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► **To cite this version:**

Hervé Rostaing, Valérie Léveillé, Badia Yacine. Bibliometric study as an objective picture of the Algerian scientific research practices. The 8th International Conference on Scientometrics and Informetrics, ISSI & The University of New South Wales, Sydney, Jul 2001, Sydney, Australia. pp.607-618. hal-01579927

HAL Id: hal-01579927

<https://hal.science/hal-01579927v1>

Submitted on 1 Sep 2017

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BIBLIOMETRIC STUDY AS AN OBJECTIVE PICTURE OF THE ALGERIAN SCIENTIFIC RESEARCH PRACTICES

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INTRODUCTION

The bibliometric study presented in this paper is included in a more important project of understanding the Algerian scientific research. There is a big gap between the statements of the Algerian policy of scientific research, and the practice of research itself in the universities. The final aim of this project is to assess the existing gap between speech and reality. In this light, this bibliometric study allows to give an objective vision of the practice of the Algerian scientific research according to scientific production. This image is based upon a survey obtained thanks to a questionnaire proposed to scientists themselves. The analysis of this fieldwork on one hand and of policy statements on the other hand allows the valuation of this gap.

The present study only deals with the process used for this bibliometric analysis, the bibliometric results and their first analyses. This study is certainly one of the first bibliometric analyses on the Algerian scientific research. We only know about one attempt of assessment of the Algerian scientific outputs conducted by Labidi J (1993). This previous analysis was built up only with "in house" data collection.

The present work tries to propose an objective view of the Algerian scientific research from data collected in an international database that is a neutral source.

METHODS

Data collection

This paper presents a bibliometric study based on the Pascal database as the source of the data analyzed. This database produced by the INIST¹ French organization was chosen for several reasons: its multidisciplinary scope in science, technical and medical research (8500 journals indexed and 4500 completely indexed), its multi-affiliation referencing (all the organization affiliations contributing to a publication are present) and its quality of subject indexing (controlled keywords and classification codes resulting from a documentary analysis of the publications).

The data set for the study was extracted from two CD-ROM versions of Pascal database (Dialog On Disc and Jouve). The Algerian references were selected from CD-ROMs covering the 10 years window from 1990 to 1999. This selection was obtained by applying the query CS=ALGERIAN or AD=DZA according to the CD-ROM version. With the intention to update the data, the publications of the year 99 not already introduced in the CD-ROM of the year 99 were collected on an online version of Pascal database (a Sylverplatter web access available for the laboratories of my University).

As a risk of duplicate references exists due to the overlapping of all of these Pascal versions, a duplicate control was applied. This data processing was realized using a function of the *Infotrans*² software after the creation of a duplicity code for each reference. This duplicity code was a string of

¹ INIST: Institut pour l'Information Scientifique et Technique, 2, allée du Parc de Brabois, 54514 Vandoeuvre-les-Nancy CEDEX, France, [<http://www.inist.fr>]

² Infotrans developed by IuK, IuK GmbH, Maria-Theresia-Str. 4, D 79102 Freiburg, Germany [<http://www.iukrieth.de/>]

characters composed of the extraction of the first word of the title, the first author, the year of the publication and the first word of the journal. This duplicity code is unique for each reference and can be used as an identity card. Infotrans allows creating this duplicity code by data extraction from references and after identifying the publications holding the same duplicity code to removes all duplicates references, keeping only one. 138 duplicate references were removed.

For this 10 years period, the final corpus is composed of 2545 Algerian references.

Data standardization

The aim of the study of this corpus was defined as follows:

- The bibliometric analysis results should take into consideration three levels of Algerian scientific actors: Algerian authors, Algerian affiliations and Algerian towns.
- The bibliometric analysis results should take into consideration three levels of the actors of international collaborations: foreign affiliations, country and geographical regions by country grouping.
- The bibliometric analysis results should take into consideration two levels of scientific fields of Algerian publications: scientific specialities and scientific domains.
- Others characteristics from Algerian scientific publications should be extracted and compared to the three previous categories of data: journal of publications, dates of publications, languages of publications and document types.

