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Red de coautoría de investigadores ambientalistas y su impacto en México

Co-Authorship Network of Environmental Researchers and Their Impact in Mexico

Rede de coautoria de pesquisadores ambientais e seu impacto no México

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Resumen

En México los investigadores más destacados son distinguidos por el Consejo Nacional de Ciencia y Tecnología. Aunque en la literatura internacional se han estudiado las redes de coautoría de los investigadores y el impacto de sus publicaciones, en el contexto mexicano este tipo de estudios son incipientes, por lo que el objetivo de este trabajo consistió en explorar la correlación entre dos métricas de centralidad y el índice *h* de los investigadores ambientalistas eméritos, niveles dos y tres del país. Para ello, el método de investigación se fundamentó en la correlación de Pearson entre las métricas de centralidad de grado y de cercanía con el índice *h*. Se concluye que, a pesar de que los investigadores ambientalistas publican en forma colaborativa, por lo que promedian altos valores de centralidad de grado, no existe correlación con el impacto de sus publicaciones.

Palabras clave: impacto de las redes de coautoría, investigadores nacionales en ciencias ambientales, métricas de centralidad.

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Abstract

In Mexico, the most outstanding researchers are distinguished by the Consejo Nacional de Ciencia y Tecnología. Although in the international literature researchers' co-authorship networks and the impact of their publications have been studied, in Mexico this type of studies is incipient, so the objective of this work is to explore the correlation between two centrality metrics and the *h* index of environmental researchers emeritus, levels one and three of the country. For this, the research method was based on the Pearson correlation of the grade centrality and closeness metrics with the *h* index. It is concluded that although environmental researchers publish in a collaborative way so they average high values of degree centrality, there is no correlation with the impact of their publications.

Keywords: impact of coauthorship networks, national research in environmental sciences, centrality metrics.

Resumo

No México, os pesquisadores mais proeminentes são distinguidos pelo Conselho Nacional de Ciência e Tecnologia. Embora as redes de coautoria de pesquisadores e o impacto de suas publicações tenham sido estudados na literatura internacional, no contexto mexicano esses tipos de estudos são incipientes, portanto o objetivo deste trabalho foi explorar a correlação entre duas métricas de centralidade e índice h de pesquisadores ambientais emeritus, níveis dois e três do país. Para tanto, o método de pesquisa baseou-se na correlação de Pearson entre as métricas de centralidade de grau e proximidade com o índice h. Conclui-se que, apesar do fato de os pesquisadores ambientais publicarem de forma colaborativa, portanto, medem os valores de centralidade de alto grau, não há correlação com o impacto de suas publicações.

Palavras-chave: impacto de redes de co-autores, pesquisadores nacionais em ciências ambientais, métricas de centralidade.

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Introduction

In Mexico, researchers in whatever their work discipline are recognized by the National System of Researchers (SNI) in one of its five levels: candidate, level one, level two, level three and emeritus; The latter are among the most distinguished for the quality of their publications. Although researchers may exhibit different trends in collaboration, there is a growing popularity in co-authoring regardless of the discipline they are part of (Lopaciuk-Gonczaryk, 2016; De Stefano, Fuccella, Prosperina and Zaccarin, 2013; Kronegger, Ferligoj and Doreian, 2011), although to varying degrees, differing from one country to another, and even between disciplines (Liberman and Wolf, 2013; Yu Cheng, Wah Hen, Piew Tan and Fai Fok, 2013).

Co-authorship is an explicit product of scientific collaboration with relational patterns that have been explained by topological structures and properties of networks based on the theory of centrality (Newman, 2001a, 2001b, 2004a; Barabasi and Albert, 1999; Freeman, 1979); In addition, they enable answers to questions such as “who is the most central author of the network” and “if there is a relationship between collaboration and the author's productivity” (Kumar and Mohd, 2014, p. 356). In this regard, previous studies have shown that research collaboration has a greater impact than a single researcher in terms of the number of publications (Lotka, 1926; Katz and Hicks, 1997; Lee and Bozeman 2005; Ponomariov and Boardman, 2010; De Stefano et al., 2013) and citations (Gazni, Sugimoto and Didegah, 2012; Sooryamoorthy, 2009). Also, the relationships between collaboration and scientific impact seem to be more positive in hard sciences, such as physics and astronomy, than in soft sciences, such as sociology (Bridgstock, 1991) and ecology (Peters, 1991).

