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Twenty-five Years of Journal of Universal Computer Science: A Bibliometric Overview

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Abstract: The Journal of Universal Computer Science is a monthly peer-reviewed open-access scientific journal covering all aspects of computer science, launched in 1994, so becoming twenty-five years old in 2019. In order to celebrate its anniversary, this study presents a bibliometric overview of the leading publication and citation trends occurring in the journal. The aim of the work is to identify the most relevant authors, institutions, countries, and analyze their evolution through time. The article uses the Web of Science Core Collection citations and the ACM Computing Classification System in order to search for the bibliographic information. Our study also develops a graphical mapping of the bibliometric material by using the visualization of similarities (VOS) viewer. With this software, the work analyzes bibliographic coupling, citation and co-citation analysis, co-authorship, and co-occurrence of keywords. The results underline the significant growth of the journal through time and its international diversity having publications from countries all over the world and covering a wide range of categories which confirms the "universal" character of the journal.

Keywords: Bibliometrics, Web of Science, ACM Computing Classification System, h-index, VOSviewer
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1 Introduction

The Journal of Universal Computer Science (J.UCS) is an international journal that covers all areas of computer science where articles are classified by categories based

on the ACM Computing Classification System [Coulter, 98]. Its reviewing system assures rapid turn-around of submitted articles, having currently the support of over 160 high profile editors, with a few areas of computer science which are not covered by some expert editors.

J.UCS was one of the first journals to allow readers to interact with the authors, allowing readers to post comments on articles. This feature which is now considered one of the basic features of Web 2.0 has been available in J.UCS already ten years before the term Web 2.0 was even coined. Another feature that J.UCS was pioneer to introduce is the "Link into the Future" which provides information about whether one of the authors of an article has published others in J.UCS at a later stage and the citations an article has received by other articles published in J.UCS.

Hermann Maurer was the founding Editor-in-Chief. Christian Gütl is the current editor-in-chief. In 1994, J.UCS published one issue (corresponding to the volume 0) with 5 articles, but starting in 1995 it has been regularly publishing 12 or 13 issues a year, with exceptions from 2008 to 2014 when it published slightly over 18 issues a year on the average, being 2008 the most prolific year with 21 issues. The journal has been registered in WoS since 2001.

The journal has an impact factor of 0.910 according to the 2018 Journal Citation Reports of the Web of Science (WoS), currently owned by Clarivate Analytics. It is positioned in the 97th position out of 108 journals in the Web of Science Core Collection category of Computer Science, Software Engineering (quartile 4), and in the 90th position out of 108 journals in the category Computer Science, Theory and Methods (quartile 4).

Motivated by the journal's 25th anniversary, this article develops a bibliometric analysis of the leading trends occurring therein. The aim is to identify the most significant aspects of the journal in terms of most cited articles, authors, institutions and countries. For doing so, the work analyzes all the documents published in the journal between 2001 and 2019 using the Web of Science Core Collection, and from 1993 to 2000 using the ACM Computing Classification System [Coulter, 98]. The study also applies the Visualization of Similarities (VOS) viewer software [Van Eck, 10] to graphically map the bibliographic material by employing a wide range of bibliometric methods including bibliographic coupling [Kessler, 63] and co-citation [Small, 73]. It is very common in the literature to develop some special activities when the journal celebrates a significant anniversary including editorials [Barley, 16] [Shugan 06], reviews [Huang, 13] [Van Fleet, 06] [Zurita, 20a], and special issues [Kozlowski, 17].

Many Computer Science journals have presented a bibliometric analysis of the published articles, especially when celebrating their anniversaries. For example, [Zurita, 20b] study a bibliometric overview of the Journal of Network and Computer Applications between 1997 and 2019, [Merigó, 17b] study the first twenty years of Soft Computing, [Laengle, 18] study the twenty-five years of Group Decision and Negotiation, [Shukla, 19] study the thirty years of Engineering Applications of Artificial Intelligence, [Laengle, 17] study the forty years of European Journal of Operational Research, [Merigó, 17a] study the thirty years of the International Journal of Intelligent Systems, and [López-Robles, 18] study the sixty years of the Business Intelligence journal.

This article is organized as follows: section 2 presents the applied bibliographic methods, section 3 presents the results of applying them to obtain information about the citation of the articles structure, the topics and categories of the published articles,

the most prolific authors as well as the geographical zones they are based and their affiliations. This section also presents various graphs representing various types of relations among articles like the co-citation frequency among articles by authors and countries, co-occurrence of keywords and co-authoring. Section 4 concludes this study.

2 Bibliographic Methods

Bibliometrics is a research area of information and library sciences that analyzes bibliographic data, such as year of publication, authors, country of origin, among others, by using a quantitative approach [Broadus, 87] [Pritchard, 69]. The development of a bibliometric analysis is very useful in order to classify and provide a representative overview of a set of bibliographic documents. In the literature, many bibliometric studies analyze a wide range of issues including topics, journals [Thongpapanl, 12], institutions [Coupé, 03] or countries [Fiala, 15]. In fact, there are several bibliometric overviews of journals related to Computer Science including the Journal of Educational Technology and Society [Kinshuk, 13], Fuzzy Decision Research [Liu, 17], Genetic Algorithms [Dao, 17] and Computer Networking Research [Iqbal, 19]. Some of them provide bibliometric studies about research in Computer Science associated to various world regions, as for example in India [Parmar, 16] [Singh, 19], Eastern Europe [Fiala, 15] and Malaysia [Bakri, 17].

There are many different bibliometric indicators to represent the respective information, such as the number of articles and citations [Ding, 16] [Garfield, 55]. This study considers several of them in order to provide different perspectives in order to help readers understand the results according to their specific interests and priorities. An important reason for adopting this approach is that today there is no consensus regarding a single optimal method that can correctly evaluate a set of documents. Depending on the problem, a method may be better than another one. From a general point of view, the two main perspectives to evaluate research are productivity and influence [Podsakoff, 08]. Productivity is usually measured as the number of publications, while the influence as the number of citations. However, there are other indicators and many exceptional situations may arise. Some authors [Alonso, 09] have tried to unify productivity and influence in the same indicator. A very popular measure is the h-index [Hirsch, 05] that combines them by finding the threshold that connects the number of documents with the number of citations. That is, if a set of documents has an h-index of X, then this means that the set has X documents that have X or more citations and, at the same time, there are not X + 1 documents that have received X + 1 citations or more. The work also considers other bibliometric indicators including the number of cites per article, the cites per year, citation thresholds, citing articles, and the evolution through time. It is also common to analyze for a single country the number of articles and citations per million inhabitants.

Additionally, this study also graphically maps the bibliographic material by using the VOSviewer software [Van Eck, 10]. The VOSviewer collects the data and builds maps in terms of bibliographic coupling, citation, co-citation, co-authorship and co-occurrence of author keywords. Let us recall that bibliographic coupling counts the documents that cite the same third document [Kessler, 63]. This metric is useful to identify similar research profiles. Citation analysis identifies how the documents cite each other counting the number of times that A cites B and vice versa. Co-citation

occurs when two documents receive a citation from the same third source [Small, 73]. Co-authorship counts the documents that are co-authored by more than one author, institution or country and shows how they are connected. Co-occurrence of author keywords identifies the most frequent keywords and those keywords that appear more frequently in the same documents. Finally, note that in the literature there is a wide range of software for mapping bibliographic data [Cobo, 11].

Our analysis uses the Web of Science Core Collection database that is currently owned by Clarivate Analytics. The initial search selects the option of "publication name" and the time span between 2001 and 2019. The search has taken place in January 2020. The journal has published 2251 documents during this period. This number reduces to 2014 if only articles and reviews are considered. Up to January 2020, the journal has received 12,911 citations from the other documents available in the Web of Science database. This means an average number of cites per article of 6.41. The h-index is 40, meaning that 40 articles have received 40 cites or more.

3 Results

3.1 Publication and citation structure

As mentioned above, the first issue of J.UCS was published in 1994 and the journal was indexed by WoS already by 2001. The journal presents a significant growth since it entered into WoS in the number of articles published yearly after that.

Figure 1 presents the number of articles published by J.UCS since it appeared in 1994. The journal has published an average of 85 documents per year, being 2008 the most prolific year (192 documents).

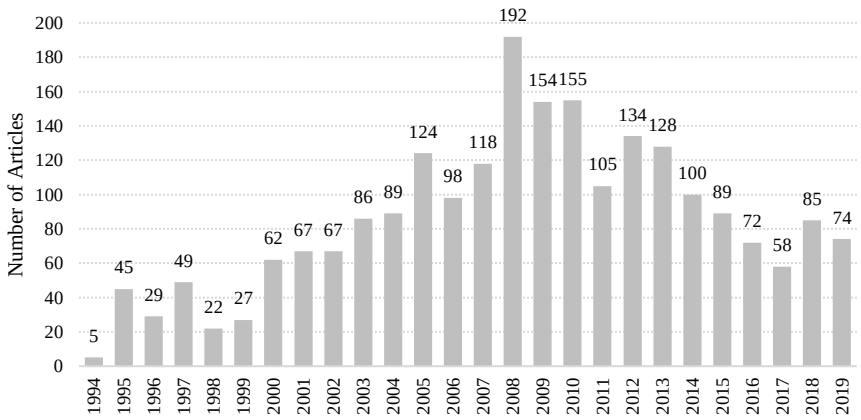

Figure 1: Number of J.UCS publications by year between 1994 and 2019

Table 1 presents the citation structure of the journal by showing for each year since 2001 the total number of documents published in the journal and it reports the number of citations they have received according to several citation thresholds. From the Table 1, we can see that J.UCS journal articles have been cited an average of 614 times annually. Similar to the total article analysis, the year 2008 was the one with most cites

totaling 1,310 cites, followed by 2010 with 1,212 cites. These two years represent the 21.61% of the total cites of the journal. There are 12 years in which J.UCS articles have more than 500 cites.

Regarding the most cited articles, five documents have more than 100 cites, two of them were published in the year 2006, and 29 with more than 50 cites. Notably, 2006 is the year that has the highest number of articles with more than 50 cites (12 documents), although it is not the most influential year. Then, year 2010 is the most influential period with 19 articles that have received more than 20 cites. For the following thresholds, the most influential year is 2008, which is also the most cited year. This means that although 2008 seems to be the most influential year, the most remarkable publications of the journal were not published during that year.

Table 1: Annual citation structure of J.UCS

Year	>=100	>=50	>=20	>=10	>=5	>=1	>=0	TC	TA	TC/TA
2001	0	1	4	15	31	53	67	452	67	6.75
2002	1	1	5	13	18	50	67	537	67	8.01
2003	0	0	11	20	45	73	86	667	86	7.76
2004	1	1	9	26	40	76	89	771	89	8.66
2005	0	0	13	37	55	99	124	841	124	6.78
2006	2	12	12	24	42	79	98	945	98	9.64
2007	0	1	8	30	45	95	118	706	118	5.98
2008	0	3	13	45	75	172	192	1,310	192	6.82
2009	1	1	8	26	59	116	154	993	154	6.45
2010	0	5	19	40	69	123	155	1,212	155	7.82
2011	0	2	7	16	48	96	105	716	105	6.82
2012	0	1	5	19	52	119	134	677	134	5.05
2013	0	1	8	16	37	107	128	651	128	5.09
2014	0	0	5	10	28	75	100	388	100	3.88
2015	0	0	3	13	28	74	89	405	89	4.55
2016	0	0	2	11	20	58	72	270	72	3.75
2017	0	0	0	0	1	30	58	56	58	0.97
2018	0	0	0	0	3	43	85	68	85	0.80
2019	0	0	0	0	0	4	74	5	74	0.07
AC	5	29	132	361	696	1,542	1,995	11,670	1,995	
PAC	0%	1%	7%	18%	35%	77%	100%	100%	100%	

Abbreviations: TA = Total number of Articles; TC = Total number of Citations; ≥100, ≥50, ≥20, ≥10, ≥5, ≥1 means number of articles with equal or more than 100, 50, 20, 10, 5 and 1 citations up to January 2020; AC = Accumulated articles; PAC = Percentage of accumulated articles; TC/TA = mean value of citations per article.

Table 2 presents a list with the details of the fifty most cited articles ordered by number of citations received. We also included the number of citations per year (C/Y) which is the number of total cites it has received divided by the number of years since it has been published until 2019. 2010 was the most prolific year for publications, since 7 articles of this list were published that year. It is followed by year 2006, with 6 articles belonging to this ranking.

The article “Multilayer Ensemble Pruning via Novel Multi-sub-swarm Particle Swarm Optimization” [Zhang, 09] has 13.30 cites per year. The second article with high number of cites per year is “Energy Efficient Smartphone-Based Activity

Recognition using Fixed-Point Arithmetic" [Anguita, 13] (C/Y: 11.33), which is noteworthy considering that it is in the 12th position according to the number of citations. Closely in the C/Y ranking, we can find the articles "A Clustering Approach for Collaborative Filtering Recommendation Using Social Network Analysis" [Pham, 11], and "Situational Method Engineering: State-of-the-Art Review" [Henderson-Sellers, 10] with 10.88 and 10.11 cites per year respectively.

