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RESEARCH PAPER

This century (so far) of HCI in Mexico: a bibliometric analysis

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Abstract
We aim to give a panoramic view of the HCI field in Mexico, from an academic perspective. We conduct a bibliometric analysis to have a glance of Mexican academia activity within the international CHI community: the productivity, main authors, institutions, collaborations, and research topics. We use the archives of the main journals and conferences to conduct this analysis. The results indicate that productivity has experienced a notable increase in recent years and that Mexican authors prefer to publish their research in archival journals rather than top conferences.

Keywords:
Human-Computer Interaction; HCI in Mexico; Bibliometric Analysis; Thematic Trends.

1. Introduction
Human-Computer Interaction (HCI) is an academic area with intense activity in Mexico, as attested by the presence of a national association on the subject (Asociación Mexicana de Interacción Humano Computadora – AMexIHC), which organizes a biennial conference (MexIHC), a presence on ACM SIGCHI with a Chartered Mexican Chapter, graduate and postgraduate courses across many universities and academic institutions, and many other activities since the mid-1990s. A general view of the academic HCI activity was published recently [7], outlining how the Mexican HCI community strives to gain a presence on the International stage. We now try to complement this view with quantitative data to better understand the current status of the Mexican academic community in this field and possibly identify actionable points.

We conduct a bibliometric analysis to identify the magnitude of participation at the national and international stages; we do this by selecting the top conferences and journals and analyzing the publications in which Mexican institutions have participated. From this analysis we discuss the status of the field.

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2. Methodology
We conducted a bibliometric analysis [2] to identify the trends in themes covered by the HCI community in Mexico, collaboration patterns, and prominent research groups.

A quantitative performance analysis was first conducted to identify the number of publications by Mexican scholars in HCI, contributing authors, citations, and collaborations.

The main questions we are trying to answer regarding the academic HCI Mexican community are: In which top conferences and journals are they publishing? How many papers are presented annually?

The methodology for our analysis encompasses the following steps:

1. *Data collection* – we chose the relevant databases to conduct the searches using the required specific queries. Database selection included the following criteria: free access, API existence, and search parameters available.
2. *Pre-processing* – after obtaining the data we had to perform conversion (*e.g.*, export to CSV format), fusion (combine results from different sources), cleaning (*e.g.*, wrong character conversions, spurious linefeeds), and purging (*e.g.*, redundancies, merging fields).
3. *Analysis* – with all the available data converted to actionable information, try to answer the questions presented above. One method we used, which differs from traditional bibliometric analysis, is using large language model (LLM) systems to extract relevant data from the papers [3,5,6].
4. *Visualization* – production of figures, graphs, and diagrams to identify trends and facts; several of these were produced with python scripts using the appropriate libraries.
5. *Interpretation* – using contextual information to identify trends and explain observed phenomena.

The following subsections will provide specific details on applying this methodology to each case.

3. Publications in Journals
We used the SCIMAGO and JCR-Clarivate databases to determine a list of relevant journals in HCI. Both databases include a ranking in the area: “Human-Computer Interaction” in

SCIMAGO[1] with 134 journals and "Computer-Science-Cybernetics"[2] with 24 journals. Both lists include journals that are too broad (*i.e.*, IA Open) and/or would not be considered as a core HCI journal (*i.e.*, Foundations and Trends in Machine Learning). Thus, both authors reviewed the list independently and came up with a consensus list of 28 journals (9 Q1; 9 Q2; 7 Q3; 3 Q4 in JCR). In 14 of these journals at least one paper has been published with an author with an affiliation from a Mexican institution.

A search was conducted in SCOPUS to retrieve papers with at least one author from a Mexican institution in the list of journals selected and published since 1990. A segment of the query used for some of the journals searched is as follows:

AFFILCOUNTRY(MEXICO) AND (ISSN(0747-5632) OR ISSN(1949-3045) OR…)) AND PUBYEAR > 1990 AND PUBYEAR < 2024

The data was exported from Scopus and analyzed using Bibliometrix [1], a package developed with the R System, including a set of tools to conduct bibliometric analysis.