In consequence, a great part of the bibliometric study was devoted to the morphological standardization of the corpus to obtain valuable results according to these aims: standardization of institution names, author names, town names, country names, journal names... Then, cluster rules were processed on standardized data to create some new data like geographical regions, scientific specialities and scientific domains.

This data processing was made easier in a semi-automatic way with the *Infotrans* software. The techniques used for this data processing are presented in the following sections.

Standardization of the document types and publication languages

The data coming from different versions of Pascal database, the document type and the publication language were not given in the same way. Dialog on disc and Silverplatter systems are English version of Pascal database whereas Jouve is a French one.

The document type field was normalized in four categories: Serial, Conference, Book and Report.

The Algerian publications are exclusively edited in English and French. The normalization of this field was a simple translation.

Standardization of the publication authors

The author field is certainly the most difficult to normalize. The variety of the author names and the variety of forms of the first name and last names make things difficult. This kind of following variations occurred frequently:

HADJ MOUSSA S	AGOUNITESTANE D	BOUDJEMA A
HADJ-MOUSSA S	AGOUNITESTANE DJ	BOUDJEMA Arezki

The rules of the automatic normalization of this field were restricted to only keeping the first initial of the first names and removing the hyphen in surnames. The supplementary terms like (ed.) or (pref.) or (comment.) were systematically removed.

Unfortunately, without a time consuming manual treatment many mistakes persist. These mistakes are mainly input errors like theses:

BOUDGHENE-STAMBOULI	○
BOUDHENE-STAMBOULI	○
BOUDHGENE-STAMBOULI	○

In the case of our bibliometric analysis, we consider that the effects should not be important. Nevertheless, we must keep in mind the name spelling errors found of the author field for the further bibliometric treatments.

Standardization of the publication media

One part of the study must focus upon the communication practice of the Algerian scientific research. The stability of the publication media field is required. To reduce the form diversity of forms of the publication media, data processing was necessary to reduce the diversity of forms of the publication media. The publication media field was systematically switched to uppercase letters. The punctuation marks as the full point, comma and colon as well as the data outlining the number of sections, parts and series were automatically removed.

For example, the following journal entries are converted into the unique form "COMPTES RENDUS DE L'ACADEMIE DES SCIENCES":

```
Comptes rendus de l'Académie des sciences. Série 1, Mathématique
Comptes rendus de l'Académie des sciences. Série 2, Mécanique,
physique, chimie, astronomie
Comptes rendus de l'Académie des sciences. Série 2, Mécanique,
physique, chimie, sciences de l'univers, sciences de la terre
Comptes rendus de l'Académie des sciences. Série 2, Mécanique,
Physique, Chimie, Sciences de l'univers, Sciences de la Terre
Comptes rendus de l'Académie des sciences. Série 2, Sciences de
la terre et des planètes, earth & planetary sciences
Comptes rendus de l'Académie des sciences. Série 3, Sciences de
la vie
Comptes-rendus de l'académie des sciences. Série 2, mécanique,
physique, chimie, astronomie
```

and this following journal entries into the unique form "JOURNAL OF PHYSICS":

```
Journal of physics A : mathematical and general
Journal of Physics D: Applied Physics
Journal of physics. A. Mathematical and general
Journal of physics. B, Atomic, molecular and optical physics
Journal of physics. Condensed matter
Journal of physics. D. Applied physics
Journal of physics. E. Scientific instruments
```

Standardization of the affiliations and new data creation

Even though the previous standardization data processing were obtained with complete automatic treatments using general rules (rules suitable to all references), the case of affiliation field is quite much more difficult to automate. Many information useful for bibliometric analysis are introduced in this field as seen in this example:

```
CS- Univ. H. Boumediene, dep. mathematiques, Alger, DZA^Univ.
Caen, dep. mathematique mecanique, 14032 Caen, FRA^
```

All affiliation addresses of the authors are introduced and separated with a circumflex accent. The address gives information about organization of author affectation (in the case, two universities, one Algerian and one French), department or laboratory including the author belonging, the town and the country of the organization. All of this information should be useful for a bibliometric analysis considering different levels of collaborations (Hinze S, 1999).