Also, notice that seven articles have only one author. These articles are: "Quality of experience in communications ecosystem" [Kilkki, 08], "Towards a systematic study of representational guidance for collaborative learning discourse" [Suthers, 01], "Query transformation based on semantic centrality in semantic social network" [Jung, 08], "Health monitoring and assistance to support aging in place" [Cook, 06], "Automatic test data generation for data flow testing using a genetic algorithm" [Girgis, 05], "Verification of ASM refinements using generalized forward simulation"[Schellhorn, 01], and "Extensions of affine arithmetic: Application to unconstrained global optimization" [Messine, 02].

Given that the journal is not focused on a certain topic and it accepts articles touching a wide variety of subjects of Computer science, we think that it should be relevant to analyze which are the categories covered by the articles and if there is a trend or preference of the categories chosen by the authors and if there has been an evolution of the categories' importance through the years. In order to do this analysis systematically we classified the articles using their keywords according to the categories used by J.UCS which are based on the ACM categorization. These categories are divided in main and sub categories. The main categories are the following:

A - General Literature
B - Hardware
C - Computer Systems Organization
D - Software
E - Data
F - Theory of Computation
G - Mathematics of Computing
H - Information Systems
I - Computing Methodologies
J - Computer Applications
K - Computer Milieus
L - Science and Technology of Learning
M - Knowledge Management

First, we will analyze the most frequent categories of the 50 most influential articles (according to Table 2). From Table 3 we can see that the most frequent categories that were associates to the 50 most cited articles are I, H, L, D, K, but the frequency of the first two ones together overpass the sum of all the rest. This can be seen more clearly in Figure 2. This situation might be because Computing Methodologies and Information Systems are very broad categories, but it also points that most authors of this selected list have chosen this journal to publish works on applied computing applications. It can be noted that Computer Supported Learning has a prominent place, since it appears in the third place as the first non-general subject which clearly identifies the aim of the application sphere of the system(s) being presented on the article.

When looking at the keywords authors have chosen for these articles we see from Figure 3 that the most frequent ones are Knowledge management, Semantic Web, Ontologies, Security and e-learning. We can note that the first three are related since they deal with understanding the information coded in the machine. It is important to note that these keywords were freely chosen by the authors, not bounded to a pre-

defined group like it is for the categories. This observation gives us a closer look at what really aims the contribution of the articles.

Table 2: The 50 most cited articles in J.UCS between 2001 and 2019.

R	TC	Title	Authors	Year	C/Y	ACM Category(ies) level 1
1	153	Finding plagiarisms among a set of programs with JPlag	Prechelt, L; Malpohl, G; et al.	02	9.00	F(1), H(2), I(1), K(2)
2	133	Multilayer Ensemble Pruning via Novel Multi-sub-swarm …	Zhang, J; Chau, K	09	13.30	L(1)
3	125	Plagiarism - A survey	Maurer, H; Kappe, F; Zaka, B	06	9.62	K(4)
4	123	The transformation of the Web: How emerging communities …	Kolbitsch, J; Maurer, H	06	9.46	H(5)
5	101	Exploiting the potential of concept lattices …	Carpineto, C; Romano, G	04	6.73	H(2)
6	99	Quality of experience in communications ecosystem	Kilkki, K	08	9.00	H(1)
7	91	Situational Method Engineering…	Henderson-Sellers, B; Ralyte, J	10	10.11	D(1)
8	87	A Clustering Approach for Collaborative Filtering …	Pham, MC; Cao, YW; et al.	11	10.88	H(2)
9	77	Opening Learning Management Systems to Personal …	Garcia-Penalvo, FJ; Conde, MA; et al.	11	9.63	L(6)
10	71	The Berlin brain-computer interface: Machine …	Blankertz, B; Dornhege, G; et al.	06	5.46	G(1), H(2), I(3), J(3)
11	69	Towards a systematic study of representational guidance …	Suthers, DD	01	3.83	K(1)
12	68	Energy Efficient Smartphone-Based Activity Recognition …	Anguita, D; Ghio, A; Oneto, L; et al.	13	11.33	D(1), H(1), I(3), J(2)
13	68	A Selection Process Based on Additive Consistency …	Cabrerizo, FJ; Heradio, R; et al.	10	7.56	H(1), I(2), J(1)
14	63	A Context Model based on Ontological Languages: …	Hervas, R; Bravo, J; Fontecha, J	10	7.00	H(1), I(1), M(1)
15	60	Mining Feature-Opinion in Online Customer Reviews …	Somprasertsri, G; Lalitrojwong, P	10	6.67	H(3), I(1)
16	59	Toward the Next Wave of Services: Linked Services …	Pedrinaci, C; Domingue, J	10	6.56	D(1), H(1), I(1), K(1)
17	54	Query transformation based on semantic centrality …	Jung, JJ	08	4.91	H(2), I(1)
18	54	An OWL ontology of set of experience knowledge structure	Sanin, C; Szczerbicki, E; et al.	07	4.50	H(2), I(3), M(4)
19	52	An Evaluation Technique for Binarization Algorithms	Stathis, P; et al.	08	4.73	I(1)
20	50	Discovering Consumer Insight from Twitter via Sentiment …	Chamlertwat, W; et al.	12	7.14	H(2), M(1)
21	49	Software Technologies in Knowledge Society …	Lytras, M; de Pablos, PO	11	6.13	D(2), H(2), J(3), L(2), M(2)
22	49	Population P systems	Bernardini, F; Gheorghe, M	04	3.27	F(2)
23	49	Propositional interval neighborhood temporal logics	Goranko, V; Montanari, A; et al.	03	3.06	F(1), I(1)
24	48	ARLearn: Augmented Reality Meets Augmented Virtuality	Ternier, S ; Klemke, R ; Kalz, M ; et al.	12	6.86	L(1)
25	47	Health monitoring and assistance to support aging …	Cook, DJ	06	3.62	I(2), M(1)

R	TC	Title	Authors	Year	C/Y	ACM Category(ies) level 1
26	47	Game-based learning in universities and lifelong …	Pivec, M; Dziabenko, O	04	3.13	H(1), I(2), K(3)
27	46	On the use of graph transformation in the formal …	Karsai, G; Agrawal, A; Shi, F; Sprinkle, J	03	2.88	D(1)
28	43	Proposal for a Conceptual Framework for Educators …	Alario-Hoyos, C; et al.	14	8.60	K(2)
29	43	A DCM Based Orientation Estimation Algorithm …	Phuong, NHQ; Kang, HJ; et al.	09	4.30	I.(3)
30	43	A modular architecture for nodes in wireless sensor …	Portilla, J; de Castro, A; et al.	06	3.31	B(3)
31	43	Automatic test data generation for data flow testing using …	Girgis, MR	05	3.07	D(1), K(1)
32	43	P systems with active membranes and separation rules	Pan, LQ; Ishdorj, TO	04	2.87	C(1), F(1)
33	42	Fuzziness and uncertainty in temporal reasoning	Dubois, D; HadjAli, A; Prade, H	03	2.63	I(1)
34	42	VOC: A methodology for the translation validation of Optimizing…	Zuck, L; Pnueli, A; Fang, Y;Goldberg, B	03	2.63	D(2), I(1)
35	41	Finding median partitions using information-theoretical-based…	Cristofor, D; Simovici, D	02	2.41	E(1), H(1)
36	41	Verification of ASM refinements using …	Schellhorn, G	01	2.28	D(2), F(3)
37	40	ASM-based testing: Coverage criteria and automatic test …	Gargantini, A; Riccobene, E	01	2.22	D(2)
38	39	Methodological Approach and Technological Framework …	Fidalgo-Blanco, A; et al.	15	9.75	K(2)
39	39	The Use of Social Networking Sites in Education: A Case …	Bicen, H; Uzunboylu, H	13	6.50	L(4)
40	39	KMDL - Capturing, analysing and improving …	Gronau, N; Muller, C; Korf, R	05	2.79	D(1), H(4), I(6)
41	38	Complexity Analysis of Ontology Integration …	Duong, TH; Jo, GS; Jung, JJ; Nguyen, N	09	3.80	E(1), H(2), I(5), M(1)
42	36	TRAILER Project: A Methodology to Make …	Garcia-Penalvo, FJ; Conde, MA; et al.	13	6.00	L(6), M(1)
43	35	Development of the Learning Analytics Dashboard …	Park, Y; Jo, IH	15	8.75	L(3)
44	35	Extensions of affine arithmetic: Application to unconstrained …	Messine, F	02	2.06	G(2)
45	34	Towards a Ubiquitous End-User Programming System …	Garcia-Herranz, M; Haya, P	10	3.78	H(1), I(2)
46	34	Watermarking Techniques for Relational Databases: …	Halder, R; Pal, S; Cortesi, A	10	3.78	D(1), E(1), H(1)
47	34	Persian/Arabic baffletext CAPTCHA	Shirali-Shahreza, MH; et al.	06	2.62	I(2)
48	33	A Quantum-Inspired Immune Algorithm for Hybrid Flow …	Niu, Q; Zhou, TJ; Ma, SW	09	3.30	F(1), I(1)
49	33	A Metamodel-based Language and a Simulation Engine …	Gargantini, A; Riccobene, E; et al.	08	3.00	B(1), D(2), F(1)
50	33	Certificateless public key encryption secure against …	Hwang, YH; Liu, JK; Chow, SSM	08	3.00	E(1)

Abbreviations: R=Rank; TC=Total citations; C/Y=Citations per year.

Table 3: ACM categories frequency of the top 50 most cited articles in J.UCS between 2001 and 2019.

ACM Category	TA
I. Computing Methodologies	**43**
I.2 Artificial Intelligence	3
I.2.4 Knowledge Representation Formalisms and Methods	7
I.2.6 Learning	5
I.2.1 Applications and Expert Systems	3
I.2.11 Distributed Artificial Intelligence	3
I.2.9 Robotics	2
I.2.0 General	1
I.2.3 Deduction and Theorem Proving	1
I.2.2 Automatic Programming	1
I.2.5 Programming Languages and Software	1
I.2.7 Natural Language Processing	1
I.2.8 Problem Solving, Control Methods, and Search	1
I.6 Simulation and Modeling	1
I.6.4 Model Validation and Analysis	2
I.6.8 Types of Simulation	1
I.6.3 Applications	1
I.5 Pattern Recognition	1
I.5.2 Design Methodology	1
I.5.4 Applications	1
I.3.6 Methodology and Techniques	1
I.3.7 Three-Dimensional Graphics and Realism	1
I.3.5 Computational Geometry and Object Modeling	1
I.4.5 Reconstruction	1
I.4.0 General	1
I.7.5 Document Capture	1
H. Information Systems	**39**
H.3.3 Information Search and Retrieval	5
H.3.5 Online Information Services	5
H.3.1 Content Analysis and Indexing	2
H.3.7 Digital Libraries	2
H.3.0 General	1
H.3.4 Systems and Software	1
H.5.2 User Interfaces	4
H.5.1 Multimedia Information Systems	1
H.5.4 Hypertext/Hypermedia	1
H.1.2 User/Machine Systems	3
H.1.1 Systems and Information Theory	2
H.1.0 General	1
H.4 Information Systems Applications	1
H.4.3 Communications Applications	4
H.2 Database Management	1
H.2.8 Database Applications	1
H.2.4 Systems	1
H.0 General	2
H.m Miscellaneous	1
L. Science and Technology of Learning	**23**
L.2 Learning	1
L.2.1 Individualised Learning Solution	3
L.2.0 Adaption/Adaptive eLearning	2
L.2.3 Innovation	2
L.3.0 eLearning Systems/ Technology/Tools/Platforms	3
L.3.6 Technology Enhanced Learning	3
L.3.5 Online Education	1
L.1 Knowledge and Media	1
L.1.3 Ontology/Taxonomy and Classification	1
L.1.4 Semantic Web	1
L.6.1 Virtual Community	1
L.6.0 Learning Networks	1
L.5.1 Game Based Learning/ Gaming	1
D. Software	**17**
D.2 Software Engineering	2
D.2.4 Software/Program Verification	3
D.2.2 Design Tools and Techniques	3
D.2.1 Requirements/Specifications	2
D.2.5 Testing and Debugging	2
D.2.6 Programming Environments	1
D.2.11 Software Architectures	1
D.3.3 Language Constructs and Features	1
D.3.4 Processors	1
D.0 General	1
K. Computing Milieux	**16**
K.3 Computers and Education	1
K.3.1 Computer Uses in Education	4
K.3.2 Computer and Information Science Education	2
K.3.m Miscellaneous	1
K.3.0 General	1
K.5 Legal Aspects of Computing	1
K.5.1 Hardware/Software	1

ACM Category	TA
Protection	
K.4 Computers and Society	1
K.4.4 Electronic Commerce	1
K.8.0 General	1
K.0 General	1
K.6.3 Software Management	1
M. Knowledge Management	**11**
M.0 Knowledge Acquisition	4
M.4 Knowledge Modeling	2
M.3 Knowledge Maintenance	2
M.1 Knowledge Engineering Methodologies	1
M.6 Knowledge Publishing	1
M.7 Knowledge Retrieval	1
F. Theory of Computation	**10**
F.4.1 Mathematical Logic	2
F.4.3 Formal Languages	1
F.3.1 Specifying and Verifying and Reasoning about Programs	2
F.3.2 Semantics of Programming Languages	1
F.2.2 Nonnumerical Algorithms and Problems	2
F.1.1 Models of Computation	2
J. Computer Applications	**9**
J.7 Computers in Other Systems	2
J.6 Computer-Aided Engineering	2
J.3 Life and Medical Sciences	2
J.4 Social and Behavioral Sciences	1
J.0 General	1
J.2 Physical Sciences and Engineering	1
E. Data	**4**
E.3 Data Encryption	2
E.1 Data Structures	1
E.4 Coding and Information Theory	1
B. Hardware	**4**
B.5.1 Design	1
B.7.0 General	1
B.6.0 General	1
B.2 Arithmetic and Logic Structures	1
G. Mathematics of Computing	**3**
G.1.6 Optimization	2
G.1.0 General	1
C. Computer Systems Organization	**1**
C.1.4 Parallel Architectures	1

Another analysis we performed was regarding the evolution of the categories through time. Tables 4a and 4b presents this information, by showing for each year the number of articles for which the authors have chosen the main category. We see from these tables that Information systems has maintained its predominance through the years, while Software and Computing Methodologies have increased their share. On the contrary, Mathematics of Computing, Hardware and Theory of Computation seem to have less relative importance nowadays than in the early years. The Science and Technology of Learning which had no mentions before 2006 had a peak in the middle of the 2010s.