Surprisingly, few studies have proven this proposition, and particularly those oriented to the field of environmental sciences. Therefore, the objective of this research was to explore the nature of the correlation between the centrality and the impact of the publications (index h) of the emeritus national environmental researchers, levels two and three of Mexico. To achieve this, the research method was based on Freeman's centrality and Pearson correlation metrics.

Theoretical basis

Impact of scientific collaboration

The publication of the research results is one of the main drivers of the prestige of the institutions for being one of the criteria in the rankings that rank universities worldwide, where academic publication in indexed journals plays an important role in their scoring methods (Munoz, Queupil and Fraser, 2016). The position of universities in the ranking can have a direct impact on both their student enrollment and their financing (Dill and Soo, 2005; Dill, 2009). So quantifying the scientific impact of an author has become the metric par excellence for faculties and / or research centers.

Various measures of a researcher's performance are used in bibliometry and scientometrics, such as article counting (Lee and Bozeman, 2005); the number of citations provided by Clarivate, formerly ISI Web of Knowledge (McFadyen and Cannella, 2017; Badar, Hite and Yuosre, 2013); the Hirsch (h) impact index (Pike, 2010; Sidiropoulos, Katsaros and Manolopoulos, 2007; Batista, Campitel, Kinouchi and Martinez, 2006; Kelly and Jennions, 2006; Hirsch, 2005); and the Leo Egghe (G) index (Costas and Bordons, 2007; Egghe, 2006; Van Raan, 2006) and the Jin BiHui (R) index. However, they all indicate the degree to which a scientist's work has been used by other researchers (Bornmann, Mutz, Neuhaus and Daniel, 2008), which in turn can lead to those researchers who publish more in terms of impact factor attract more potential collaborators, have a higher performance (Li, Liao and Yen, 2013; Liao, 2011) and become, from the perspective of centrality theory, more central researchers.

Networks of scientific co-authorship: impact index and centrality metrics

From the classic study by Zuckerman (1967), in which he analyzed the research patterns of 41 Nobel laureates and empirically showed that the winners are very selective in choosing their collaborators as they select renowned and productive scientists. Zuckerman (1967) identified a strong relationship between collaboration and productivity. More recent studies have focused on the scientific impact of researchers' publications as a measure of their productivity. An example of this is the one carried out by Pike (2010), who, when using the impact index (h), determined that researchers with high h indexes tend to collaborate with other high impact scientists, while those with a low index of impact they seem not to want to collaborate with others less successful than them. Other studies have identified the positive influence between the centrality of researchers and the efficiency in co-authored networks: Badar, Hite and Badir (2014) in Pakistan's chemistry scientists; Bordons, Aparicio, González-Albo and Díaz-Faes (2015) in the nanoscience, pharmacology and statistics of Spain; Eaton, Ward, Kumar and Reingen (1999) in consumer behavior researchers; Fischbach, Putzke and Schoder (2011) in electronic market research; González-Brambila (2014) in the social science scientists of Mexico; Lee, Seo and Choe (2012) in science and engineering fields of public research institutions in Korea.

While the aforementioned studies have rigorously proven that the centrality of the network leads to the performance hypothesis - while others show that the degrees and types of collaboration differ from country to country and from discipline to discipline (Newman, 2004a, 2004b, Liberman and Wolf, 2013; Yu Cheng Wah Hen, Piew Tan and Fai Fok, 2013) -; The case of researchers in environmental sciences has not been analyzed with the same depth as it has been for other sciences, although among them is that of Pike (2010) for behavioral ecology under a correlational approach between the coefficient of clustering and scientific impact, and that of Kumar and Mohd (2014) for land scientists in India, in which they concluded with the existence of a strong correlation between degree centralization and intermediation with the author's productivity (number of jobs).