The aim of the normalization of the affiliation field was to clearly extract and normalize three data:

- the country of each organization to study the collaboration at international level,

- the town of Algerian organization to study the Algerian research activities and collaborations at the town level,
- the name of each organization to study the research activities of Algerian organization and to study collaboration at organization level.

Unfortunately, the affiliation addresses are indexed in this field without any rules. For instance, we found more than 120 different varieties of the university name “*Université des Sciences et de la Technologie Houari Boumediene*” (USTHB). The names of laboratories or departments are also writing in so many ways. Still more embarrassing, the arrangement of the organization and the laboratory is not regular. The organization name can equally be before or after the laboratory name. In these circumstances, a complete automatic data processing is practically impossible with general rules.

Some general rules were easily elaborated to extract and normalize countries names and Algerian towns. The results of this data processing were isolated in two new fields (country field and Algerian town field).

A third field was created representing amalgamations of countries by geographical region proximity or geographical continent belonging. The foreign countries were gathered in nine regions: Western Europe, Eastern Europe, North America, Latin America, Maghreb nations, Oriental nations, Asia, India/Pakistan, Africa and Oceania (Appendix A: Geographical regions by countries grouping). France was not associated with the Western Europe region because Algerian collaborations are mainly with this country.

On the other hand, the normalization processing of organization names required the creation of big “correspondence table” to identify all the ways of writing an organization name and to specify in which normalized name this organization will be transformed into. In this correspondence table the 120 different ways of writing the Scientific and Technical University of Houari Boumediene are specified turning into the normalized name USTHB.

The drawing up of this correspondence table was quite time-consuming. Also, we decided to consider only forms of organization names occurring at least twice for Algerian affiliations and at least 5 times for others, that is to say around 1100 entries. All the same, this drudgery allowed reducing the number of different organization names from 4004 to 1570. The set of this normalized organization names is 170 including 84 Algerian organizations. This normalized set is present in 90% of references (2299 / 2545).

For example, the following affiliation field

```
CS- ^IMAGE PROCESSING LABORATORY, ELECTRONIC INSTITUTE, USTHB, BP 32 EL-ALIA
    BAB-EZZOUAR, 16111 ALGIERS, ALGERIA^EUROPEAN SPACE AGENCY/EARTHNET, ESRIN,
    VIA GALILEO GALILEI, 00044 FRASCATI, ITALY^VEGETAL BIOLOGY LABORATORY,
    NATURAL SCIENCES INSTITUTE, USTHB, BP 32 EL-ALIA BAB-EZZOUAR, 16111
    ALGIERS, ALGERIA^EUROPEAN SPACE AGENCY, PARIS, FRANCE^
```

was automatically processed to create the four new fields using general rules and correspondence tables

```
CO- ALGERIA; ITALY; ALGERIA; FRANCE
RE- ALGERIA; EUROPE; ALGERIA; FRANCE
VI- ALGIERS; ALGIERS
AF- USTHB/ALGERIA; EUROPEAN SPACE AGENCY/EARTHNET/ITALY; USTHB/ALGERIA;
    EUROPEAN SPACE AGENCY/FRANCE
```

National research programs categorization

To be able to study the scientific activities of the Algerian organizations is certainly one of the most important task to do. At first, a normalization of Pascal subject classification code to create sub-fields categories using CHI schemes and schemes of previous bibliometric studies (Barré R, 1991 and Narvaez N et al, 1999) was trying used The results of this scientific categorization seemed to be

difficult to compare to Algerian policy statements and the research programs planned by the Algerian government.

Privileging the appropriation of the bibliometric results by the Algerian actors involved in the scientific research activities, the scientific categorization of the 2545 references was based on the latest five-year research program plan defined by the Algerian government (Loi n°98-11, 1998). The law text presents the strategy for the scientific research and the technological development interpreted in national research programs. 30 national research programs are drawn up as having priority. Each national research program is divided into fields, the fields into sub-fields and sub-fields into subjects. For the 30 national research programs only 16 were retained in our study (Appendix B: the Algerian research programs). The other national research programs do not concern scientific or technical scopes and could not be represented with data coming from Pascal databases. For a more specific analysis, the study should take into consideration each field of these 16 national programs. To have a better knowledge of the contents of these national programs, we consulted a report in which the national research programs of the previous five-years research plan were detailed (Programmes nationaux de recherche, 1995).