Table 4a: Number of articles published in J.UCS according to ACM category level 1 and year between 1995 to 2019. Articles in 1994 were not classified. (First part).

ACM Category	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09
H. Information Systems	25	22	22	16	8	23	27	59	55	63	94	57	80	164	112
D. Software	7	2	27	5	7	31	46	16	62	53	62	59	73	97	75
I. Computing Methodologies	11	6	18	10	8	8	13	24	35	23	31	48	34	84	56
L. Science and Technology of Learning	0	0	0	0	0	0	0	0	0	0	0	0	0	15	45
F. Theory of Computation	14	13	29	6	23	43	34	36	23	37	52	44	40	33	36
K. Computing Milieux	7	15	12	9	0	7	19	10	19	21	23	13	25	34	31
C. Computer Systems Organization	7	5	5	1	3	12	11	4	9	11	16	20	22	29	26
M. Knowledge Management	0	4	6	3	1	0	2	4	4	5	4	5	32	20	16
J. Computer Applications	0	2	1	1	3	7	7	6	13	6	7	21	3	21	17
G. Mathematics of Computing	14	2	7	7	3	5	6	7	1	6	14	16	14	16	19
E. Data	4	2	3	1	3	2	0	1	3	6	7	5	7	9	10
B. Hardware	11	3	5	0	4	4	1	0	3	5	3	8	17	7	0
A. General Literature	0	1	3	1	0	2	0	3	10	5	3	0	0	2	0
	100	**77**	**138**	**60**	**63**	**144**	**166**	**170**	**237**	**241**	**316**	**296**	**347**	**531**	**443**

The numbers 95 to 09 in the header of the table, represent the years 1995 to 2009.

Table 4b: Number of articles published in J.UCS according to ACM category level 1 between 1995 to 2019. Articles in 1994 were not classified with ACM. (Second part).

ACM Category	10	11	12	13	14	15	16	17	18	19	Total
H. Information Systems	127	96	106	115	75	66	53	2	63	49	**1,579**
D. Software	66	44	55	54	55	21	35	18	38	35	**1,043**
I. Computing Methodologies	68	35	42	42	23	28	27	61	50	27	**812**
L. Science and Technology of Learning	55	42	85	97	61	90	65	72	67	57	**751**
F. Theory of Computation	46	7	20	10	7	7	9	3	6	3	**581**
K. Computing Milieux	21	28	43	26	19	26	26	9	22	29	**494**
C. Computer Systems Organization	20	11	25	17	11	7	12	32	12	16	**344**
M. Knowledge Management	24	20	16	23	16	8	12	18	16	8	**267**
J. Computer Applications	17	14	24	17	12	13	15	6	16	17	**266**
G. Mathematics of Computing	17	6	8	2	6	3	5	1	2	3	**190**
E. Data	5	3	5	9	5	8	3	5	6	14	**126**
B. Hardware	1	0	5	5	1	3	1	6	5	3	**101**
A. General Literature	3	2	3	0	1	0	0	11	0	0	**50**
	470	**308**	**437**	**417**	**292**	**280**	**263**	**244**	**303**	**261**	

The numbers 10 to 19 in the header of the table, represent the years 2010 to 2019.

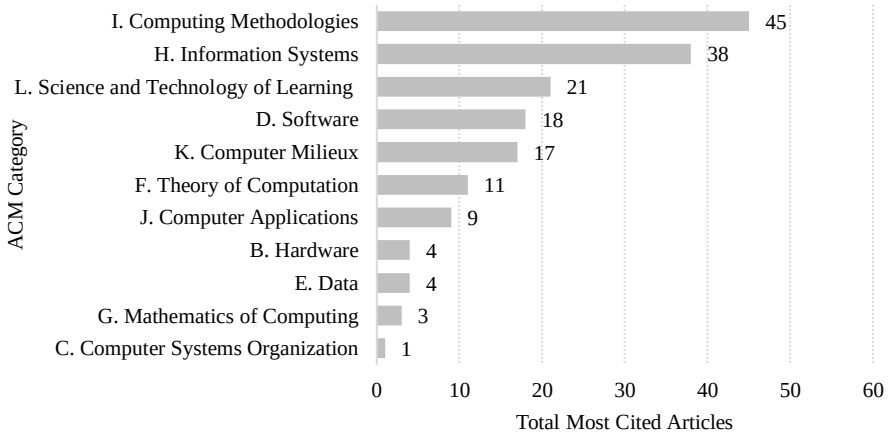

Figure 2: ACM level 1 categories frequency of the top 50 most cited articles in J.UCS between 2001 and 2019.

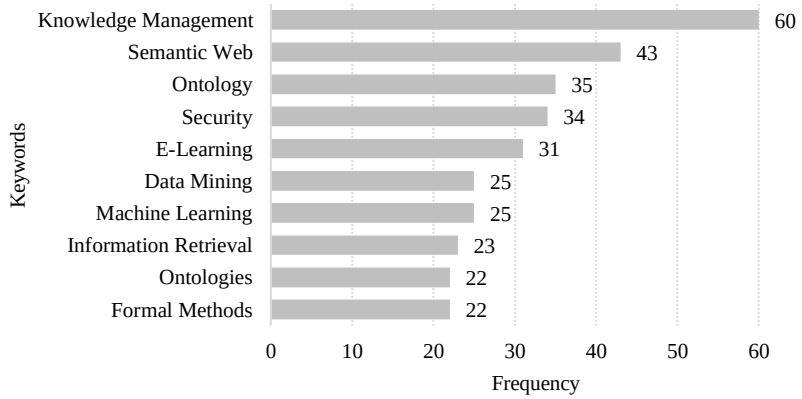

Figure 3: Keywords frequency of the top 50 most cited articles in J.UCS between 2001 and 2019.

Table 5a: Most-productive and influential authors publishing in J.UCS between 2001 and 2019. (First part).

R	Author	Afilliation	TA	TC	H	TC/TA	TA/ TAW
1	Maurer, H	Graz University of Technology	18	306	6	17.00	0.72
2	Garcia-Penalvo, FJ	Universidad de Salamanca	15	233	8	15.53	0.56
3	Jung, JJ	Yeungnam University	14	181	8	12.93	0.19
4	Kloos, CD	Universidad Carlos III Madrid	13	67	5	5.15	1.00
5	Baloian, N	Universidad de Chile	10	29	4	2.90	0.91
6	Ierusalimschy, R	U. Católica Rio Janeiro	10	37	3	3.70	0.53
7	Lins, RD	U. Federal Pernambuco	10	26	3	2.60	0.43
8	Nguyen, NT	Wrocław U. Science Technology	9	91	5	10.11	0.75
9	Asensio-Perez, JI	Universidad de Valladolid	8	56	4	7.00	0.25
10	Ochoa, SF	Universidad de Chile	8	62	4	7.75	0.32
11	Pino, JA	Universidad de Chile	8	57	3	7.13	0.29
12	Colomo-Palacios, R	Østfold University College	7	9	6	1.29	0.17
13	Zurita, G	Universidad de Chile	7	25	4	3.57	0.23
14	Barbosa, JLV	U. do Vale do Rio dos Sinos	6	19	3	3.17	0.16
15	Barbosa, LS	Universidade do Minho	6	42	3	7.00	0.27
16	Borba, P	U. Federal de Pernambuco	6	23	2	3.83	0.21
17	Borger, E	Università di Pisa	6	66	4	11.00	0.30
18	Bote-Lorenzo, ML	Universidad de Valladolid	6	31	3	5.17	0.50
19	Bravo, J	U. de Castilla La Mancha	6	123	5	20.50	0.21
20	De Pablos, PO	Universidad de Oviedo	6	80	4	13.33	0.21
21	Hwang, D	Yeungnam University	6	21	3	3.50	0.21
22	Lopez-de-Ipina, D	Universidad de Deusto	6	42	3	7.00	0.15
23	Lytras, MD	The American College of Greece	6	81	5	13.50	018
24	Ortega, M	U. de Castilla La Mancha	6	42	3	7.00	0.15
25	Thalheim, B	Kiel University	6	47	3	7.83	0.32
26	Weihrauch, K	University of Hagen	6	52	6	8.67	0.29
27	Collazos, CA	Universidad del Cauca	5	23	3	4.60	0.23
28	Conde, MA	Universidad de Salamanca	5	126	5	25.20	0.26
29	Fernandez-Medina, E	U. de Castilla La Mancha	5	43	4	8.60	0.63
30	Gallud, JA	U. de Castilla La Mancha	5	17	3	3.40	0.31
31	Hernandez-Leo, D	Universidad Pompeu Fabra	5	39	4	7.80	0.14
32	Kulathuramaiyer, N	Universiti Malaysia Sarawak	5	43	3	8.60	0.50
33	Lukosch, S	Delft University of Technology	5	27	3	5.40	0.20
34	Molina, AI	U. de Castilla La Mancha	5	40	3	8.00	0.50
35	Pardo, A	The University of Sydney	5	33	3	6.60	0.20
36	Penichet, VMR	U. de Castilla La Mancha	5	21	4	4.20	0.42
37	Redondo, MA	U. de Castilla La Mancha	5	40	3	8.00	0.31
38	Szczypiorski, K	Warsaw U. of Technology	5	12	2	2.40	0.45
39	Afzal, MT	Athabasca University	4	24	3	6.00	0.27
40	Alario-Hoyos, C	U. Carlos III de Madrid	4	50	2	12.50	0.67
41	Alier, M	U. Politécnica de Cataluña	4	120	4	30.00	0.57
42	Barreiro, A	Universidad de La Coruña	4	10	2	2.50	0.19
43	Bigonha, RS	U. Federal de Minas Gerais	4	7	2	1.75	0.33
44	Bonifacio, M	Trent University	4	42	3	10.50	0.36
45	Chang, CC	Feng Chia University	4	12	2	3.00	0.01
46	Choi, J	Soongsil University	4	18	3	4.50	0.57
47	Da Silva, AF	U. Estadual de Maringá	4	3	1	0.75	0.57
48	Dhir, A	Aalto University	4	68	3	17.00	0.24
49	Drusinsky, D	Naval Postgraduate School	4	13	3	3.25	0.33
50	Duval, E	KU Leuven	4	43	3	10.75	0.13

Abbreviations: R=Rank; TA=Total articles; TC=Total citations; TC/TA=Citations per article; TAW=Total articles in WoS.

Table 5b: Most-productive and influential authors publishing in J.UCS between 2001 and 2019. (Second part).