Research method

The objective of this study was to analyze the correlation between the centrality of proximity and the impact of the publications (index h) of emeritus environmental researchers, levels two and three of Mexico. For this, the quantitative cutting methodology involved two phases: a first one of compilation and preparation of the database of the publications and the Scopus h index (impact) of the researchers under study; and a second phase of quantitative analysis to calculate the centrality metrics of each of the researchers and of a correlational analysis with their impact. The phases are more fully described below:

Database collection and preparation phase

There is no category for scientists in environmental sciences in the National Council of Science and Technology (Conacyt), so identifying researchers in this field involved selecting, from the list of current researchers from January to December 2016, at scientists of the disciplines related to the study of the environment. In this way, seven disciplinary fields were identified: climatology, sustainable development, ecology, environment, oceanography, environmental technology and other specialties. From this, national emeritus researchers and Mexican levels two and three of the environmental sciences were recognized. In total, 88 active investigators were found, from whom, through a public consultation on January 2, 2017, the National Institute of Transparency, Access to Information and Protection of Personal Data (INAI), its article productivity was acquired and compiled from the period from 2012 to 2016.

In the preparation of the database each of the articles was verified in the journals where they were published and validated regarding the co-authors involved. This created a database with a total of 3642 publications, of which 3537 correspond to co-authored articles and 105 to sole authors (see annex table 3). A total of 4751 authors were identified in the publications, of which 4663 are co-authors and the remaining researchers who publish individually. However, in some of them it implied correcting the disambiguation of their names, that is, the records were verified to visualize the variations of the names of the authors, in addition to the incorrect characters of the Conacyt database itself. The way to disambiguate was validating the institutional affiliation of the authors.

Quantitative and correlational analysis phase

This phase involved a descriptive statistic of the productivity of the researchers' articles. In addition, to individually assess the impact of the researchers, the Scopus h index was selected and compared among scientists from different environmental disciplines. A researcher has an index h if h of their N_p publications have at least h citations each, and the other (N_p - h) publications have ≤ h cites each (Hirsch, 2005).

For the analysis of the network of co-authors of environmental researchers, the centrality for each of them was calculated from the database of their publications. Two of the three classic Freeman metrics (1979) were considered, which are commonly used and which are the object of interest of this study: analyze communication (degree) and independence (closeness), but not communication control (intermediation).

The centrality of degree C_D A node is the simplest and most intuitive measure of its potential communication activity (Freeman, 1979); It represents the number of edges attributed to it, regardless of the intensity of the connection. The degree of a node p_i it's simply the number of nodes p_j $(i \neq j)$ that are adjacent to him (Nieminen, 1974). It is calculated as the degree or number of adjacencies for the node p_k: $C_D(p_k) = \sum_{i=1}^{n} a(p_i, p_k)$.

The centrality of closeness C'_c It is based on the degree to which a node is close to the other nodes in the network. Here a node is considered central to the extent that it can avoid the potential control of others. In reality, it is a measure of decentrality or inverse centrality, as it grows as the points separate, and centrality in this context means closeness. (Freeman, 1979). Mathematically it is: $C'_c(p_k) = \frac{n-1}{\sum_{i=1}^{n} d(p_i, p_k)}$, where $d(p_i, p_k)$ is the number of edges in the geodesic (shortest distance of two nodes) that joins p_i y p_k. Centrality metrics were computed through the program Cytoscape.

Finally, the Pearson correlation coefficient computed in SPSS was used to calculate the association index of the variables studied.

Results

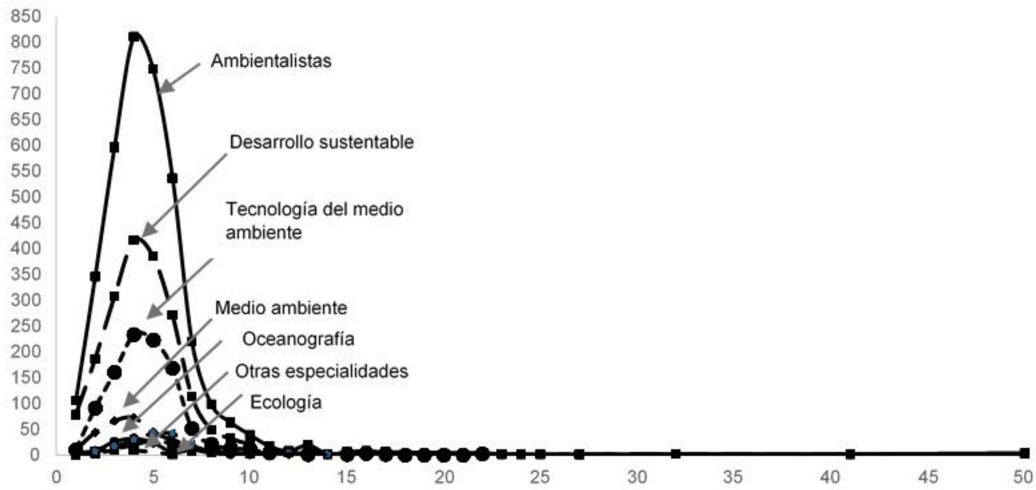
88 national researchers in the environmental sciences were identified, all of them in seven different disciplinary fields. Of them, 65 are in level two, in level three there are 22 and a single emeritus. The discipline of environmental technology, with a total of 40, has the highest number of researchers. Ecology is the discipline that has a single researcher and is emeritus (see annex).