3.1 Results

A total of 136 papers were published, with at least one author affiliated with a Mexican institution. Four of these publications, corresponding to guest editorials, were eliminated for a resulting number of 132 papers. Figure 1 shows the number of papers published yearly since 1998 in 22 journals. The results show that before 2009, not more than one paper was published every year. In contrast, almost 13.9 papers, on average, have been published per year since 2017.

The notable increase in papers published in 2023 is partially due to a Special Issue devoted to HCI in Latin America in the journal Interacting with Computers [4]. This SI compiled the best papers from three conferences held in 2021: the Latin American Conference on Human Computer Interaction (CLIHC), the Brazilian Symposium on Human Factors in Computer Systems (IHC), and the Mexican Conference on Human–Computer Interaction (MexIHC). Similarly, 5 papers were published in the Special Issue on New Generation Collaborative Learning Systems of Computers in Human Behavior (Vol 51, Part B, 2015); 5 out of a total of 85 papers list a Mexican institution, being the Instituto Politécnico Nacional (IPN) where all authors were affiliated to, as is also one of the editors.

Regarding sources, two journals account for one-third of the total production, with 22 published in Computers in Human Behavior and in Universal Access in the Information Society.

The 132 manuscripts have accumulated 2181 citations registered in Scopus, averaging 16.5 citations per paper. Figure 2 shows the average number of citations for these papers yearly. Five of the ten papers with more citations were published in Computers in Human Behavior. These ten papers account for 35% of all citations (Figure 3). In contrast, ten papers have not been cited yet, but 8 of them were published in 2023.

The top 12 papers, in terms of number of citations, are presented in Table 1. The most cited paper [12] appeared in Computers in Human Behavior, which is a Q2 journal; the thematic keywords listed in the paper are Online reviews, Theory of planned behavior, and Big-Five personality.

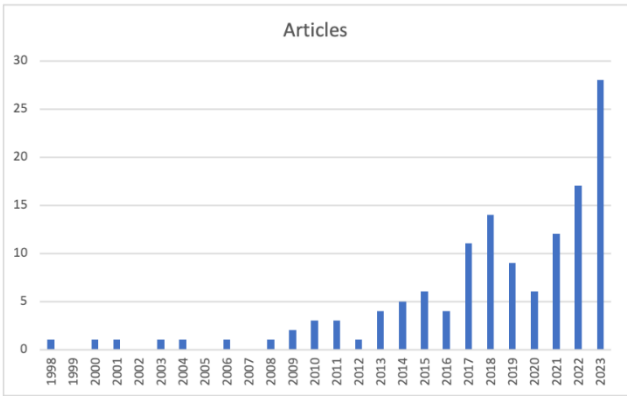

Figure 1. Annual scientific production in journals

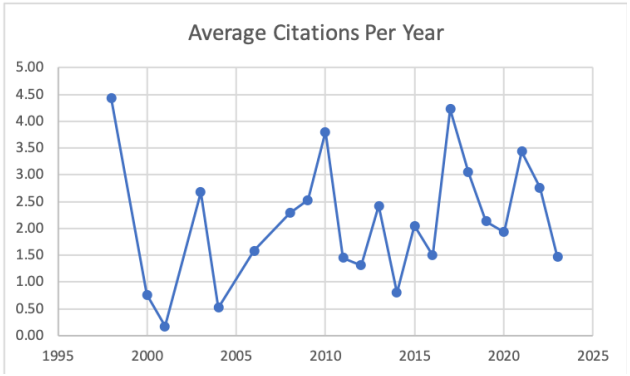

Figure 2. Average citations per year.

Table 1. Papers with more citations per year.