R	A. General Literature	B. Hardware	C. Computer Systems Organization	D. Software	E. Data	F. Theory of Computation	G. Mathematics of Computing	H. Information Systems	I. Computing Methodologies	J. Computer Applications	K. Computing Milieux	L. Science and Technology of Learning	M. Knowledge Management
1	2	0	0	0	0	0	0	12	0	4	6	2	3
2	0	0	0	3	1	0	1	4	1	3	3	7	3
3	0	0	0	0	1	0	0	14	11	1	0	0	1
4	0	0	0	2	0	0	0	3	0	2	5	8	0
5	0	0	1	0	0	0	0	7	0	3	1	3	1
6	0	0	1	9	1	1	0	0	0	0	0	0	0
7	0	0	1	6	0	2	0	4	0	0	0	0	0
8	0	0	0	0	4	0	0	6	8	0	0	0	3
9	0	0	1	1	0	0	0	3	2	1	5	3	1
10	0	0	2	4	0	0	0	3	0	2	1	1	1
11	0	0	1	3	0	0	0	3	0	3	1	1	1
12	0	0	1	5	0	0	0	2	1	0	2	0	0
13	0	0	0	0	0	0	0	5	0	1	0	2	1
14	0	0	2	0	0	0	0	2	0	3	0	6	1
15	0	0	0	6	0	3	0	0	2	0	0	0	0
16	0	0	0	6	0	0	1	1	0	0	0	0	0
17	0	0	1	4	0	2	1	1	2	0	0	0	0
18	0	0	1	0	0	0	0	2	2	1	4	3	0
19	0	0	0	0	0	3	0	5	3	0	1	0	2
20	0	0	0	0	0	0	1	3	1	1	1	1	0
21	0	0	0	0	0	0	0	4	3	0	0	0	0
22	0	0	4	2	1	0	0	2	0	1	1	0	0
23	0	0	1	0	0	0	0	2	0	0	0	1	1
24	0	0	0	3	0	0	0	4	1	1	3	1	1
25	0	0	0	3	2	0	0	4	1	1	0	1	1
26	0	0	0	0	0	6	2	0	0	0	0	0	0
27	1	0	0	2	0	0	0	4	1	0	1	0	0
28	0	0	0	2	0	0	0	0	0	0	2	5	1
29	0	0	2	2	0	0	0	2	0	0	4	3	0
30	0	0	0	2	0	0	0	3	1	0	1	0	0
31	1	0	0	1	0	0	0	2	1	1	3	3	1
32	0	0	0	0	0	0	0	5	1	0	2	1	2
33	0	0	1	2	0	0	0	6	0	3	0	1	1
34	0	0	1	4	0	0	1	4	4	2	2	3	0
35	0	0	0	1	0	0	0	1	0	1	0	4	0
36	0	0	0	2	0	0	0	1	1	0	2	0	0
37	0	0	0	3	0	0	0	3	1	1	3	2	0
38	0	0	4	2	0	0	0	0	2	0	3	0	0
39	0	0	0	0	0	0	0	3	1	1	1	1	2
40	0	0	0	1	0	0	0	0	0	0	3	1	0
41	0	0	0	2	0	0	0	0	0	0	2	5	1
42	0	0	0	0	0	0	0	4	2	1	0	1	2
43	0	0	1	3	0	0	0	0	0	0	0	0	0
44	2	0	1	1	0	0	1	4	0	0	1	0	0
45	0	0	0	0	0	0	0	0	1	0	0	0	1
46	0	0	0	1	0	0	0	1	1	0	1	0	0
47	0	0	3	4	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	4	0	0	0	4	0
49	0	0	0	4	0	4	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	2	0	0	0	2	0

3.2 Main authors, institutions and countries

Another analysis we would like to show concerns the main article contributors as well as their affiliations and the countries of origin. Tables 5a and 5b show the list of the 50 top contributing authors, their affiliations, the categories of their articles and some bibliographical statistics. H. Maurer of the Graz University of Technology, Austria is the most productive author with 18 articles. He is followed by FJ. Garcia-Penalvo, from Universidad de Salamanca, Spain; and JJ. Jung from the Yeungnam University, Korea (15 and 14 documents respectively). The median of articles published by authors is 6, and 13 authors of the ranking published 6 articles.

In terms of citations, the most influential author is H. Maurer with 306 cites. He is followed by FJ. Garcia-Penalvo with 233 cites, and JJ. Jung with 181 cites. There are 6 authors with more than 100 cites, and they represent 40.01% of the cites of the ranking.

The h-index ranking shows that FJ. Garcia-Penalvo and JJ. Jung are in the first place, both with an h-index of 8. This means that 8 articles published by those authors have at least 8 cites. In terms of standard deviation among authors, there is a difference of only 1.41 documents.

The ranking changes completely if we consider the ratio of cites per article. M. Alier of the Universidad Politechnica de Cataluña is the author with most cites per article (TC/TA: 30.00), followed by MA. Conde, from Universidad de Salamanca (TC/TA: 25.20), and J. Bravo from Universidad de Castilla La Mancha (TC/TA: 20.50). These three top authors are from Spain.

Regarding the affiliation of the authors, they represent 36 different institutions. Seven of the authors belong to the Universidad de Castilla La Mancha, Spain, and four of them to the Universidad de Chile. It is also worth noticing that most of the authors are from non-speaking English countries. In Tables 6a and 6b, it can be seen that the top three most productive institutions are: Graz University of Technology, Austria (TA: 44); Universidad de Castilla La Mancha, Spain (TA: 38); and Universidad Carlos III de Madrid, Spain (TA: 35). Six universities have more than 25 documents published in the journal, and 44 universities have more than 10 articles published. The published articles median by university is 12, and 34 institutions have 12 or more cites. Concerning citations, the top three most productive institutions remain in the same positions: Graz University of Technology (TC: 426), Universidad de Castilla La Mancha, and Universidad Carlos III de Madrid (both with TC: 271). Nineteen institutions have more than 100 cites, and 40 more than 50 cites. The first 10 universities of the ranking accumulate 46.80% of the cites. Tables 7a and 7b show the evolution of the contributions of WoS articles by years, of the most productive and influential institutions that published in J.UCS between 2001 and 2009.

Table 6a: The most productive and influential institutions publishing in J.UCS between 2001 and 2019. (First part).

R	Institution	Country	TA	TC	H	TC/TA	TA/TPW
1	Graz University of Technology	Austria	44	426	9	9.68	0.36
2	Universidad de Castilla La Mancha	Spain	38	271	10	7.13	0.23
3	Universidad Carlos III de Madrid	Spain	35	271	10	7.74	0.28
4	Wroclaw U. of Science Technology	Poland	29	255	11	8.79	0.19
5	Universidad de Chile	Chile	26	96	6	3.69	0.08
6	Universidade Federal de Pernambuco	Brazil	26	58	4	2.23	0.14
7	Open University Netherlands	Netherlands	21	234	9	11.14	0.92
8	Universidad Complutense de Madrid	Spain	18	143	7	7.94	0.03
9	Fern University Hagen	Germany	18	118	7	6.56	1.01
10	Universidade do Minho	Portugal	17	94	5	5.53	0.09
11	Universidad Politecnica de Cataluña	Spain	16	221	7	13.81	0.06
12	Universidad de Malaga	Spain	16	106	6	6.63	0.09
13	Universidad Politecnica de Madrid	Spain	16	155	6	9.69	0.07
14	University of Auckland	New Zealand	16	54	3	3.38	0.03
15	University of Salamanca	Spain	16	253	9	15.81	0.08
16	Universidade Federal do Rio de Janeiro	Brazil	15	65	6	4.33	0.03
17	Yeungnam University	South Korea	15	149	6	9.93	0.09
18	University of Bucharest	Romania	14	134	7	9.57	0.10
19	University of Murcia	Spain	14	109	5	7.79	0.07
20	Universitat Politecnica de Valencia	Spain	13	56	5	4.31	0.05
21	University of Belgrade	Serbia	13	71	4	5.46	0.03
22	University of Granada	Spain	13	102	4	7.85	0.03
23	Autonomous University of Madrid	Spain	12	106	5	8.83	0.03
24	Chinese Academy of Sciences	China	12	183	4	15.25	0.00
25	King Saud University	Saudi Arabia	12	64	5	5.33	0.03
26	Near East University	Cyprus	12	76	6	6.33	0.35
27	Pontificia Universidade Catolica Parana	Brazil	12	36	4	3.00	0.24
28	Technische Universitat Wien	Austria	12	86	6	7.17	0.05
29	Universidad de Alcala	Spain	12	51	5	4.25	0.09
30	Universidad de Valladolid	Spain	12	63	4	5.25	0.08
31	Universidad Rey Juan Carlos	Spain	12	27	3	2.25	0.12
32	Universite de Lorraine	France	12	53	6	4.42	0.03
33	University of Debrecen	Hungary	12	11	2	0.92	0.07
34	University of Sevilla	Spain	12	88	4	7.33	0.03
35	Dortmund University of Technology	Germany	11	22	2	2.00	0.06
36	Universidade de Vigo	Spain	11	51	5	4.64	0.07
37	University of London	England	11	15	3	1.36	0.00
38	University of Munich	Germany	11	40	4	3.64	0.01
39	U. Nacional de Educacion A Distancia	Spain	10	114	5	11.4	0.33
40	Universidade de Lisboa	Portugal	10	54	5	5.40	0.01
41	Universidade de Sao Paulo	Brazil	10	55	3	5.50	0.01
42	Universitat Rovira I Virgili	Spain	10	129	6	12.90	0.06
43	Universite de Toulouse	France	10	75	4	7.50	0.01
44	University of Oviedo	Spain	10	95	6	9.50	0.04
45	Bundeswehr University Munich	Germany	9	21	2	2.33	0.36
46	King Abdulaziz University	Saudi Arabia	9	58	4	6.44	0.03
47	Pontificia U. Catolica do Rio de Janeiro	Brazil	9	58	4	6.44	0.21
48	Universidade da Coruna	Spain	9	35	4	3.89	0.07
49	Universidade Federal de Minas Gerais	Brazil	9	19	2	2.11	0.02
50	Universita della Svizzera Italiana	Switzerland	9	41	3	4.56	0.05

Abbreviations: R=Rank; TA=Total articles; TC=Total citations; H=h-index; TC/TA=Citations per article; TAW=Total articles in WoS.

Table 6b: The most productive and influential institutions publishing in J.UCS between 2001 and 2019. (Second part).

R	A. General Literature	B. Hardware	C. Computer Systems Organization	D. Software	E. Data	F. Theory of Computation	G. Mathematics of Computing	H. Information Systems	I. Computing Methodologies	J. Computer Applications	K. Computing Milieux	L. Science and Technology of Learning	M. Knowledge Management
1	3	1	2	5	1	1	0	27	3	7	10	9	10
2	0	0	3	13	0	2	0	13	9	1	12	9	2
3	0	0	2	13	0	0	0	11	2	3	11	10	2
4	0	0	3	2	4	0	1	12	12	1	0	0	4
5	0	0	3	13	0	0	1	17	1	6	9	10	2
6	0	0	1	17	0	2	1	5	3	0	1	0	1
7	0	0	0	3	0	0	0	7	2	2	4	12	3
8	0	0	0	10	0	7	1	3	3	2	6	4	1
9	0	0	1	3	0	8	2	4	0	1	1	1	0
10	0	0	0	13	0	5	0	6	5	0	3	0	0
11	0	0	1	3	1	0	1	2	1	1	4	5	0
12	0	0	2	13	0	0	1	0	3	0	2	1	2
13	0	1	1	1	0	0	1	6	3	1	2	2	4
14	2	0	0	1	5	3	1	3	2	2	2	0	0
15	0	0	0	3	1	0	1	4	1	3	3	7	3
16	0	1	3	8	1	1	0	1	0	2	5	4	1
17	0	0	1	0	2	0	0	13	12	0	0	0	1
18	0	0	0	1	1	7	7	0	0	1	0	0	0
19	0	1	4	4	1	1	1	5	5	2	4	4	3
20	0	0	2	4	0	0	0	4	3	3	0	1	0
21	0	1	0	1	1	3	1	2	5	1	5	4	2
22	0	1	2	4	0	1	0	10	2	3	2	1	0
23	0	0	2	1	0	1	1	5	4	1	4	1	0
24	0	1	1	1	4	1	4	3	3	2	2	2	0
25	0	1	0	2	3	1	1	5	2	0	2	3	2
26	0	0	0	0	0	0	0	0	0	1	4	7	0
27	0	0	1	3	0	3	0	3	5	0	0	0	1
28	0	0	4	5	0	3	0	3	2	1	2	0	1
29	0	1	0	1	0	0	1	0	2	0	3	2	1
30	0	0	2	2	0	0	0	4	3	1	6	5	1
31	0	0	0	5	0	1	0	6	2	1	6	2	2
32	0	0	0	3	0	8	1	0	4	0	0	0	0
33	0	0	1	4	1	1	2	5	3	1	0	0	0
34	0	1	1	1	0	4	1	1	2	0	0	0	0
35	0	0	1	4	0	1	2	5	2	1	1	0	0
36	1	0	1	1	0	0	0	4	2	2	5	3	4
37	0	0	0	5	0	1	0	0	1	0	1	2	0
38	1	0	0	3	0	5	3	1	1	1	1	0	0
39	0	0	1	1	0	0	0	5	1	3	3	4	0
40	0	0	0	1	0	2	0	5	0	0	1	1	1
41	0	0	0	3	0	0	0	5	2	1	0	1	0
42	0	1	2	0	0	6	1	0	0	0	0	0	0
43	0	0	0	2	1	0	0	4	3	1	0	2	0
44	0	0	1	2	0	0	1	4	2	1	2	2	0
45	0	0	0	0	0	7	4	0	0	1	0	0	0
46	0	0	0	4	0	0	0	6	2	0	2	4	1
47	0	0	0	6	1	1	0	2	1	0	0	0	0
48	0	0	1	3	0	0	0	4	1	1	0	1	1
49	0	0	1	10	0	3	0	0	0	0	0	0	0
50	0	0	0	1	0	0	0	5	1	3	2	5	2

Table 7a: Year evolution of the most productive and influential institutions publishing in J.UCS between 2001 and 2019. (First part).