Description of the productivity of the researchers

A significant volume of co-authored publications with 97% of environmental researchers is distinguished, while those made by an individual author represent the remaining 3%. These percentages are very close in six of the seven disciplines, except in ecology, where the most prominent researcher of environmental sciences publishes all his articles in collaboration with others.

While sustainable development and environment show outliers of up to 49 co-authors per publication. The first, although it has seven national researchers, entails a great diversity of co-authors in its publications. This can be explained by some collaborative reciprocity because of the discipline with the greatest amount of publications, while the environment is in third place. In this sense, all disciplines have articles published co-authored with 10 or more researchers, except for ecology that has a maximum of five and climatology up to nine. However, for the last two years (2015 and 1026) there is a decrease in both forms of publication, which is largely attributable to the lack of updating of the Conacyt curriculum (CVU) by researchers (see figure one).

Figure 1. Número de publicaciones y coautores



Fuente: Elaboración propia

In this same sense, on average each of the researchers publishes eight articles a year. Although from the particular perspective by discipline, it is observed that the emeritus researcher collaborates in five annual publications, which contrasts with sustainable development, which is one of the disciplines with the least number of national researchers with seven, only above oceanography, which It has six, and ecology, which has only one. However, sustainable development is the field with the most articles published with a total of 1901, which represents 52% of the total publications of this science; Of these, 1823 are co-authored (represents 50% of the total articles written collaboratively) versus 78 that are written individually. Derived from the above, it is not surprising that sustainable development averages the highest value of publications per national researcher with four during the analyzed period and the one with the highest number of co-authors per article.

Below the number of sustainable development publications is environmental technology, with 993, and it is the discipline that concentrates the largest number of researchers with 40, representing 45% of the total of scientists and 27% of the total of publications in co-authorship, which makes it the second with the greatest amount of collaborative work in environmental sciences. In a third place, there is the environmental discipline that, with 17% of national researchers in this field, contributes 8% of the total of co-authored publications.

In this sense, sustainable development is the only environmental area that contributes sensitively to all the articles published individually with 3%. In this way, it is concluded that environmental researchers publish collaboratively.

Correlation: degree and proximity centrality with the h index

Centrality metrics reveal the concentration of authority, control or other resources within the network. Table 1 summarizes the characteristics and centrality metrics of the network of national researchers of environmental sciences, as well as the disciplinary networks that compose it.

Tabla 1. Características y métricas de centralidad de las redes de coautoría ambientalistas

Métricas/Áreas	**Am**	**Cl**	**DS**	**Ec**	**MA**	**Oc**	**TMA**	**Otras**

Características								
Total SNI	88 (100 %)	6 (7 %)	7 (8 %)	1 (1 %)	15 (17 %)	10 (11 %)	40 (45 %)	9 (10 %)
Nivel 2	65	4	4	0	10	8	31	8
Nivel 3	22	2	3	0	5	2	9	1
Emérito	1	0	0	1	0	0	0	0
Número de artículos	3642	110	1901	22	315	119	993	182
Número de autores	4751	297	278	32	1057	393	2110	584
Artículos autor único	105 (2.88 %)	4 (3.64 %)	78 (4.10 %)	0 (0 %)	10 (3.17 %)	1 (0.84 %)	10 (1.01 %)	2 (1.10 %)
Artículos en coautoría	3537 (97.12 %)	106 (96.36 %)	1823 (95.90 %)	22 (100 %)	305 (96.83 %)	118 (99.16 %)	983 (98.99 %)	180 (98.90 %)
Promedio de autores por artículo	8.49	5	14.79	2.75	14.3	6.75	8.86	7
Promedio de artículos por autor	3.77	4.05	3.74	2.40	4.09	3.86	3.70	4.59
Grado promedio	14.80	12.49	17.55	10.875	17.36	10.47	14.09	12.91
Cercanía promedio	0.215	0.502	0.507	0.569	0.377	0.513	0.234	0.299