Paper	TC /Year
Picaso-Vela S, 2010, COMPUT HUM BEHAV	9.33
Bourges-Waldegg P, 1998, INTERACT COMPUT	4.44
Cornejo R, 2013, INT J HUM COMPUT STUD	8.00
Ramírez-Montoya MS, 2017, COMPUT HUM BEHAV	8.50
Jasso-Medrano JL, 2018, COMPUT HUM BEHAV	9.57
González MG, 2003, COMPUT HUM BEHAV	2.68
Rojas-López A, 2019, UNIVERS ACCESS INF SOC	9.67
Seering J, 2018, ACM HUM COMPUT INTERACT	8.00
Zapata A, 2015, INT J HUM COMPUT STUD	5.30
Rodríguez MD, 2009, COMPUT HUM BEHAV	3.13

Figure 3 shows the production of the 6 authors with more than four or more papers over time. Only one of them (M. Tentori) had publications before 2014, and two of the other 5 were her doctoral students. In addition, 13 authors with a Mexican affiliation have authored 3 papers.

[1] https://www.scimagojr.com/journalrank.php?category=1709&area=1700&type=j

[2] https://jcr.clarivate.com/jcr/browse-journals?query=ewB9AA%3D%3D

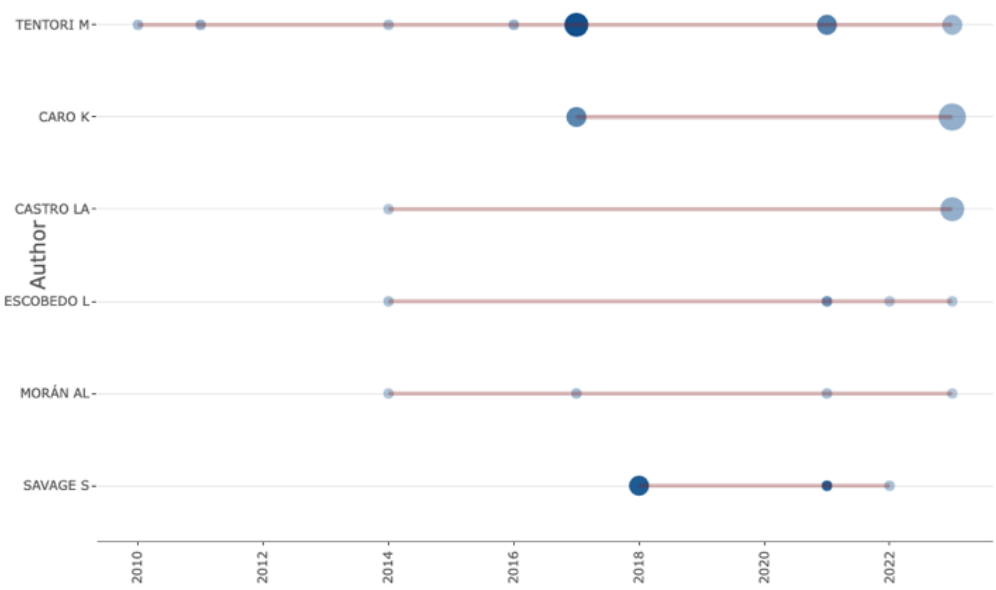

Figure 3. Authors production over time (4 or more papers)

The 132 papers have authors from 52 Mexican institutions, mainly from Research Centers and Universities, and a handful of authors from National Health Institutes and companies. Figure 4 shows the 17 institutions that have published more than 3 papers. Five of these institutions have more than 10 papers (CICESE 20; UNAM 17; UABC 12: IPN 12; ITESM 11). Authors are mostly affiliated with Computer Science or Engineering Departments, with others affiliated to Business, Medical, and Psychology Departments. Slightly more than half of the papers have authors from only Mexican institutions (72/132). Of the remaining 60 papers with authors affiliated with institutions in other countries, there are 16 papers with coauthors from Spain, 15 from the USA, and 10 from the UK.