R	University	Country	01	02	03	04	05	06	07	08	09
1	Graz University of Technology	Austria	5	3	3	2	1	2	3	4	0
2	Universidad de Castilla La Mancha	Spain	0	0	0	0	3	3	1	8	3
3	Universidad Carlos III de Madrid	Spain	0	0	0	0	1	1	2	1	1
4	Wroclaw U. of Science Technology	Poland	0	0	0	0	3	0	6	3	3
5	Universidad de Chile	Chile	0	0	0	0	0	0	2	4	3
6	U. Federal de Pernambuco	Brazil	0	0	4	1	1	0	5	5	1
7	Open University Netherlands	Netherlands	0	0	0	0	0	0	2	2	0
8	Complutense University of Madrid	Spain	0	0	0	2	3	4	2	0	2
9	Fern University Hagen	Germany	0	2	0	0	1	0	0	5	4
10	Universidade do Minho	Portugal	1	0	1	1	1	2	2	4	0
11	U. Politecnica de Cataluña	Spain	0	0	2	0	0	0	0	0	1
12	Universidad de Malaga	Spain	0	0	0	1	1	3	0	3	2
13	Universidad Politecnica de Madrid	Spain	0	1	0	0	0	1	1	0	0
14	University of Auckland	New Zealand	1	5	3	0	1	0	1	0	2
15	University of Salamanca	Spain	0	0	0	0	0	0	1	3	1
16	U. Federal do Rio de Janeiro	Brazil	0	0	1	0	1	3	0	1	1
17	Yeungnam University	South Korea	0	0	0	0	0	0	0	3	2
18	University of Bucharest	Romania	1	3	0	1	1	0	8	0	0
19	University of Murcia	Spain	0	0	0	0	0	1	0	0	2
20	Universitat Politecnica de Valencia	Spain	0	0	0	1	0	1	0	2	0
21	University of Belgrade	Serbia	0	0	0	0	0	0	1	0	0
22	University of Granada	Spain	0	0	0	1	0	0	1	4	0
23	Autonomous University of Madrid	Spain	0	0	0	0	1	1	0	4	1
24	Chinese Academy of Sciences	China	0	0	0	0	0	0	0	1	2
25	King Saud University	Saudi Arabia	0	0	0	0	0	0	0	0	1
26	Near East University	Cyprus	0	0	0	0	0	0	0	0	0
27	Pontificia U. Catolica do Parana	Brazil	0	0	2	0	0	1	1	5	1
28	Technische Universitat Wien	Austria	0	2	1	0	1	1	0	1	0
29	Universidad de Alcala	Spain	0	0	0	0	0	0	2	0	0
30	Universidad de Valladolid	Spain	0	0	0	0	0	0	1	1	0
31	Universidad Rey Juan Carlos	Spain	0	0	0	0	0	0	1	1	1
32	Universite de Lorraine	France	1	2	3	1	0	1	2	1	0
33	University of Debrecen	Hungary	0	0	0	0	0	11	0	0	0
34	University of Sevilla	Spain	0	0	0	4	2	0	3	1	1
35	Dortmund U. of Technology	Germany	1	4	1	1	0	1	1	0	1
36	Universidade de Vigo	Spain	0	0	0	0	1	0	1	0	1
37	University of London	England	0	0	0	1	0	0	0	4	0
38	University of Munich	Germany	1	0	0	0	4	1	0	1	1
39	U. Nac. de Educacion a Distancia	Spain	0	0	0	0	0	0	0	1	0
40	Universidade de Lisboa	Portugal	0	0	0	0	1	0	2	3	1
41	Universidade de Sao Paulo	Brazil	0	0	0	0	0	1	0	0	0
42	Universitat Rovira I Virgili	Spain	1	1	0	3	0	2	1	0	1
43	Universite de Toulouse	France	0	0	3	0	0	0	0	0	1
44	University of Oviedo	Spain	0	0	0	0	0	0	0	0	2
45	Bundeswehr University Munich	Germany	1	0	0	0	1	0	0	4	2
46	King Abdulaziz University	Saudi Arabia	0	0	0	0	0	0	0	0	0
47	Pont. U. Catolica do Rio de Janeiro	Brazil	0	0	0	0	2	0	0	3	1
48	Universidade da Coruna	Spain	0	0	0	0	0	0	0	1	1
49	U. Federal de Minas Gerais	Brazil	0	0	2	2	0	0	3	2	0
50	Universita della Svizzera Italiana	Switzerland	0	0	0	1	0	0	0	1	1

Abbreviations: R=Rank; the numbers 01 to 09 represent the years 2001 to 2009.

Table 7b: Year evolution of the most productive and influential institutions publishing in the J.UCS between 2001 and 2019. (Second part).

R	10	11	12	13	14	15	16	17	18	19	Total	%
1	6	4	1	1	2	2	2	0	2	1	**44**	5.86
2	4	0	4	9	2	0	0	1	0	0	**38**	5.06
3	1	1	8	5	5	3	1	3	2	0	**35**	4.66
4	2	0	2	3	0	1	4	0	1	1	**29**	3.86
5	1	4	0	3	4	0	3	0	0	2	**26**	3.46
6	0	2	0	0	4	0	0	1	0	2	**26**	3.46
7	1	2	2	3	2	2	1	1	3	0	**21**	2.80
8	1	1	1	0	1	1	0	0	0	0	**18**	2.40
9	1	0	1	1	0	0	1	1	0	1	**18**	2.40
10	1	1	0	1	1	0	0	0	1	0	**17**	2.26
11	2	1	3	3	2	1	1	0	0	0	**16**	2.13
12	2	2	1	0	1	0	0	0	0	0	**16**	2.13
13	1	1	4	4	0	2	0	1	0	0	**16**	2.13
14	1	0	0	0	0	2	0	0	0	0	**16**	2.13
15	0	2	5	3	0	1	0	0	0	0	**16**	2.13
16	0	5	1	0	1	0	0	0	1	0	**15**	2.00
17	3	0	2	1	0	2	2	0	0	0	**15**	2.00
18	0	0	0	0	0	0	0	0	0	0	**14**	1.86
19	1	1	3	3	2	0	0	0	1	0	**14**	1.86
20	1	0	1	2	1	1	2	1	0	0	**13**	1.73
21	1	3	3	3	1	0	1	0	0	0	**13**	1.73
22	2	0	1	2	0	1	0	0	0	1	**13**	1.73
23	2	1	0	1	0	0	0	1	0	0	**12**	1.60
24	1	0	0	1	2	1	0	0	0	4	**12**	1.60
25	0	0	0	0	6	3	1	1	0	0	**12**	1.60
26	0	0	0	3	0	2	3	4	0	0	**12**	1.60
27	0	2	0	0	0	0	0	0	0	0	**12**	1.60
28	2	0	0	2	0	0	2	0	0	0	**12**	1.60
29	0	0	0	3	1	1	3	1	1	0	**12**	1.60
30	2	0	2	1	1	1	1	0	2	0	**12**	1.60
31	0	0	3	1	1	2	1	0	1	0	**12**	1.60
32	0	0	0	1	0	0	0	0	0	0	**12**	1.60
33	0	0	0	0	0	0	0	0	1	0	**12**	1.60
34	1	0	0	0	0	0	0	0	0	0	**12**	1.60
35	0	0	0	0	0	1	0	0	0	0	**11**	1.46
36	3	0	0	2	1	2	0	0	0	0	**11**	1.46
37	3	0	0	0	1	0	0	1	1	0	**11**	1.46
38	2	0	1	0	0	0	0	0	0	0	**11**	1.46
39	1	0	1	1	1	3	2	0	0	0	**10**	1.33
40	0	1	0	1	1	0	0	0	0	0	**10**	1.33
41	2	1	1	1	1	2	0	0	1	0	**10**	1.33
42	0	0	0	1	0	0	0	0	0	0	**10**	1.33
43	1	1	0	0	1	2	0	0	0	1	**10**	1.33
44	0	2	2	0	2	1	0	0	0	1	**10**	1.33
45	1	0	0	0	0	0	0	0	0	0	**9**	1.20
46	0	0	1	5	1	2	0	0	0	0	**9**	1.20
47	1	1	0	0	0	0	0	1	0	0	**9**	1.20
48	0	1	1	0	3	2	0	0	0	0	**9**	1.20
49	0	0	0	0	0	0	0	0	0	0	**9**	1.20
50	0	1	4	1	0	0	0	0	0	0	**9**	1.20

Abbreviations: R=Rank; the numbers 10 to 19 represent the years 2010 to 2019.

Table 8a: The most productive and influential countries publishing in J.UCS between 2001 and 2019. (First part).

R	Country	TA	TC	H	TC/TA	> 100	> 50	Population	TAW	TA/ TAW	TA/P	TC/P
1	Spain	349	2,253	22	6.46	0	4	46,75MM	1.118M	0.03	7.46	48.19
2	Germany	220	1,478	18	6.72	1	3	83,78MM	2.322M	0.01	2.63	17.64
3	USA	161	990	14	6.15	0	1	331MM	11.615M	0.00	0.49	2.99
4	Brazil	159	546	12	3.43	0	0	212,56MM	747M	0.02	0.75	2.57
5	Austria	110	820	14	7.45	2	2	9,01MM	330M	0.03	12.21	91.05
6	England	110	640	13	5.82	0	1	55,98MM	2.589M	0.00	1.97	11.43
7	China	108	608	12	5.63	1	1	1439,32MM	3,637M	0.00	0.08	0.42
8	France	88	532	13	6.05	0	0	65,27MM	2.001M	0.00	1.35	8.15
9	Italy	84	692	14	8.24	1	2	60,46MM	1.420M	0.01	1.39	11.45
10	South Korea	72	432	10	6.00	0	1	51,27MM	872M	0.01	1.40	8.43
11	Poland	69	441	14	6.39	0	0	37,85MM	549M	0.01	1.82	11.65
12	Netherlands	57	426	13	7.47	0	0	17,13MM	866M	0.01	3.33	24.86
13	Portugal	54	339	11	6.28	0	0	10,2MM	215M	0.03	5.30	33.25
14	Australia	50	399	9	7.98	0	2	25,5MM	1.156M	0.00	1.96	15.65
15	Greece	47	346	11	7.36	0	1	10,42MM	230M	0.02	4.51	33.20
16	Japan	42	151	8	3.60	0	0	126,48MM	2.491M	0.00	0.33	1.19
17	Chile	41	146	7	3.56	0	0	19,12MM	135M	0.03	2.14	7.64
18	New Zealand	40	115	5	2.88	0	0	4,82MM	211M	0.02	8.29	23.85
19	Canada	39	253	9	6.49	0	0	37,74MM	1.688M	0.00	1.03	6.70
20	Finland	36	301	8	8.36	0	1	5,54MM	305M	0.01	6.50	54.33
21	Saudi Arabia	34	168	8	4.94	0	0	34,81MM	158M	0.02	0.98	4.83
22	India	32	121	6	3.78	0	0	1380MM	1.223M	0.00	0.02	0.09
23	Hungary	30	78	5	2.60	0	0	9,66MM	186M	0.02	3.11	8.07
24	Switzerland	27	272	8	10.07	0	1	8,65MM	649M	0.00	3.12	31.43
25	Mexico	26	137	7	5.27	0	0	128,93MM	255M	0.01	0.20	1.06
26	Turkey	26	151	7	5.81	0	0	84,34MM	476M	0.01	0.31	1.79
27	Romania	24	207	9	8.63	0	0	19,24MM	144M	0.02	1.25	10.76
28	South Africa	23	117	5	5.09	0	0	59,31MM	252M	0.01	0.39	1.97
29	Belgium	22	170	8	7.73	0	0	11,59MM	472M	0.00	1.90	14.67
30	Sweden	21	109	6	5.19	0	0	10,1MM	656M	0.00	2.08	10.79
31	Argentina	19	54	5	2.84	0	0	45,2MM	198M	0.01	0.42	1.19
32	Serbia	19	91	5	4.79	0	0	8,74MM	90M	0.02	2.17	10.42
33	Iran	18	87	5	4.83	0	0	83,99MM	403M	0.00	0.21	1,04
34	Ireland	16	83	5	5.19	0	0	4,94MM	153M	0.01	3.24	16.81
35	Pakistan	15	56	4	3.73	0	0	220,89MM	125M	0.01	0.07	0.25
36	Czech Rep.	14	48	4	3.43	0	0	10,7MM	232M	0.01	1.31	4.49
37	Slovenia	14	63	5	4.50	0	0	2,08MM	69M	0.02	6.73	30.30
38	Norway	13	102	6	7.85	0	0	5,42MM	271M	0.00	2.40	18.81
39	Scotland	13	49	3	3.77	0	0	5,42MM	391M	0.00	2.40	9.03
40	Malaysia	12	42	4	3.50	0	0	32,37MM	147M	0.01	0.37	1.30
41	Denmark	10	28	3	2.80	0	0	5,79MM	372M	0.00	1.73	4.83
42	Tunisia	10	21	3	2.10	0	0	11,82MM	58M	0.02	0.85	1.78
43	Croatia	9	47	4	5.22	0	0	4,11MM	68M	0.01	2.19	11.45
44	Egypt	9	56	3	6.22	0	0	102,33MM	181M	0.00	0.09	0.55
45	Colombia	8	33	3	4.13	0	0	50,88MM	70M	0.01	0.16	0.65
46	Jordan	8	34	3	4.25	0	0	10,2MM	29M	0.03	0.78	3.33
47	Singapore	8	62	4	7.75	0	0	5,85MM	204M	0.00	1.37	10.60
48	Vietnam	8	18	2	2.25	0	0	97,34MM	43M	0.02	0.08	0.18
49	Ecuador	7	40	4	5.71	0	0	17,64MM	17M	0.04	0.40	2.27
50	Lithuania	7	45	3	6.43	0	0	2,72MM	38M	0.02	2.57	16.53

Abbreviations: R=Rank; TA=Total articles; TC=Total citations; H=h-index; TC/TA=Citations per article; TAW=Total articles in WoS.

