	29	16	55	4.61

Denmark	2		1		3	0.25
Egypt	3	1	1		5	0.42
England	4	2	2	2	10	0.84
Finland	2				2	0.17
Germany			1	3	4	0.34
Greece	8	4	4	1	17	1.42
Hungary			5	1	6	0.50
India			3		3	0.25
Indonesia	2			1	3	0.25
Iran	18	89	20	3	130	10.89
Ireland			6	1	7	0.59
Israel				1	1	0.08
Italy	15		22	20	57	4.77
Japan	1		2	1	4	0.34
Jordan			1	2	3	0.25
Kazakhstan			5	3	8	0.67
Latvia			1		1	0.08
Lebanon			4		4	0.34
Lithuania			2	1	3	0.25
Luxembourg			2		2	0.17
Malaysia	61	8	35	16	120	10.05
Mexico			1	2	3	0.25
Montenegro			1		1	0.08
Netherlands			3		3	0.25
New Zealand				1	1	0.08
Nigeria				2	2	0.17
Oman			2		2	0.17
Pakistan			2		2	0.17
Peoples R China	5		2	6	13	1.09
Peru		1			1	0.08
Philippines				1	1	0.08
Poland			1	2	3	0.25
Portugal	4	1		4	9	0.75
Romania	4	10	67	31	112	9.38
Russia			1	8	9	0.75
Saudi Arabia	1	1	2	1	5	0,42
Serbia			6	4	10	0.84
Singapore	2	2	7	2	13	1.09
Slovakia			1	5	6	0,50
Slovenia	1				1	0.08
South Africa	4		1	1	6	0.50
South Korea	1		2	1	4	0.34
Spain	7		21	47	75	6.28
Sri Lanka			1	1	2	0.17
Sweden				1	1	0.08
Taiwan	2	1	4		7	0.59
Thailand	4		8	2	14	1.17
Tunisia			2		2	0.17
Turkey	169	34	68	82	353	29.56
United Arab Emirates	1			1	2	0.17

Ukraine			1		1	0.08
USA	5	1	9	8	23	1.93
Wales				1	1	0.08

3.2. Productividad de las instituciones

The work recovered has been signed by a total of 451 institutions. By countries, the country that has a major number of institutions that have collaborated in the realisation of a greater number of works presented in different congresses presented in the WCLTA that have been gathered by the WoS is Turkey, with 97 institutions, followed by Romania with 39, Malaysia with 29, Spain with 28, Iran with 22 and USA with 21 (see Table 2). The country that presents a major productivity, Turkey, outstands also for being the one that counts also with the participation of a greater number of institutions. It is observed that the countries with a greater number of works are those that count with a greater number of participant institutions.

Table 2. Distribution of works per countries and number of institutions

Rank	Countries	No. of institutions	No. of works
1	Turkey	97	353
2	Iran	22	130
3	Malaysia	29	120
4	Romania	39	112
5	Spain	28	76
6	Italy	20	57
7	Czech Republic	16	55
9	USA	21	23
8	Cyprus	11	23
10	Greece	9	17
11	Thailand	6	14
12	Peoples Republic of China	8	13
13	Singapore	5	13
14	Australia	10	10
15	England	7	10
16	Serbia	5	10
17	Portugal	7	9
18	Russia	5	9
19	Kazakhstan	6	8
21	Taiwan	6	7
20	Ireland	4	7
23	Canada	6	6
25	Slovakia	6	6
24	Hungary	4	6
26	South Africa	3	6
22	Algeria	2	6
27	Egypt	3	5
28	Saudi Arabia	3	5
30	Japan	4	4
29	Germany	3	4
32	South Korea	2	4
31	Lebanon	1	4
35	India	3	3