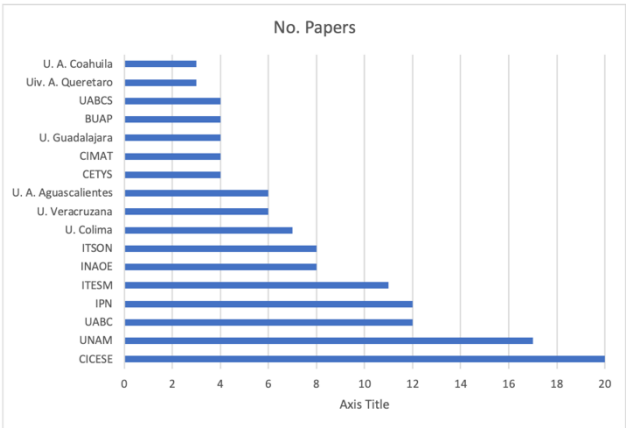

Figure 4. Affiliations of authors with 3 or more papers

Figure 5 shows the collaboration network, showing five main clusters. The largest one includes 8 authors from Mexican institutions led by M. Tentori. The second largest network is relatively tight, reflecting that these authors share several documents as co-authors. Only one author from a Mexican institution is included in this network (H.J. Escalante, INAOE). A similarly tight network has 5 authors, all affiliated to IPN. An additional network is associated to a collaboration between INAOE and UABC and includes four authors. Finally, the smallest network corresponds to two co-authors affiliated with CICESE-Nayarit. It is worth noting that these five networks have connectivity between them, even though they include authors from the same institution, as authors from INAOE, CICESE, and UABC appear in two of these networks.

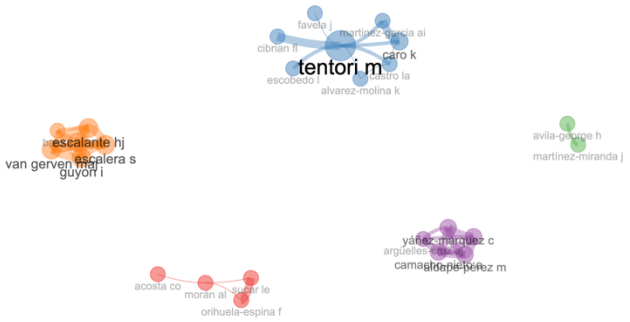

Figure 5. Collaboration Network showing five main clusters

Figure 6 shows a thematic map that clusters topics based on their density and centrality. Density measures the cohesiveness among topics, and centrality is the degree of correlation among them.

As can be seen in Figure 6, the HCI field is notably dynamic, and some research themes have been either exhausted or fallen out of favor. A topic such as “learning systems” with high centrality and medium density is a leading theme within the field. The theme “virtual reality” is a central theme that can be further developed.