The technique to assign these national programs and these fields to the references of the corpus is based on the drawing up of correspondence table in between Pascal classification scheme³ and the Algerian national programs. The matching of the national programs and theirs fields with the corresponding subject classification codes was realized manually. To make this task easier, the whole classification scheme was downloaded from the INIST web site. All the downloaded HTML pages were indexed with a full text processing using the Altavista Discovery software⁴. The search system allowed quickly finding classification codes matching with the subjects of fields or national programs because their definition contains some relevant terms. The results of a search are displayed via your Internet Browser, so we still have hypertext link facilities of the INIST's HTML pages to explore the codes relationships.

The systematic analysis of the found candidates allowed us to draw up the correspondence table and a specific method to apply it. From the matching of this correspondence table with the subject classification codes belonging to a reference, a new bibliographic field was automatically created. The new field contains one or several research programs in which the reference is corresponding to. The data assigned to this field in codifying as follows: a 9 digits code to indicate the research program title (Appendix B: the Algerian research programs) following by a slash and the field subject of this research program. The following examples present the subjects classification codes matching with the Information Technologies research program:

Research program code/field	Corresponding classification codes
INFO-TECH/SYSTEMS ENGINEERING	001B00G05B, 001B00G05D, 001D02A01, 001D02A02, 001D02A04, 001D02A08, 001D03H, 001D03I, 001D03J01, 001D03J02, 001D03J03, 001D03J07, 001D03J08, 001D03J09, 001D03J10, 001D03J11,
INFO-TECH/ARTIFICIAL INTELLIGENCE	001B00G05M, 001D02C
INFO-TECH/MICRO-ELECTRONICS	001D03F
INFO-TECH/SOFTWARE TECHNOLOGIES	001A01F, 001B00G05H, 001B00G05K, 001B00G05P, 001B00G05R, 001B00G05T, 001B00G05W, 001D02A05, 001D02A06, 001D02A07, 001D02B, 001D03J04, 001D03J05
TECH-INFO/TELECOMMUNICATIONS	001A01E, 001A01G, 001D04

³ Pascal classification scheme is available on the web site of INIST [<http://www.inist.fr/pascal/intropepas.htm>]

⁴ The Altavista Discovery used in this study is an old free version no longer available at the Altavista web site. This version 1.0 allows indexing files on your own computer in full text mode. From the same Altavista user interface and with the same Altavista search commands it allows you to perform searches in your files.

To obtain a complete correspondence, we were obliged to introduce a new subject code to identify all technical aspects not defined in the plan of the national research programs. The code is labeled ENG&TECHN (Appendix B: the Algerian research programs).

RESULTS

This stable corpus was processed by three bibliometric softwares developed by CRRM⁵: Dataview (Rostaing, 1993), Datalist (Pohl, 1997) and Matrisme (Boutin, 1999). The results could be divided into different kinds of analyses:

- Information about global scientific evolution with time:
 - o Evolution of scientific output for Algerians institutions and Algerian towns
 - o Evolution of Algerian international collaborations with geographical regions, with foreign countries or with main foreign institutions
 - o Evolution of practice of the Algerian scientific communications (modification of the publication policy to improve the visibility or better acknowledgement of Algerian scientific research)
 - o Evolution of scientific domains and specialities in Algeria through research programs codification
- Information about characteristics of Algerian towns:
 - o Identification of scientific institutions for each Algerian town
 - o Affinities of international collaborations for each Algerian town at region level, country level and foreign institution level. Evolution of these international affinities with time
 - o Scientific specialities for each Algerian town and their evolutions with time
- Information about in home scientific organisation
 - o Network of collaborations in between Algerian towns
 - o Network of collaborations in between Algerian institutions
 - o Networks of collaboration in between Algerian authors (including foreign authors)
 - o Number of Algerian institutions involved in research programs

All the bibliometric results could not be presented in this paper. The sample of results exposed in the following sections focuses on the Algerian research programs. The following charts are a first set of pictures to analyse the scientific potentials, organizations and activities in Algeria.