Table 8b: The most productive and influential countries publishing in J.UCS between 2001 and 2019. (Second part).

R	A. General Literature	B. Hardware	C. Computer Systems Organization	D. Software	E. Data	F. Theory of Computation	G. Mathematics Computing	H. Information Systems	I. Computing Methodologies	J. Computer Applications	K. Computing Milieux	L. Science and Technology of Learning	M. Knowledge Management
1	4	11	42	103	9	30	14	140	71	43	84	82	34
2	14	4	18	62	6	63	22	102	43	24	34	23	14
3	2	10	17	45	10	31	16	41	34	11	21	13	7
4	0	5	13	82	3	21	6	38	23	8	10	21	11
5	5	1	11	17	4	8	3	67	15	23	27	13	15
6	2	2	10	25	3	15	7	32	22	12	12	20	11
7	0	5	18	14	14	11	9	41	22	13	8	11	7
8	0	3	14	27	6	16	7	34	20	8	5	8	5
9	3	4	8	23	2	14	5	33	21	12	12	7	5
10	1	1	12	8	8	3	3	31	21	7	4	8	6
11	0	1	20	11	8	8	7	31	41	7	16	4	9
12	1	0	6	15	0	11	4	22	4	5	11	19	4
13	0	2	2	27	0	12	2	20	8	4	15	9	6
14	0	0	1	12	8	7	2	25	10	9	10	10	7
15	0	0	5	4	2	2	3	20	7	4	12	12	5
16	0	1	3	11	4	10	4	16	9	3	3	3	3
17	0	0	3	13	0	0	1	17	1	6	9	10	2
18	2	0	2	8	9	14	4	13	4	2	5	1	1
19	0	2	6	9	4	9	1	10	6	4	4	3	3
20	0	1	2	8	2	11	2	13	2	2	3	8	0
21	0	1	4	9	4	2	1	17	7	2	5	10	4
22	0	1	4	7	6	5	5	11	14	6	2	2	2
23	0	0	2	5	2	8	7	12	8	8	1	0	0
24	1	0	2	8	0	2	1	11	2	3	4	9	6
25	0	2	3	1	2	4	1	15	9	7	6	7	2
26	0	0	2	7	0	1	1	5	4	3	3	8	0
27	0	1	0	1	1	14	7	0	4	1	2	0	0
28	0	0	0	1	1	5	1	6	7	4	2	1	0
29	0	0	0	6	0	4	0	7	5	5	1	5	2
30	0	1	1	5	1	5	1	3	1	2	2	1	2
31	0	0	1	9	0	1	1	3	6	2	1	2	0
32	1	1	0	4	1	3	1	8	8	2	8	7	3
33	0	1	2	5	0	6	2	3	3	2	2	1	3
34	1	1	2	6	0	3	1	7	5	4	3	4	3
35	0	0	3	2	0	1	0	6	2	1	1	2	3
36	0	2	5	2	0	3	1	5	5	0	0	0	0
37	0	0	1	1	1	0	3	5	4	5	5	3	1
38	1	0	1	6	0	0	0	4	2	1	0	1	1
39	0	0	2	3	0	0	1	4	3	0	0	2	1
40	0	0	0	2	2	2	0	8	3	0	2	2	1
41	0	0	1	5	0	2	0	6	0	3	2	3	0
42	0	0	2	4	0	2	2	4	4	1	1	2	0
43	1	0	0	3	0	2	2	3	3	1	3	1	1
44	0	0	1	2	0	1	1	2	2	2	1	2	2
45	0	0	1	3	0	0	0	4	5	2	3	3	2
46	0	0	1	5	0	0	0	4	3	3	1	1	0
47	1	0	1	1	1	1	0	2	1	1	0	1	0
48	0	0	1	1	1	0	0	2	4	0	0	2	3
49	0	1	0	1	0	0	0	1	2	0	2	5	1
50	0	0	0	0	0	0	0	2	3	1	0	1	1

Table 9a: Year evolution of the most productive and influential countries publishing in J.UCS between 2001 and 2019. (First part).

R	Country	01	02	03	04	05	06	07	08	09
1	Spain	1	3	4	14	13	18	18	38	22
2	Germany	20	17	26	10	16	11	5	23	22
3	USA	11	5	7	14	17	6	17	15	8
4	Brazil	0	0	12	8	9	11	13	24	9
5	Austria	10	14	9	6	6	3	3	12	3
6	England	3	0	3	7	5	3	2	10	8
7	China	0	0	1	3	1	1	8	3	15
8	France	4	7	7	3	3	4	7	14	5
9	Italy	4	4	6	9	4	2	6	9	10
10	South Korea	0	1	0	1	1	1	0	9	15
11	Poland	0	0	0	0	5	1	7	8	3
12	Netherlands	2	1	1	1	6	1	2	3	5
13	Portugal	1	0	4	1	4	3	5	9	4
14	Australia	1	0	2	2	2	0	1	5	8
15	Greece	0	0	2	2	1	0	5	3	3
16	Japan	2	2	2	1	2	4	6	1	4
17	Chile	0	0	0	0	0	0	2	5	3
18	New Zealand	1	5	4	1	6	0	1	3	8
19	Canada	2	4	1	1	1	2	3	5	4
20	Finland	3	3	2	1	3	0	1	2	0
21	Saudi Arabia	0	0	0	0	0	0	0	1	1
22	India	0	0	0	1	2	0	2	0	2
23	Hungary	0	2	0	0	0	25	0	0	1
24	Switzerland	1	1	0	1	3	0	2	2	1
25	Mexico	0	0	0	0	1	2	1	1	1
26	Turkey	0	0	0	0	0	0	0	0	0
27	Romania	1	4	0	2	2	1	10	2	0
28	South Africa	0	1	1	1	1	0	0	2	1
29	Belgium	1	0	1	0	0	0	0	4	1
30	Sweden	0	0	0	0	3	0	0	1	1
31	Argentina	0	0	0	0	1	0	0	5	0
32	Serbia	0	0	0	0	0	0	1	0	0
33	Iran	0	0	0	1	3	1	2	2	0
34	Ireland	1	0	2	1	0	1	1	0	1
35	Pakistan	0	0	0	0	1	0	0	0	0
36	Czech Republic	0	0	1	1	1	0	0	0	1
37	Slovenia	0	0	0	0	0	0	1	1	1
38	Norway	0	1	1	0	0	0	1	1	1
39	Scotland	0	0	0	1	2	1	0	1	0
40	Malaysia	0	0	0	1	0	0	1	1	2
41	Denmark	3	1	0	0	0	0	0	0	2
42	Tunisia	0	0	0	0	1	1	0	1	1
43	Croatia	0	0	0	1	0	0	0	1	2
44	Egypt	0	0	0	0	3	0	0	1	0
45	Colombia	0	0	0	0	0	0	0	3	0
46	Jordan	0	0	0	0	0	0	0	0	0
47	Singapore	0	0	0	0	0	0	0	1	1
48	Vietnam	0	0	0	0	0	0	0	0	2
49	Ecuador	0	0	0	0	0	0	0	0	0
50	Lithuania	0	0	0	0	0	0	0	0	0

Abbreviations: R=Rank; the numbers 01 to 09 in the header of the table, represent the years 2001 to 2009.

Table 9b: Year evolution of the most productive and influential countries publishing in J.UCS between 2001 and 2019. (Second part).

R	10	11	12	13	14	15	16	17	18	19	Total	%
1	30	14	38	41	29	27	13	8	13	5	**349**	14.32
2	20	10	7	12	1	4	4	4	3	5	**220**	9.02
3	12	6	9	5	7	2	2	5	8	5	**161**	6.60
4	5	14	5	5	15	5	5	7	6	6	**159**	6.52
5	10	10	2	4	5	4	5	1	2	1	**110**	4.51
6	14	7	14	9	2	7	4	6	5	1	**110**	4.51
7	7	8	12	8	7	8	1	4	11	10	**108**	4.43
8	5	4	7	5	4	5	0	1	1	2	**88**	3.61
9	3	1	6	4	6	2	1	3	3	1	**84**	3.45
10	9	5	6	5	1	4	5	0	8	1	**72**	2.95
11	4	1	4	5	1	3	7	1	9	10	**69**	2.83
12	1	4	9	5	3	3	3	3	4	0	**57**	2.34
13	1	3	4	7	4	2	1	0	1	0	**54**	2.21
14	7	4	1	2	3	6	2	0	0	4	**50**	2.05
15	2	4	6	6	4	1	3	4	0	1	**47**	1.93
16	3	1	3	2	0	1	5	0	2	1	**42**	1.72
17	2	4	0	4	7	3	6	0	3	2	**41**	1.68
18	5	1	1	0	0	2	0	0	0	2	**40**	1.64
19	6	0	3	1	3	1	0	1	0	1	**39**	1.60
20	4	2	4	5	1	2	0	1	1	1	**36**	1.48
21	2	1	2	7	8	5	2	1	4	0	**34**	1.39
22	1	3	6	1	0	2	3	0	6	3	**32**	1.31
23	0	0	0	1	0	0	0	0	1	0	**30**	1.23
24	4	4	6	2	0	0	0	0	0	0	**27**	1.11
25	3	1	1	5	2	1	1	1	4	1	**26**	1.07
26	2	0	2	4	1	2	4	6	2	3	**26**	1.07
27	0	0	1	0	0	0	0	1	0	0	**24**	0.98
28	0	2	7	0	0	0	1	2	1	3	**23**	0.94
29	8	0	2	0	1	3	0	0	1	0	**22**	0.90
30	1	1	5	1	1	1	1	5	0	0	**21**	0.86
31	2	1	2	3	1	0	1	2	0	1	**19**	0.78
32	1	3	5	5	1	0	2	0	0	1	**19**	0.78
33	0	1	0	4	0	1	2	0	0	1	**18**	0.74
34	5	1	0	0	0	2	1	0	0	0	**16**	0.66
35	1	3	3	1	2	0	1	0	1	2	**15**	0.62
36	1	0	2	1	2	3	0	0	1	0	**14**	0.57
37	2	1	2	2	0	1	0	1	2	0	**14**	0.57
38	3	0	0	1	1	1	1	0	1	0	**13**	0.53
39	0	0	0	0	2	3	1	2	0	0	**13**	0.53
40	1	0	1	0	1	0	1	2	0	1	**12**	0.49
41	2	1	1	0	0	0	0	0	0	0	**10**	0.41
42	0	0	0	0	3	2	0	0	0	1	**10**	0.41
43	2	0	1	0	0	0	1	1	0	0	**9**	0.37
44	0	0	1	1	1	0	0	0	1	1	**9**	0.37
45	0	0	1	1	1	1	0	0	0	1	**8**	0.33
46	0	0	0	1	0	0	4	1	0	2	**8**	0.33
47	2	0	1	0	0	2	0	1	0	0	**8**	0.33
48	1	0	0	2	0	0	2	0	1	0	**8**	0.33
49	0	0	1	0	0	1	2	0	3	0	**7**	0.29
50	0	0	0	0	3	0	0	1	3	0	**7**	0.29

Abbreviations: R=Rank; the numbers 10 to 19 in the header of the table, represent the years 2010 to 2019.

The h-index shows different positions for the institutions, since Wroclaw University of Science Technology, Poland is in the first position. It is followed by

Universidad de Castilla La Mancha and Universidad Carlos III de Madrid, both with 10 articles that have at least 10 citations. Twelve institutions have an h-index of 4, and 10 institutions have an h-index of 6, which is also the median of the h-index for the ranking. More than 29 institutions have five articles with at least five or more cites.

Universidad de Salamanca has the higher number of cites per published articles (15.81), followed by the Chinese Academy of Sciences, China (15.25); and Polytechnic Universidad de Cataluña (13.81). The average of cites per article for the first three institutions represent 2.27 times the average of the ranking.

The university ranking shows that Spanish universities are the most influential and productive in this journal. 20 universities belong to Spain, followed by Brazil with 6 universities in the country. The rest of the universities belong to 17 other countries.