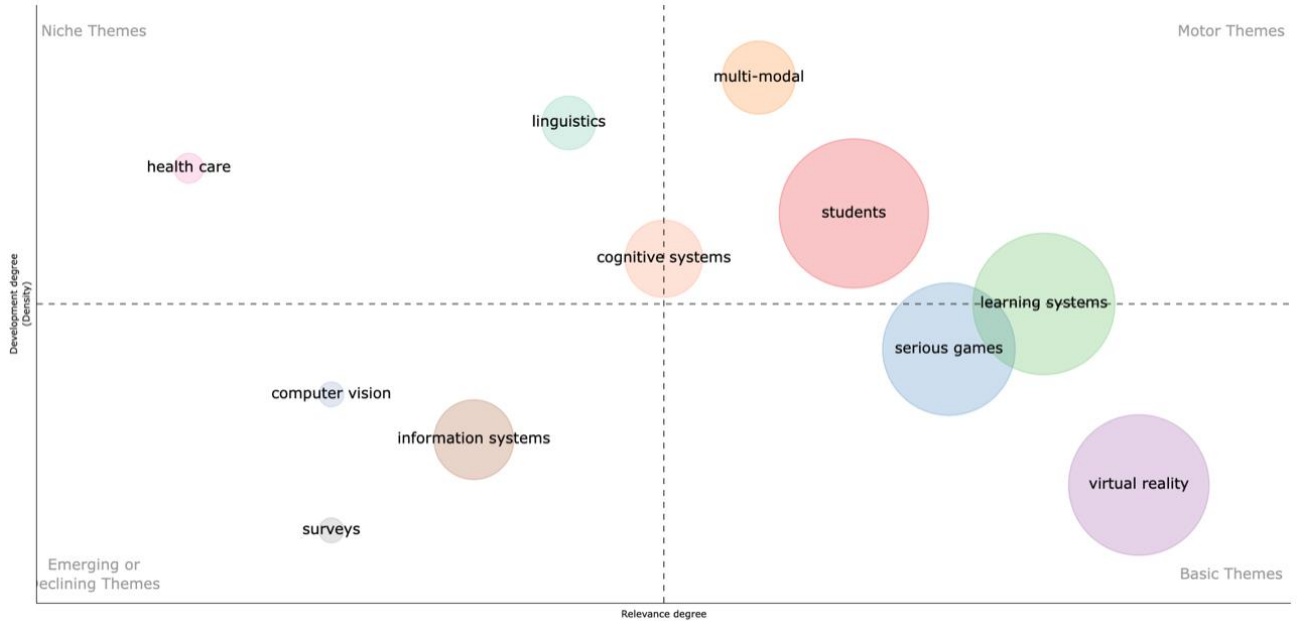

Figure 6. Thematic map of journal publications

We also used SCIMAGO Country Rankings to determine how Mexico compares with other countries regarding the number of publications each year in the HCI field. We selected the 1996-2023 years range and only those countries with more than 500 publications during that time in all World regions. We obtained an output of 68 countries, with the USA leading with 102952 publications and Peru trailing with 505 publications; the mean value is 8239.88, and the median is 2677.5; Mexico is in position 39 with 2306 publications.

In Figure 7, to include Mexico, we show the top 40 countries with HCI publications; note that the only other Latin-American country in the list is Brazil, at position 15, with 8473 publications.

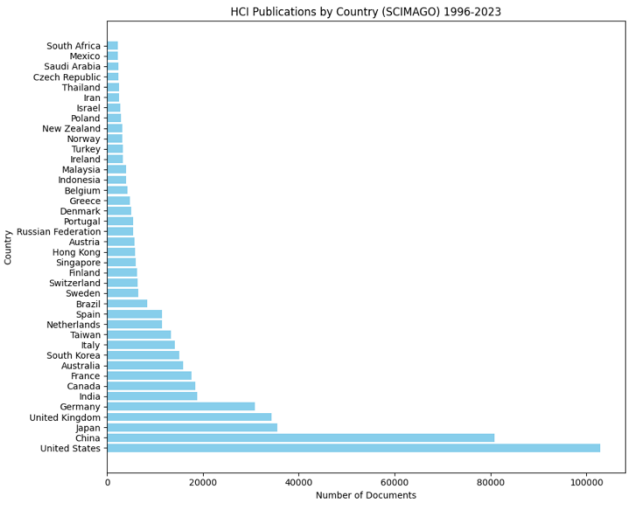

Figure 7. Number of participations in CHI and Ubicomp.

4. Publications in Conferences

For the data collection process, we evaluated several bibliographic databases. We intended to conduct our searches by programmatic means; however, we found out that for some cases, the publicly available API was either limited or nonexistent; some limitations found on some APIs were searches restricted to a few fields (e.g., title, date range, author), more advanced searches required paid subscription.

We found that the Scopus database provided the flexibility needed for our searches as it has an API as well as a Web interface, it is publicly available for free if intended for academic purposes (at least the basic version), and it allows to specify all the fields needed for our purposes.