Nota: Am: Ambientalistas, Cl: Climatología, DS: Desarrollo sustentable, Ec: Ecología, MA: Medio ambiente, Oc: Oceanografía, TMA: Tecnología del medio ambiente, Otras: Otras especialidad medioambientales.

Fuente: Elaboración propia

Discussion

Degree centrality

The average degree of authors in the network (giant component) has a value of 14, which shows that the authors in the environmental network, in general, are well connected. However, sustainable development with 17 and environment also with 17 are the disciplines with the highest average grade values. In contrast, oceanography has the lowest average grade with 10. In this sense, those authors with higher grades become the most influential because of their position.

Centrality of proximity

The average central proximity of the network is 0.215, and associated with 6 degrees average separation. It is ecology with 0.569 the discipline with the highest proximity coefficient; climatology and sustainable development also have coefficients above 0.5. This indicates that their nodes are closer to the other nodes of the network, so that in these networks are the most central researchers who can avoid the potential control of others.

Correlation between centrality metrics and the impact index h

On the one hand, the correlation coefficient between the degree centrality and the h index (see table 2), considering the environmental disciplines as a whole, is of a value of 0.131 with a bilateral significance of 0.223, which indicates a correlation Too weak but not significant. For the proximity metric and the h index (table 2), the correlation coefficient is -0.107 and a bilateral significance of 0.322, so it has a minimum and not significant degree of association. In this way, it is concluded that there is no correlation between the degree and / or proximity centrality with the impact index of emeritus environmental scientists and levels two and three of Mexico. However, researchers from other environmental specialties have a high correlation of 0.744 *, significant at the 0.05 level (two tails) of their degree centrality with the impact of their published works. It is the only one of the disciplines that presents some value in terms of this association.

Tabla 2. Correlación por disciplina de los investigadores nacionales niveles dos y tres

Disciplina	**Correlaciones de Pearson**	
	Grado vs. índice *h*	**Cercanía vs. índice *h***

	SNI´s	Nivel 2	Nivel 3	SNI´s	Nivel 2	Nivel 3
Todas las disciplinas	0.131, *N* = 88	0.322** *N* = 65	-0.068 *N* = 22	-0.107 *N* = 88	-0.009 *N* = 65	-0.558** *N* = 22
Ecología[1]	No aplica	No aplica	No aplica	No aplica	No aplica	No aplica
Medio ambiente	0.289 N=15	0.554 N=10	0.589 N=5	0.132 N=15	0.390 N=10	0.261 N=5
Desarrollo sustentable	-0.157 *N* = 7	0.582 *N* = 4	-0.923 *N* = 3	0.501 *N* = 7	0.692 *N* = 4	0.134 *N* = 3
Climatología	-0.248 *N* = 6	-0.041 *N* = 4	-1.0** *N* = 2	-0.473 *N* = 6	-0.401 *N* = 4	-1.0** *N* = 2
Tecnología del medio ambiente	0.260 *N* = 40	0.313 *N* = 31	0.693* *N* = 9	-0.227 *N* = 40	-1.0 *N* = 31	-0.083 *N* = 9
Oceanografía	0.353 *N* = 10	0.261 *N* = 8	-1.0** *N* = 2	-0.012 *N* = 10	0.009 *N* = 8	-1.0** *N* = 2
Otras especialidades	0.744* *N* = 9	0.792* *N* = 8	No aplica *N* = 1	0.139 *N* = 9	0.269 *N* = 8	No aplica *N* = 1

Notas: [1]Ecología es la única disciplina con el investigador emérito. N: Número de investigadores. *: La correlación es significativa en el nivel 0.05 (2 colas). **: La correlación es significativa en el nivel 0.01 (2 colas).