37	Jordan	3	3
38	Lithuania	3	3
39	Mexico	3	3
41	Poland	3	3
33	Bulgaria	2	3
34	Denmark	2	3
36	Indonesia	2	3
40	Netherlands	2	3
43	Belgium	2	2
44	United Arab Emirates	2	2
45	Tunisia	1	2
46	Sri Lanka	2	2
47	Pakistan	2	2
49	Oman	1	2
42	Nigeria	1	2
48	Luxembourg	1	2
55	Finland	2	2
58	Bosnia & Herceg	2	2
59	Argentina	1	2
50	Botswana	1	1
51	Brazil	1	1
52	Chile	1	1
53	Israel	1	1
54	Latvia	1	1
56	Montenegro	1	1
57	New Zealand	1	1
60	Peru	1	1
61	Philippines	1	1
62	Slovenia	1	1
63	Sweden	1	1
64	Ukraine	1	1
65	Wales	1	1

In Table 3, it is observed the relationship between institutions with more than five works presented in the WCLTA congresses analysed, which allows to identify the most active centres or more interested in these topics. The ranking of productivity is headed by the Islamic Azad University, with 51 works, followed by the Universiti Kebangsaan Malaysia with 38 works and Karadeniz Technical University with 31 works. With more than 20 works are both the universities Ataturk University (23 works) and Anadolu University.

Table 3. Institutions with more than five works presented at the WCLTA

Rank	Institution	No. of works	Country
1	Islamic Azad Univ	51	Iran
2	Univ Kebangsaan Malaysia	38	Malaysia
3	Karadeniz Tech Univ	31	Turkey
4	Ataturk Univ	23	Turkey
5	Anadolu Univ	21	Turkey
6	Islamic Azad Univ	19	Iran
7	Gazi Univ	19	Turkey
8	Firat Univ	18	Turkey

9	Univ Malaya	17	Malaysia
10	Ankara Univ	17	Turkey
11	Uludag Univ	14	Turkey
12	Univ Tehran	13	Iran
13	Univ Catania	13	Italy
14	Univ Teknol Malaysia	13	Malaysia
15	Univ Basque Country	13	Spain
16	Hacettepe Univ	13	Turkey
17	Univ G dAnnunzio	12	Italy
18	Vasile Alecsandri Univ	12	Romania
19	Akdeniz Univ	12	Turkey
20	Natl Univ Phys Educ & Sport	11	Romania
21	Univ Hradec Kralove	10	Czech Republic
22	Shahid Rajaee Teacher Training Univ	10	Iran
23	Univ Girona	10	Spain
24	Eskisehir Osmangazi Univ	10	Turkey
25	Charles Univ Prague	9	Czech Republic
26	Acad Econ Studies, Bucharest	9	Romania
27	Bulent Ecevit Univ	9	Turkey
28	Univ Sains Malaysia	8	Malaysia
29	Dunarea de Jos Univ Galati	8	Romania
30	Valahia Univ Targoviste	8	Romania
31	Middle E Tech Univ	8	Turkey
32	Univ Hradec Kralov	7	Czech Republic
33	Bucharest Acad Econ Studies	7	Romania
34	Aksaray Univ	7	Turkey
35	Marmara Univ	7	Turkey
36	Near East Univ	6	Cyprus
37	1 Decembrie 1918 Univ Alba Iulia	6	Romania
38	Univ La Laguna	6	Spain
39	Kastamonu Univ	6	Turkey
40	Suleyman Demirel Univ	6	Turkey

3.3. Institutional collaboration

Out of the 1,115 works presented at the WCLTA congresses gathered by the WoS databases, only 68 works (6.10%) had an institutional collaboration versus the 1,047 works (93.90%), in which there is an absence of institutional collaboration. It is worthy to distinguish when we analyse the collaboration disaggregated per years, that all the works done in collaboration between different institutions and countries were presented at the fourth WCLTA and published in the year 2014. These data indicate that the working habits of researchers in this area, as it happens with other researchers from other disciplines and scientific areas, are changing and that more and more often, there is an existent tendency to create teams with researchers from other institutions.