4.1 International Conferences

We selected two of the main international conferences related to the HCI field: the ACM Conference on Human Factors in Computing Systems (CHI) and the ACM Joint Conference on Pervasive and Ubiquitous Computing (Ubicomp). The following are typical queries for Scopus to retrieve all publications after 1999 where a Mexican institution is in the affiliation for CHI and Ubicomp conferences:

```
( AFFILCOUNTRY ( mexico ) AND CONF ( conference AND on AND human AND factors AND in AND computing AND systems ) ) AND PUBYEAR > 1999

( AFFILCOUNTRY ( mexico ) AND CONF ( conference AND on AND pervasive AND ubiquitous AND computing ) ) AND PUBYEAR > 1999
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The results from these queries can show many parameters such as Author(s), Title, Year, Citation count, Affiliations, Language, Abstract, Keywords, and others. We downloaded the results in CSV format with all the relevant parameters selected and created new CSV files containing only subsets of parameters, according to what we needed to analyze. For instance, we used one of the CSV files as input to a python script to plot the graphic in Figure 8, where the number of publications from 2000 to date is shown for both the CHI and Ubicomp conferences. Also, we include all kinds of participation for both conferences, which could be further specified

by type, such as full paper in conference proceedings, short paper in workshop proceedings, poster presentation, etc.

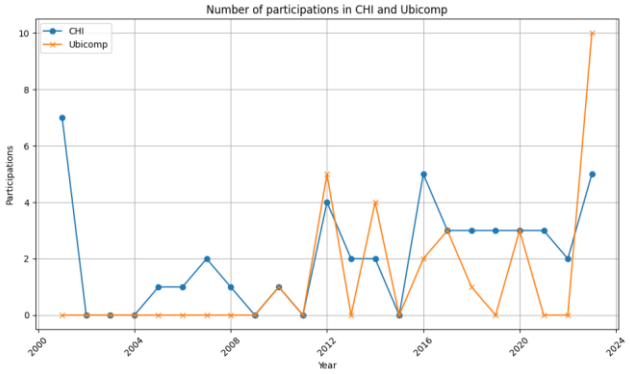

Figure 8. Number of participations in CHI and Ubicomp.

Figure 8 shows the number of papers Mexican authors published annually in these two conferences. It is worth noting that, for the CHI conference, 2001 is the year with the most participation (7 of them), although all were short contributions published in the Extended Abstracts proceedings. The other years with the second most participation were 2016 and 2023, with 5 participation in each case, although only one full paper was presented each year [8, 13]; for the remaining years, 2 full papers [9, 11] were presented in 2012 and another one [15] in 2019. Of note is that, since 2000, only 5 full papers have been presented at CHI where at least one author was affiliated with a Mexican institution.

It is also noteworthy that in 2023, when the number of publications is more than double that of any other previous year, it coincides with the first time that Ubicomp took place in a Latin American country (Mexico). For that year, no papers appeared in the main conference, as all appeared in the Adjunct Proceedings. The only times where full papers appear in the main conference Proceedings are 2010 (1 paper) [16], 2014 (2 out of 4 papers) [10, 14], and 2016 (1 out of 2 papers) [18]. For both conferences, there has not been a full paper published with all authors affiliated to Mexican institutions; this means that all papers were results of international collaborations.

4.2 MexIHC

For national conferences, we used the Mexican International Conference on Human-Computer Interaction website (mexihc.org) to analyze the publications presented at each instance of the conference. We found that the conference program was available only for 2006, 2008, 2010, 2012, 2014, 2016, 2018, 2021, and 2022 conferences.

We downloaded all available conference programs and pre-processed them to leave only the relevant information, i.e. (full and short) paper presentations, as there were other activities such as poster sessions, students' competitions, and others; we compiled for each year, a list of paper presentations for further analysis. One challenge for the automatic analysis is the diversity of formats used: in some cases, the title and authors are listed; in others, only the titles, and in one case, authors go first, and titles follow; additionally, some papers are in English and others in Spanish. We used the papers' lists as input for analysis via the Claude 3 foundational AI model. We selected this model based on its advanced features [17], like multilingual and multimodal support, long context windows, and near-perfect recall. For each instance, we used a prompt similar to this:

```
This is a list of papers accepted in a conference,
it lists the authors and the title for each paper.
How many papers were written and English and how
many in Spanish?
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Depending on the format of each input, we modified the prompt to include the title and authors (and their order of appearance) or just the title. For some years, it was also possible to obtain information on the country of affiliation, as it was listed in the conference program.