Fuente: Elaboración propia

In the same way, considering all environmental disciplines together but disaggregating the levels of national researchers, it is that some correlation is distinguished between some of the centrality metrics and the impact index of scientists. An example of this is the low correlation of 0.322 ** although significant at the 0.01 level (two tails) between the degree and the impact of the publications of the 65 level two scientists. This indicates that the number of co-authors has a weak impact on the impact of their articles. While for the 22 national researchers level three there is a moderate inverse correlation, with a value of -0.558 and significant at the 0.01 level (two tails) between proximity and index h, which translates into greater independence (proximity) of the lesser scientists is the impact of their publications.

As for the disciplines, particularly the level three researchers belonging to environmental technology are those who correlate in a high way with a Pearson value of 0.693 their degree centrality with the impact of their published articles. Similarly, level two scientists from other specialties with a high correlation of 0.792, both significant correlations at the 0.05 level (2 tails). In the cases of oceanography and climatology, a very high and significant inverse correlation is observed for level three researchers, between the degree centrality and proximity to the researchers' impact index, which is largely explained because in Both cases are only two investigators who are part of these categories.

Conclusions

Mexico as one of the emerging countries is in the process of developing competitive scientific research systems. Given this, it is essential to identify their research strengths and collaborative networks to improve the visibility and impact of their scientists. One of these networks is that of the co-author of environmental scientists. In this network, 88 national researchers of the most distinguished are identified: 1 emeritus, 22 in level two and 65 in level three, belonging to 7 disciplinary fields. It is the discipline of environmental technology that concentrates the largest number of national researchers with 45% of their total; while in ecology is where the only emeritus scientist is. Sustainable development is the discipline that, with 8% of the total researchers, produces more publications with 52%.

A first conclusion derived from this study is that environmental researchers publish collaboratively: 97% of the articles are co-authored; in addition, that all scientists with an average grade centrality of 14 are well connected. In this sense, the authors with higher degrees become, by their central position in the network, the most influential, which are in sustainable development and environment. However, the network has a low average proximity centrality with a coefficient of 0.215; It is ecology with 0.569 the discipline with the greatest proximity value. Similarly, climatology and sustainable development have coefficients above 0.5. This indicates that their researchers are closer to the other researchers in the co-author network, so they are the most central scientists, who can avoid the potential control and influence of others. What is reaffirmed in ecology by having only one national researcher: it is the most centralized discipline of all.

Finally, it concludes with the non-existent correlation between degree centrality and proximity centrality with the impact index of emeritus environmental scientists and levels two and three of Mexico. The only discipline that shows a correlation between the centrality of the degree and the impact of the published works of its researchers is classified as other specialties, which has a high and significant Pearson coefficient of 0.744. That is, the number of co-authors strongly affects the impact of their articles. Similarly, there is a low correlation of 0.322 between the degree and impact of the publications, although significant of the 65 level two scientists from all disciplines. However, for the 22 national researchers level three there is a moderate inverse correlation, with a value of -0.558, and significant between the proximity and the h index, which means that the greater the independence (proximity) of the lesser scientists is The impact of your publications.

General studies in the specialized literature on this subject empirically show that collaborations contribute to scientific visibility and productivity. However, in light of the results obtained in this research, it is recommended for future studies of the co-authorship networks of Mexican scientists to confirm or not the incidence of centrality metrics on the impact of their respective publications.

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Anexo

Tabla 3. Correlaciones por disciplina ambientalista: métricas de centralidad e índice *h*