Tables 8a and 8b reaffirms the fact that Spain is the most productive country in the journal, with 349 publications. The following countries are Germany (TA: 220), USA (TA: 161), Brazil (159), Austria and England (both with 110 publications each). These first six countries represent 45.49% of the publications of the ranking.

The cites ranking for country is the same for the first three countries, however the fourth most cited country is Austria with 820 cites. 9 countries of the ranking have more than 500 cites, which represents 59.04% of the cites; and 30 have more than 100 cites, representing 92.86% of the ranking cites.

Spain has the highest h-index of 22, and is 2.86 times bigger than the average h-index of the ranking. The average h-index of the ranking is 7.68, and the median is 6.5. 22 countries have a h-index higher than the average h-index.

Citations per article present different positions for the countries. Switzerland (TC/TA: 10.07), Romania (TC/TA: 8.63), and Finland (TC/TA: 8.36) have the highest ratios of cites per published document. 21 countries have 6 or more cites per published article. Tables 9a and 9b show the evolution of the contributions of WoS articles by years, of the most productive and influential countries that published in J.UCS between 2001 and 2009.

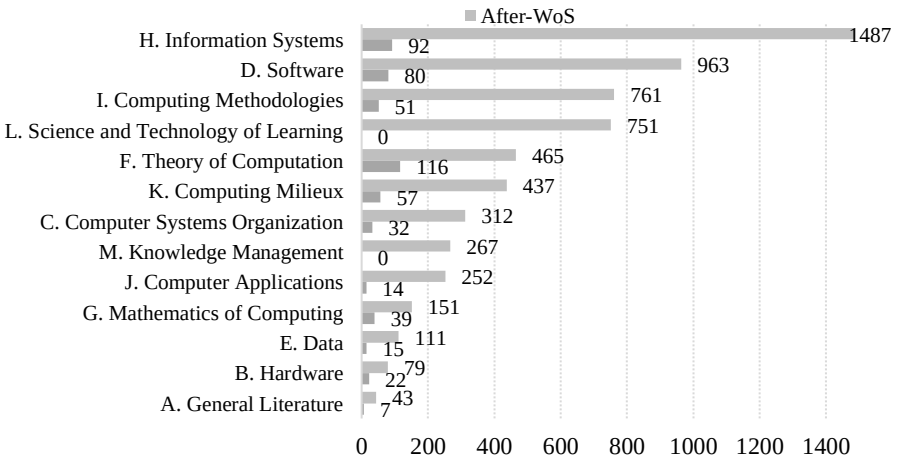

Figure 4: Number of articles per ACM category level 1 post and pre WoS, between 1995 to 2019. (Articles in 1994 were not classified with ACM).

Table 10: Number of articles per category post and pre WoS.

ACM Category	B	A	T
H. Information Systems	**92**	**1,487**	**1,579**
H. Information Systems	2	11	13
H.3 Information Storage and Retrieval	5	38	43
H.3.3 Information Search and Retrieval	9	156	165
H.3.5 Online Information Services	1	86	87
H.3.1 Content Analysis and Indexing	1	78	79
H.3.7 Digital Libraries	0	66	66
H.3.4 Systems and Software	1	40	41
H.3.2 Information Storage	0	40	40
H.3.0 General	0	12	12
H.3.m Miscellaneous	0	4	4
H.3.6 Library Automation	0	2	2
H.5 Information Interfaces and Presentation (e.g., HCI)	10	31	41
H.5.2 User Interfaces	2	118	120
H.5.1 Multimedia Information Systems	18	95	113
H.5.3 Group and Organization Interfaces	4	59	63
H.5.4 Hypertext/ Hypermedia	0	58	58
H.5.0 General	0	14	14
H.5.m Miscellaneous	0	7	7
H.5.5 Sound and Music Computing	0	4	4
H.4 Information Systems Applications	10	55	65
H.4.3 Communications Applications	1	66	67
H.4.0 General	0	28	28
H.4.2 Types of Systems	1	27	28
H.4.m Miscellaneous	3	15	18
H.4.1 Office Automation	1	12	13
H.1 Models and Principles	4	43	47
H.1.2 User/Machine Systems	2	68	70
H.1.1 Systems and Information Theory	1	51	52
H.1.0 General	0	31	31
H.1.m Miscellaneous	0	3	3
H.2 Database Management	2	37	39
H.2.8 Database Applications	3	28	31
H.2.1 Logical Design	4	20	24
H.2.3 Languages	1	14	15
H.2.4 Systems	1	13	14
H.2.5 Heterogeneous Databases	1	10	11
H.2.0 General	2	3	5
H.2.7 Database Administration	1	3	4
H.2.2 Physical Design	0	3	3
H.2.6 Database Machines	0	1	1
H.0 General	0	28	28
H.m Miscellaneous	1	5	6
D. Software	**80**	**963**	**1,043**
D. Software	2	0	2
D.2 Software Engineering	3	38	41
D.2.2 Design Tools and Techniques	6	105	111
D.2.1 Requirements/ Specifications	15	75	90
D.2.4 Software/Program Verification	7	65	72
D.2.11 Software Architectures	0	62	62
D.2.13 Reusable Software	0	49	49
D.2.10 Design	1	38	39
D.2.12 Interoperability	0	27	27
D.2.9 Management	0	27	27
D.2.6 Programming Environments	1	25	26
D.2.5 Testing and Debugging	3	20	23
D.2.7 Distribution, Maintenance, and Enhancement	1	20	21
D.2.3 Coding Tools and Techniques	0	20	20
D.2.8 Metrics	0	17	17
D.2.0 General	0	10	10
D.2.m Miscellaneous	0	5	5
D.3 Programming Languages	2	8	10
D.3.3 Language Constructs and Features	3	53	56
D.3.1 Formal Definitions and Theory	8	31	39
D.3.4 Processors	2	29	31
D.3.2 Language Classifications	1	18	19
D.3.m Miscellaneous	0	4	4
D.3.0 General	0	2	2
D.1 Programming Techniques	3	8	11
D.1.5 Object-Oriented Programming	4	32	36
D.1.3 Concurrent Programming	7	17	24
D.1.1 Applicative	2	18	20

ACM Category	B	A	T
(Functional) Programming			
D.1.6 Logic Programming	0	11	11
D.1.7 Visual Programming	0	10	10
D.1.m Miscellaneous	0	4	4
D.1.0 General	0	3	3
D.1.2 Automatic Programming	0	1	1
D.1.4 Sequential Programming	0	1	1
D.4 Operating Systems	1	3	4
D.4.6 Security and Protection	3	52	55
D.4.7 Organization and Design	0	8	8
D.4.8 Performance	1	6	7
D.4.3 File Systems Management	1	5	6
D.4.1 Process Management	1	4	5
D.4.2 Storage Management	1	4	5
D.4.5 Reliability	0	5	5
D.4.4 Communications Management	0	3	3
D.4.0 General	0	2	2
D.4.9 Systems Programs and Utilities	0	2	2
D.0 General	1	11	12
D.m Miscellaneous	0	3	3
I. Computing Methodologies	**51**	**761**	**812**
I. Computing Methodologies	0	1	1
I.2 Artificial Intelligence	3	25	28
I.2.4 Knowledge Representation Formalisms and Methods	4	84	88
I.2.6 Learning	2	73	75
I.2.1 Applications and Expert Systems	3	39	42
I.2.11 Distributed Artificial Intelligence	1	40	41
I.2.7 Natural Language Processing	3	35	38
I.2.8 Problem Solving, Control Methods, and Search	1	35	36
I.2.3 Deduction and Theorem Proving	5	14	19
I.2.10 Vision and Scene Understanding	2	13	15
I.2.2 Automatic Programming	1	12	13
I.2.0 General	1	10	11
I.2.5 Programming Languages and Software	0	9	9
I.2.9 Robotics	1	6	7
I.2.m Miscellaneous	0	4	4
I.6 Simulation and Modeling	2	12	14
I.6.4 Model Validation and Analysis	1	19	20
I.6.5 Model Development	0	20	20
I.6.3 Applications	0	11	11
I.6.0 General	0	6	6
I.6.8 Types of Simulation	0	6	6
I.6.6 Simulation Output Analysis	0	4	4
I.6.1 Simulation Theory	0	2	2
I.6.2 Simulation Languages	0	1	1
I.6.7 Simulation Support Systems	0	1	1
I.5 Pattern Recognition	1	14	15
I.5.4 Applications	0	21	21
I.5.2 Design Methodology	0	14	14
I.5.1 Models	1	12	13
I.5.3 Clustering	1	12	13
I.5.5 Implementation	1	3	4
I.5.0 General	0	3	3
I.4 Image Processing and Computer Vision	2	11	13
I.4.6 Segmentation	0	12	12
I.4.8 Scene Analysis	0	11	11
I.4.9 Applications	0	11	11
I.4.0 General	0	7	7
I.4.10 Image Representation	0	7	7
I.4.3 Enhancement	0	5	5
I.4.4 Restoration	0	4	4
I.4.7 Feature Measurement	0	4	4
I.4.5 Reconstruction	0	3	3
I.4.1 Digitization and Image Capture	0	2	2
I.4.2 Compression (Coding)	0	2	2
I.7 Document and Text Processing	0	20	20
I.7.2 Document Preparation	6	8	14
I.7.5 Document Capture	0	6	6
I.7.m Miscellaneous	0	4	4
I.7.0 General	0	3	3
I.7.1 Document and Text Editing	0	2	2
I.7.4 Electronic	0	2	2

ACM Category	B	A	T
Publishing			
I.7.3 Index Generation	0	1	1
I.3 Computer Graphics	1	4	5
I.3.5 Computational Geometry and Object Modeling	1	11	12
I.3.7 Three-Dimensional Graphics and Realism	0	11	11
I.3.6 Methodology and Techniques	1	6	7
I.3.8 Applications	0	5	5
I.3.3 Picture/Image Generation	0	4	4
I.3.0 General	0	1	1
I.3.1 Hardware Architecture	0	1	1
I.3.4 Graphics Utilities	0	1	1
I.3.m Miscellaneous	0	1	1
I.1 Symbolic and Algebraic Manipulation	1	1	2
I.1.2 Algorithms	1	17	18
I.1.1 Expressions and their Representation	3	4	7
I.1.3 Languages and Systems	0	1	1
I.1.4 Applications	0	1	1
I.1.m Miscellaneous	1	0	1
I.0 General	0	1	1
I.m Miscellaneous	0	1	1
L. Science and Technology of Learning	**0**	**751**	**751**
L.3 Methodology/ Tools/ Technology	0	22	22
L.3.6 Technology Enhanced Learning	0	94	94
L.3.0 eLearning Systems/ Technology Tools/Platforms	0	87	87
L.3.5 Online Education	0	34	34
L.3.1 Human Computer Interface	0	26	26
L.3.4 Learning Processes	0	20	20
L.3.2 Information Retrieval Search	0	19	19

Abbreviations: B=Before WoS; A=After WoS; T=Total including before and after WoS.

3.3 Science mapping analysis of Journal of Universal Computer Science

In this section, we present the co-citation analysis of journals in J.UCS. This analysis is a visualization of the citation structure between entities such as authors, countries, journals, etc. The visualization is provided by the VOSviewer platform. The results are extracted with a minimum citation threshold of 20 and 100 links.

This visualization is interpreted as it follows: every node is an entity. Nodes are grouped in clusters, according to the threshold of co-citations. Entities belonging to the same cluster have the same color. The size of the entity represents its productivity, measured by the number of publications. If two entities are co-cited, then there will be a line between them; the more co-citations there are, the thicker the line. The distance between nodes shows the number of co-citations. The smaller the distance between two nodes, the higher the number of co-citations.

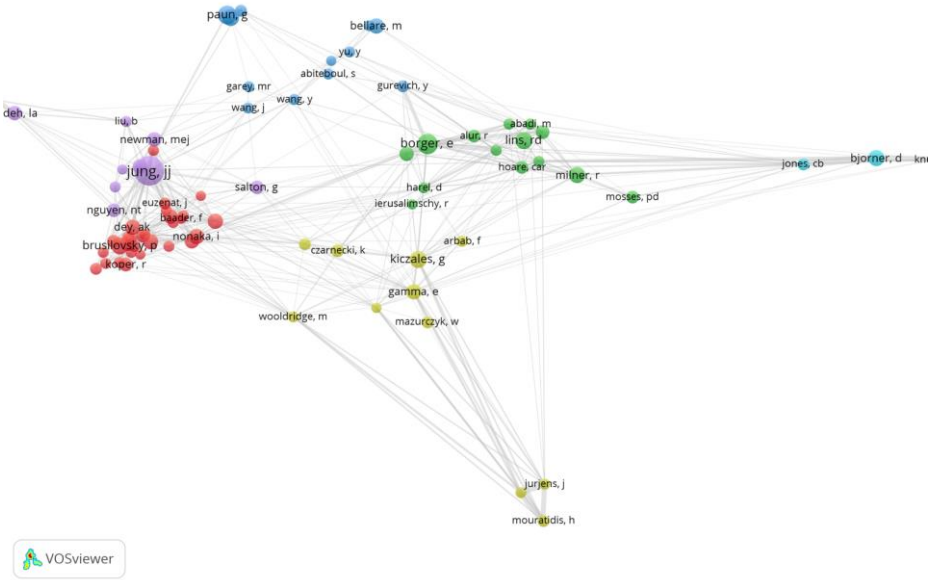

Figure 5: Co-citation of authors cited in J.UCS

Figure 5 presents the co-citation analysis of authors. There are six clusters of authors. The red and green clusters shows that the authors that belong to these clusters, cite the same publications, since they are closely together. There are some exceptions like LA. Zadeh (purple-colored cluster). On the contrary, the yellow cluster authors have less common articles cited between them (same cluster). Additionally, the sky-blue group includes the authors that have the lowest number of common documents cited by all the other map authors. The most productive author is J.J. Jung, who belongs to the purple-colored cluster.