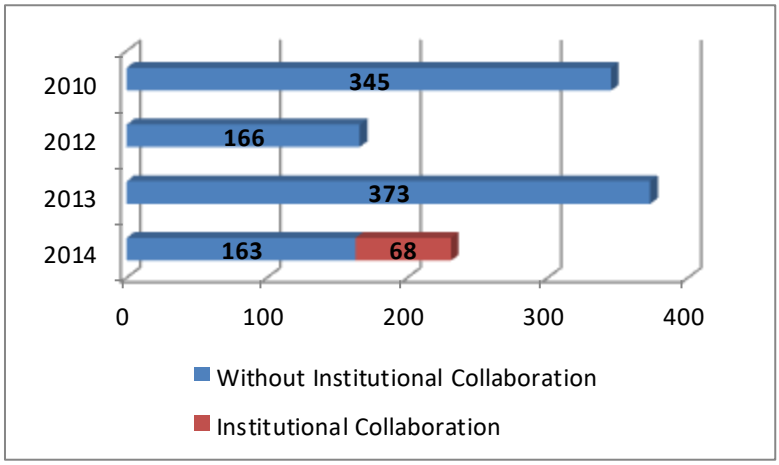


Figure 3. Distribution of the number of works according to the institutional collaboration

3.4. Collaboration networks between countries and institutions

When analysing the works done in collaboration, it is observed that in its realisation, institutions from 23 different countries have intervened. The type of collaboration may be between institutions belonging to the same country (national collaboration) or between institutions from different countries (international collaboration). In this case, the social network analysis allows to observe the relationships between the countries that have collaborated doing together works, as it is shown in Figure 2. In this image, nodes represent the countries, the size of the nodes is related to the greater or minor number of works done in collaboration by different countries and the thickness of the links between the nodes indicates the intensity of the relationships between the countries. The analysis of the co-authorships points certain differences in the institutional collaboration dynamics.

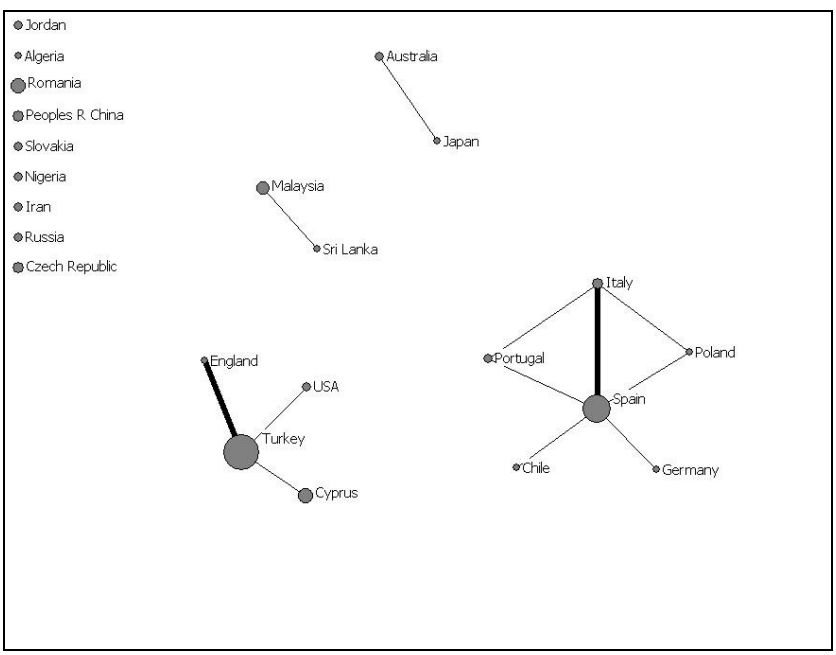


Figure 4. Collaboration network between countries

From the 23 countries that have participated, it is observed that nine are totally isolated. In this case, there are countries that have done collaboration works between institutions from the same countries (national collaboration) and 14 have been done in collaboration with institutions from other countries (international collaboration). Turkey and Spain are the countries that have collaborated in the realisation of a greater number of works with researchers from institutions belonging to other countries and also, they are characterised not only for their scientific production but also for the intermediation role within other countries inside their group.

In Figure 5, it is shown the relationships between the 92 institutions that have been done about learning, teaching and education leadership in collaboration. In this case, the nodes represent the institutions, the size of the nodes is related to the greater or minor number of works done in collaboration by the institutions and the thickness of the links between the nodes indicates the intensity of the relationships between the institutions. It is observed how 11 nodes are isolated. In this case, they represent those institutions that have done works in collaboration between researchers from the same institution (regional collaboration). Out of 81 institutions that have done works in collaboration with other institutions, it is observed that the most frequent collaboration groups are created by the collaboration between two institutions (21 groups) or three institutions (three groups).