The information obtained by querying was corroborated by manually looking it up in the compiled conference proceedings list. We then proceeded to compile the results to generate Table 2.

Table 2. Analysis of publications in MexIHC. (P - number of publications, S - pub in Spanish, E - pub in English, M - only Mexican affiliations, C - collaboration Mexico-other country, O - other country only).

Year	P	S	E	M	C	O	Countries
2006	15	12	3	10	2	4	Mex & other: GBR, CAN; Other: GTM, COL, ITA, DEU
2008	10	4	6				Mex & other: ESP; Other: USA, DEU, COL
2010	12	4	8	7	1	4	
2012	8	1	7				
2014	19	8	11	17	2		Mex & other: UK, CAN
2016	19	11	8				
2018	20	5	15				
2021	16	3	13	13	3	1	Mex & other: BRA, USA; Other: GBR, CAN
2022	6		6	1	1	4	Mex & other: ECU; Other: USA, GTM,COL

For the 2022 edition, 4 full papers and 2 short papers were presented, along with 8 posters; 3 of the full papers were from non-Mexican institutions and one of the short papers included a collaboration from a Mexican and an Ecuadorian institution.

5 Discussion

We are aware that our bibliometric analysis only considers journals and conferences in HCI. However, given the field's interdisciplinary nature, HCI papers also appear in forums related to other fields, such as AI, Software Engineering, Computer Education, Psychology, Business, etc. A more in-depth analysis would also cover these fields. This field's interdisciplinary nature is also apparent in the fact that authors are affiliated with departments in Computer Science, Psychology, Medicine, Business, and a few private companies.

Also, as we have stated, our temporal analysis is focused on the current century, partly because there was a modest number of

publications prior to that; in fact, our search did not yield any journal papers before 1998, and only a moderate amount up until 2017, with a significant increase since.

One interesting finding is the clustered nature of the academic outputs. For instance, more than half of the publications were produced by authors affiliated only with Mexican institutions, which indicates a particular strength of the field in Mexico. Collaboration networks indicate rather incipient but isolated groups. Also, several collaboration networks of journal authors do not participate in MexIHC. These facts present an opportunity to expand this community, possibly including researchers associated with non-CS Departments.

There is one particularity of the Mexican academic community that could help to understand the relatively low output in terms of publications in top conferences. Mexican researchers strive to be members of the National System of Researchers (SNI or SNII) as it provides status recognition and opens opportunities to apply for research grants, coordinate projects, etc. However, within the SNI evaluation system, Computer Science conferences (even the top ones) do not carry significant weight in evaluation points; therefore, researchers sometimes prefer not to publish in top conferences, as the effort it implies does not correspond to advancement opportunities within the SNI. Consequently, publication efforts are oriented toward journals, as they are listed as high-priority products in the SNI evaluation system; it is also noteworthy that, at least for SNI membership, sometimes there is an incentive to maximize citation count and, as can be deduced from Figure 2, even publications in Q2 journals can yield more citations than those in Q1 journals.

6 Conclusion

The scientific production in HCI journals by authors with a Mexican affiliation was marginal until a few years ago but has increased substantially recently. The fact that half the journal papers published had only authors with Mexican affiliation and the network of co-authors reflect that the field has seed groups from which the community can gain strength and international presence.

The diversity of affiliation departments reflects the field's interdisciplinary nature and the need for the AMexIHC to become more inclusive and reach members of this extended community.

An essential limitation of this study is that the analysis of journal publications focused on journals specifically associated with HCI. We understand that this misses papers that might be published in journals focused on closely related fields.

7 Acknowledgments

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