Id	Nivel SNI	Disciplina	Grado	Cercanía	Índice (*h*)	Correlación Grado - *h*	Correlación Cercanía - *h*
Id 1	Emérito	Ecología	13.17	0.5829	29	No aplica	No aplica
Id 2	3	Medio ambiente	11.57	0.1874	21	0.289	0.132
Id 3	3		10.35	0.1394	26		
Id 4	2		14.34	0.1636	14		
Id 5	3		10.35	0.1289	18		
Id 6	3		9.476	0.141	13		
Id 7	2		9.54	0.1319	11		
Id 8	2		12.64	0.1479	14		
Id 9	2		41.6	0.1678	24		
Id 10	3		15.39	0.1608	25		
Id 11	2		10.36	0.1445	13		
Id 12	2		13.54	0.1222	2		
Id 13	2		13.81	0.1643	11		
Id 14	2		11.23	0.5729	18		
Id 15	2		18.87	0.138	12		
Id 16	2		7.63	0.5434	16		
Id 17	3	Desarrollo sustentable	4.4	0.6666	11	-0157	0.501
Id 18	3		44.09	0.6549	6		
Id 19	3		14.32	0.1503	8		
Id 20	2		8.18	0.1191	4		
Id 21	2		13.75	0.1429	4		
Id 22	2		12.9	0.1039	2		
Id 23	2		32.6	0.7398	5		
Id 24	3	Climatología	17.91	0.531	4	-0.248	-0.473
Id 25	2		6.85	0.0921	11		
Id 26	3		11.46	0.1332	18		
Id 27	2		10.49	0.1149	1		
Id 28	2		15.05	0.373	3		
Id 29	2		17.02	0.1577	11		
Id 30	2	Tecnología del medio ambiente	10.35	0.62	9	0.26	-0.227
Id 31	3		10.9	0.1502	19		
Id 32	3		9.86	0.1262	17		
Id 33	2		13.21	0.128	9		
Id 34	3		37.81	0.1621	24		
Id 35	3		9.15	0.1302	19		
Id 36	3		10.31	0.1221	22		
Id 37	2		8.9	0.555	9		
Id 38	2		18.29	0.1369	11		
Id 39	3		11.38	0.1496	17		
Id 40	3		11.07	0.1688	19		

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Id	Nivel SNI	Disciplina	Grado	Cercanía	Índice (*h*)	Correlación Grado - *h*	Correlación Cercanía - *h*
Id 41	2		11.48	0.1388	9		
Id 42	2		16.45	0.1681	6		
Id 43	2		12.35	0.187	19		
Id 44	2		10.73	0.1176	2		
Id 45	3		15.23	0.1611	19		
Id 46	2		12.97	0.1823	10		
Id 47	2		16.86	0.1516	15		
Id 48	2		8.58	0.1334	7		
Id 49	2		18.88	0.1616	6		
Id 50	2		18.97	0.1472	16		
Id 51	2		18.86	0.1455	13		
Id 52	3		14.77	0.1785	17		
Id 53	2		8.51	0.5626	11		
Id 54	2		16.44	0.1641	3		
Id 55	2		11.7	0.5627	13		
Id 56	2		14.74	0.5532	12		
Id 57	2		15.78	0.1763	23		
Id 58	2		26.1	0.1766	16		
Id 59	2		17.98	0.1626	16		
Id 60	2		9.61	0.5902	7		
Id 61	2		14.75	0.1239	9		
Id 62	2		13.29	0.6112	11		
Id 63	2		9.18	0.1774	10		
Id 64	2		18.88	0.1432	6		
Id 65	2		18.2	0.1619	12		
Id 66	2		13.9	0.1196	17		
Id 67	2		12	0.1436	12		
Id 68	2		18.89	0.1697	20		
Id 69	2		14.78	0.1523	16		
Id 70	3		9.7	0.5547	5		
Id 71	2		14.25	0.1477	11		
Id 72	2		10.18	0.6412	3		
Id 73	2		15.53	0.6987	9		
Id 74	3		9.51	0.1337	6		
Id 75	2		7	0.3962	13		
Id 76	2		14.03	0.5472	17		
Id 77	2		7.57	0.1285	8		
Id 78	2		16.82	0.1145	11		
Id 79	2		10.91	0.1158	6		
Id 80	2	Otras especialidades	13.15	0.1451	10	0.744*	0.139
Id 81	3		12.8	0.1533	3		
Id 82	2		10.23	0.162	7		
Id 83	2		11.87	0.1368	6		
Id 84	2		20.18	0.1541	15		

Id	Nivel SNI	Disciplina	Grado	Cercanía	Índice (*h*)	Correlación Grado - *h*	Correlación Cercanía - *h*
Id 85	2		17.1	0.177	15		
Id 86	2		15.3	0.0914	12		
Id 87	2		13	0.123	9		
Id 88	2		15.32	0.156	18		

Nota: *: La correlación es significativa en el nivel 0.05 (2 colas).

Fuente: Elaboración propia