The groups with the greater institutional collaboration are formed by six institutions (group 1), five institutions (two groups) and four institutions (two groups). The aspect that we should highlight is that between these groups that have the greater number of institutions, there are only two with international collaboration (formed by six institutions, five Spanish institutions and one German institution and the one created by five institutions, four institutions from Cyprus and one Turkish institution), the rest of the groups present a national collaboration (collaboration between institutions from the same country), being in all cases, the collaborations between Turkish institutions.

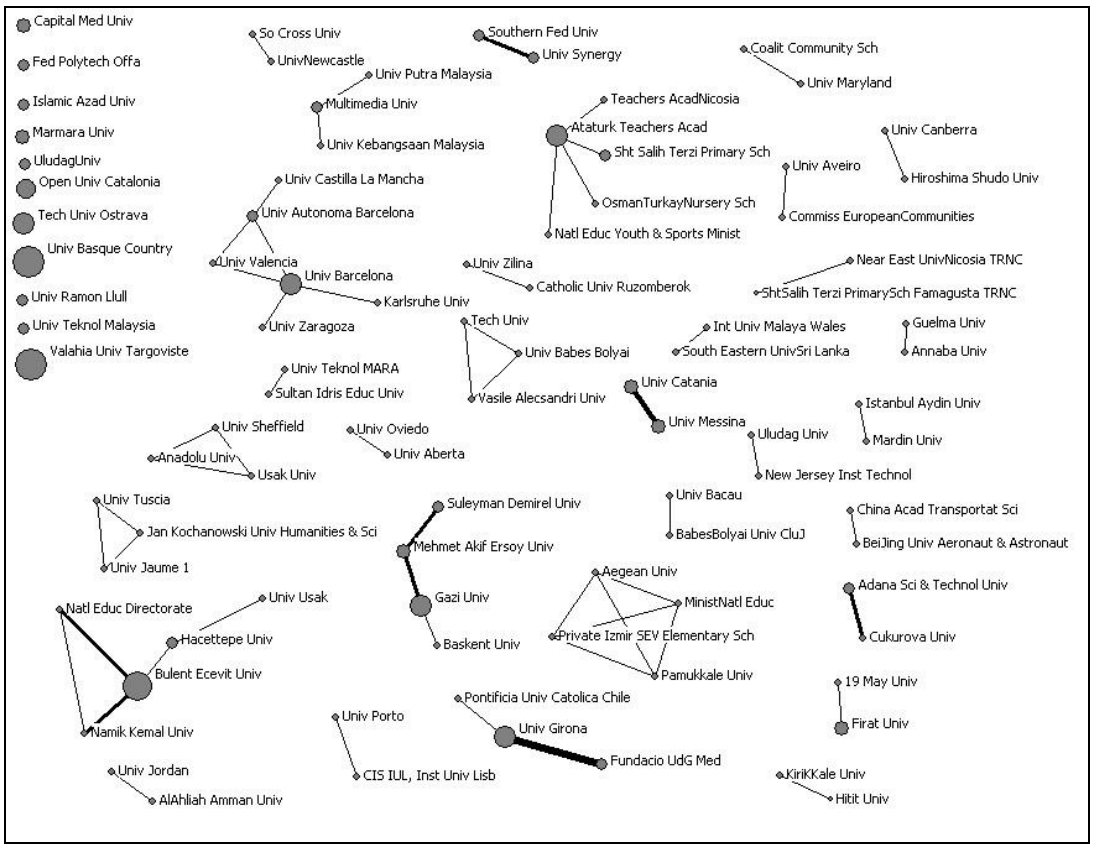


Figure 5. Social network between institutions

4. Conclusion

One of the main pending challenges of science is to impulse the scientific cooperation between the creation of collaboration networks between researchers and institutions, both from the national and international scope. The importance granted by managing organisms of scientific politics to scientific collaboration is reflected in the numerous initiatives that try to foment the cooperation and the association of scientific groups and research centres. It is pretended to create the more potent schemes of scientific cooperation that will allow achieving objectives that very difficulty could arise in a context of constrained performance.