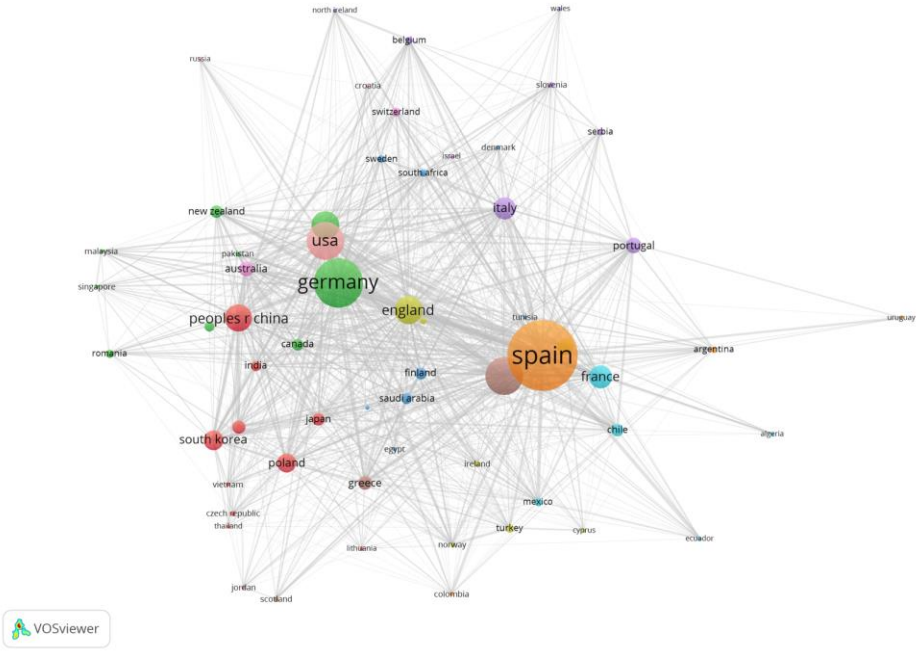

Figure 6: Bibliographic coupling of countries that publish in J.UCS

Figure 6 presents the bibliographic coupling, which means the total number of times two entities have cited the same entity. For countries, bibliographic coupling represents the number of common references they have. The cluster that contains the leading country, Spain, is the one colored in sky-blue which also includes France, Chile, Mexico, Algeria, and Ecuador. The second most prominent country is Germany, which is part of the green-colored cluster. The green-colored cluster also incorporates Canada, Pakistan, Romania, Malaysia, etc. It is worth noticing that two countries, Lithuania and Wales, are not related to any other country of the map.

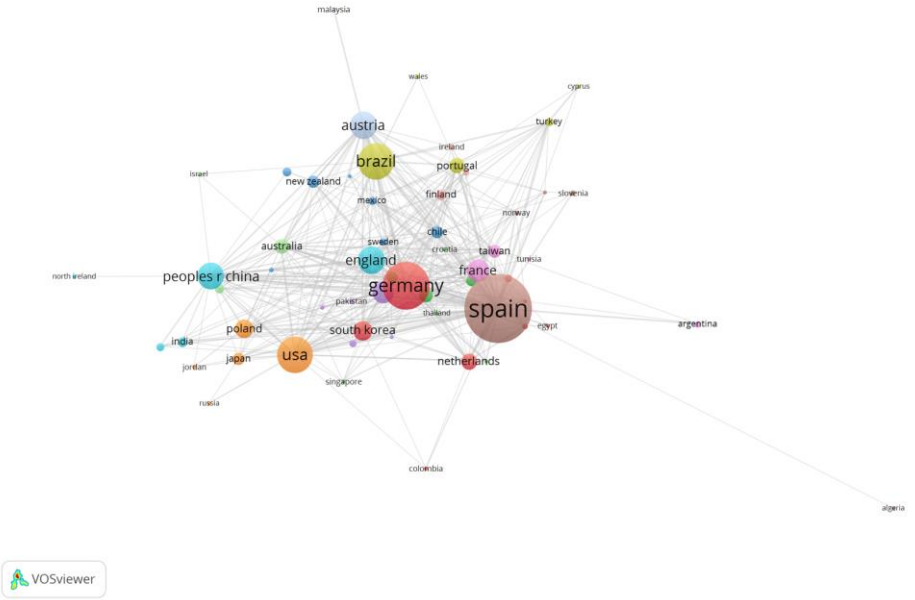

Figure 7: Citation analysis of countries publishing in J.UCS

Next, we analyze the number of citations between countries, shown in Figure 7. There are seven clusters. The most productive country in terms of number of publications is Spain, followed by Germany. Both countries belong to different clusters. Most of the countries have cited the same publications, since they are all closely together at the center of the map. Only a few countries like Algeria, Malaysia, Colombia, and Argentina are distanced from the center, meaning that they have a few documents cited in common with the other countries. In this map, the clusters definition has no relation with the geographical location of the country. For example, the orange-colored group contains USA (American country), Japan (Asian country), and Poland (European country).

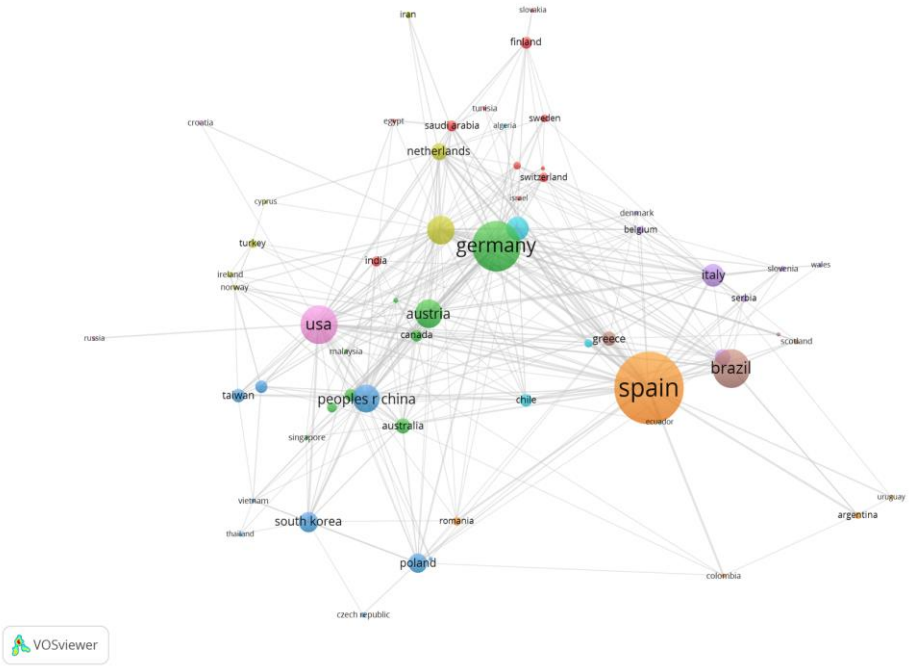

Figure 8: Co-authorship of countries that publish in J.UCS

With respect to the co-authorship of countries (Figure 8), in general terms the countries seem to have more relation with countries located together (for example, Germany and Austria in the green-colored group; China, Taiwan, and South Korea in the blue-colored group) or with countries with the same language (for example, Spain and Chile, both Spanish speakers). The stronger relation between countries includes Spain, Germany, China, and USA. It can be noted that all of these countries belong to different clusters, which indicates that there is a high number of co-citations between clusters.

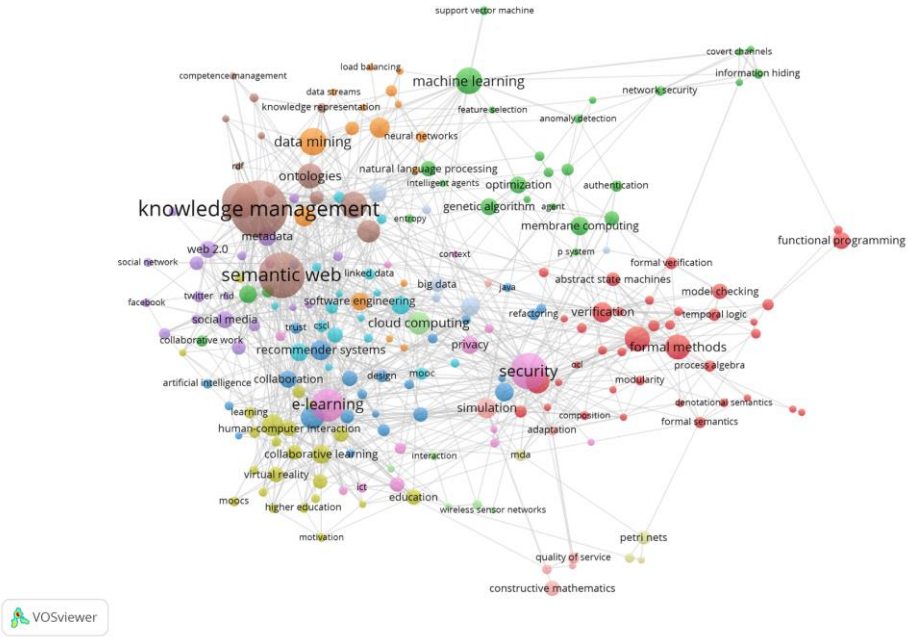

Figure 9: Co-occurrence of author keywords of documents published in J.UCS

Last, Figure 9 presents the co-occurrence of author keywords of documents published in J.UCS. The most prominent cluster is the orange-colored, which includes knowledge management, and web topics. We identify the following most prominent color-named clusters: blue, related to artificial intelligence topics; green, incorporating education and computing; red, including formal methods research; sky-blue, related to internet of things; and yellow, which includes social-media topics.

4 Conclusions

The bibliographic analysis of the first 25 years of J.UCS shows the articles published by the journal cover all areas of Computing according to the classification of subjects done by ACM. The term "Universal" in the journal name then seems appropriate (see Tables 8a, 8b, 9a and 9b). The universality of the journal also becomes clear observing the countries from which the authors of the articles are based. All continents are represented (see Tables 5a and 5b).

We can observe that the main interests of the published articles have somehow evolved. Analyzing Figure 4 and Table 10, we observe that the highest numbers of articles published before the journal was included in WoS was in Theory of Computation. By contrast, after J.UCS was included in WoS, the highest numbers of articles are found in the Information Systems category. Technology of Learning is also an important category after the journal was included in WoS. Information systems has maintained its predominance through the years, while Software and Computing

Methodologies have increased their share. On the contrary, Mathematics of Computing, Hardware and Theory of Computation seem to have less relative importance nowadays than in the early years. The Science and Technology of Learning which had no mentions before 2006 had a peak in the middle of the 2010s.

The most frequent keywords used by authors are Knowledge management, Semantic Web, Ontologies, Security and e-learning, noting that the first three are related since they deal with understanding the information coded in the machine. Due to that these keywords were freely chosen by the authors; these trends give us a closer look at what really aims the contribution of the articles.

In terms of citations, the most influential author is H. Maurer with 306 cites, followed by FJ. Garcia-Penalvo with 233 cites, and JJ. Jung with 181 cites. There are 6 authors with more than 100 cites, and they represent 40.01% of the cites of the ranking. The h-index ranking shows that FJ. Garcia-Penalvo and JJ. Jung are in the first place, both with and h-index of 8.

Regarding the affiliation of the authors, they represent 36 different institutions. The top three most productive institutions and most productive institutions are Graz University of Technology, Austria; Universidad de Castilla La Mancha, Spain; and Universidad Carlos III de Madrid, Spain. Universidad de Salamanca has the higher number of cites per published articles, followed by the Chinese Academy of Sciences, China, and Polytechnic Universidad de Cataluña.

According to the analysis of visualizations performed by the VOSviewer platform, we can notice that there are six clusters of authors. The cluster that contains the leading country for bibliographic coupling is Spain, which also includes France, Chile, Mexico, Algeria, and Ecuador, followed by Germany, which also incorporates Canada, Pakistan, Romania, Malaysia. With respect to the number of citations between countries, there are seven clusters. The most productive country in terms of number of publications is Spain, followed by Germany. Both countries belong to different clusters. With respect to the co-authorship of countries, in general terms the countries seem to have more relation with countries located together; for example, Germany and Austria; China, Taiwan, and South Korea; or with countries with the same language; for example, Spain and Chile, both Spanish speakers.

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