The bibliometric indicators and the analysis of the social networks applied to the collaboration in the scientific publications permit to identify the main groups and working networks that are generating a scientific production, beyond the formal cooperative structures available. One of the goodness that this type of analysis has for professionals is that it allows them to have reliable information about the existent research groups, which opens the possibility of integrating in any of the identified networks and increases the capacities, or widens the contact of other researchers' circles and participate in a broaden forum discussion and exchange ideas about topics of interest in their corresponding areas. On one side, it allows to know the existent links in the centres, which institutions collaborate within each other, as well as the identification of consolidated or emergent research networks.

A work done by our group where co-authorship in the works done about learning, teaching and education leadership is analysed, is predominantly done in collaboration (73%) facing the ones done individually (27%). Also, it is much more frequent those works signed by two or three authors, nevertheless, this changes when we analyse institutional collaboration.

With the achievement of this study, we have pretended to identify and quantify the institutional contributions and the countries in a knowledge area that is characterised by its multidisciplinary approach, as well to analyse the degree of cooperation between countries and institutions from the scientific work signed together.

In view of the results of this work, it is observed that the most productive institutions are those that have a greater number of collaborations. The most frequent institutional collaborations are at a national level and, particularly, the collaborations at a local level (between researchers belonging to the same institution). This collaboration pattern may obey certain conditions that foment the links, such as geographical closeness, language or the historical and socio-economical links. Also, in previous consulted studies, the countries that meet these conditions are more likely to collaborate scientifically (Frame & Carpenter, 1979). Nevertheless, some authors consider that the determinant weight of institutional collaboration is the scientific weight in the countries (De Filippo, Sanz Casado & Gomez, 2007) or geographical closeness since the nearby the countries are the greater collaboration possibilities (Katz, 1994).

It is evident that collaboration networks are produced in prestigious well-known and international quality centres. In the European context, collaboration is encouraged to consolidate the European scientific community position, because no country by itself and especially the smallest ones, may mobilise the economical and necessary intellectual resources to be at the same scientific level of more advanced countries or those that have greater economic resources. Another aspect that may contribute to the increase of collaboration is researchers' mobility. Some studies show that it exists a certain relationship between mobility and scientific collaboration production (De Filippo et al., 2007). For this reason, researchers' mobility may also contribute to the increase of institutional scientific collaboration both at national and international level.

Regarding the limitations of this study, it should be mentioned that in this work, we have only analysed the production and scientific collaboration of the institutions and countries of the authors that have presented a work about learning, teaching and education leadership in WCLTA congresses

that have been gathered by WoS databases. Future working lines should identify the evolution of institutional networks and the relationships that are established by different countries. Also, due the dynamic character of science and research groups, it would be interesting to observe the temporary evolution and analyse its variations (growth or decrease of the number of collaborations to a local, national or international level), as well as its visibility and scientific impact, institutions different thematic areas and the quality or excellence of the published works.

References

De Filippo, D., Sanz Casado, E. & Gomez, I. (2007). Movilidad de investigadores y produccion en coautoria para el estudio de la colaboracion cientifica. *Revista CTS*, *8*(3), 23–40.

Frame, D. & Carpenter, M. (1979). International research collaboration. *Social Studies of Sciences*, *9*, 481–497.

Katz, J. S. (1994). Geographical proximity and scientific collaboration. *Scientometrics*, *31*(1): 31–43.

Russell, J. M., Ainsworth, S., Del Rio, J. A., Narvaez-Berthelemot N. & Cortes, H. D. (2007). Colaboracion cientifica entre paises de la region latinoamericana. *Revista Espanola de Documentacion Cientifica*, *32*, 180–198.

Russell, J. M., Madera Jaramillo, M. J. & Ainsworth, S. (2009). El analisis de redes en el estudio de la colaboracion cientifica. *Redes: Revista hispana para el analisis de redes sociales*, *17*(2).