Evolution of scientific fields in Algeria through research programs codification (Figure 1, Figure 2)

For the Algerian scientific community the ten years period from 1990 to 1999 is meaningful because conflicts and waves of terror were strong. From 1992 to 1994 terror reached its climax. This historical background explains the important decrease of publications from 1992 until 1995. Health and Medical sciences is the only research program that has kept a strong publication activity until 1994. From 1996, all research programs publication rates increased except for Health and Medical sciences which have declined its production activities. This research program has been in a second position in 1994 and moved back to the fifth one in 1999 to become the fifth field of Algerian publication. The causes might be the lack of interest Medical researchers felt more interested for subject fields selected by the National plan, they were used to have an autonomy of choice under the control of ONRS (National Scientific research Comity) from 1973 to 1983; this decrease might also be attributed to the restriction of the budget which was reduced in order to give priority to other sectors such as Sciences and Technology

⁵ see also [<http://crrm.u-3mrs.fr/commercial/software/software.html>]

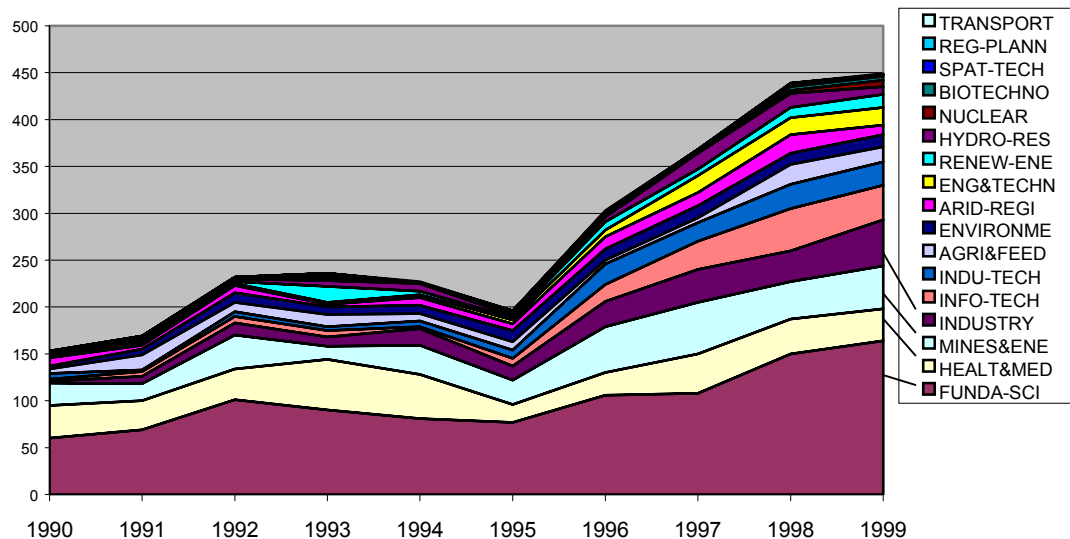


Figure 1: Evolution of national research programs publications

The recent growth from 1996 of the Information technologies research program shows the interest that Algeria takes in new technologies of information and especially in telecommunications (Figure 2) the research program is positioned as third field in 1998 and the fourth one in 1999 figure 2 illustrates, the relative share of publications for each research programs and the relative share for the subject fields of the first five research programs for the ten years period. The big part of scientific contribution, representing Basic Sciences (36%), are distributed among Physics (53%), Chemistry (17%), Earth science (16%) and Biology (7%). This predominance of Basic Sciences is not surprising because these disciplines have taken in the past advantages of the big part of trainings, funding, infrastructures and equipment and other facilities during the short life of the ex ONRS (characteristic of developing countries). The second part of scientific contribution representing 13% of publications is the Health and medical sciences (showing a relatively high percentage of research activities on public healthcare). The Mines and Energy research program, with approximatively the same percentage (12%) as the preceding program is ranked in the third position in the hierarchy of subject fields. This result shows that the development and the valorization of Algerian natural resources is a national priority and is still emerging as a research program

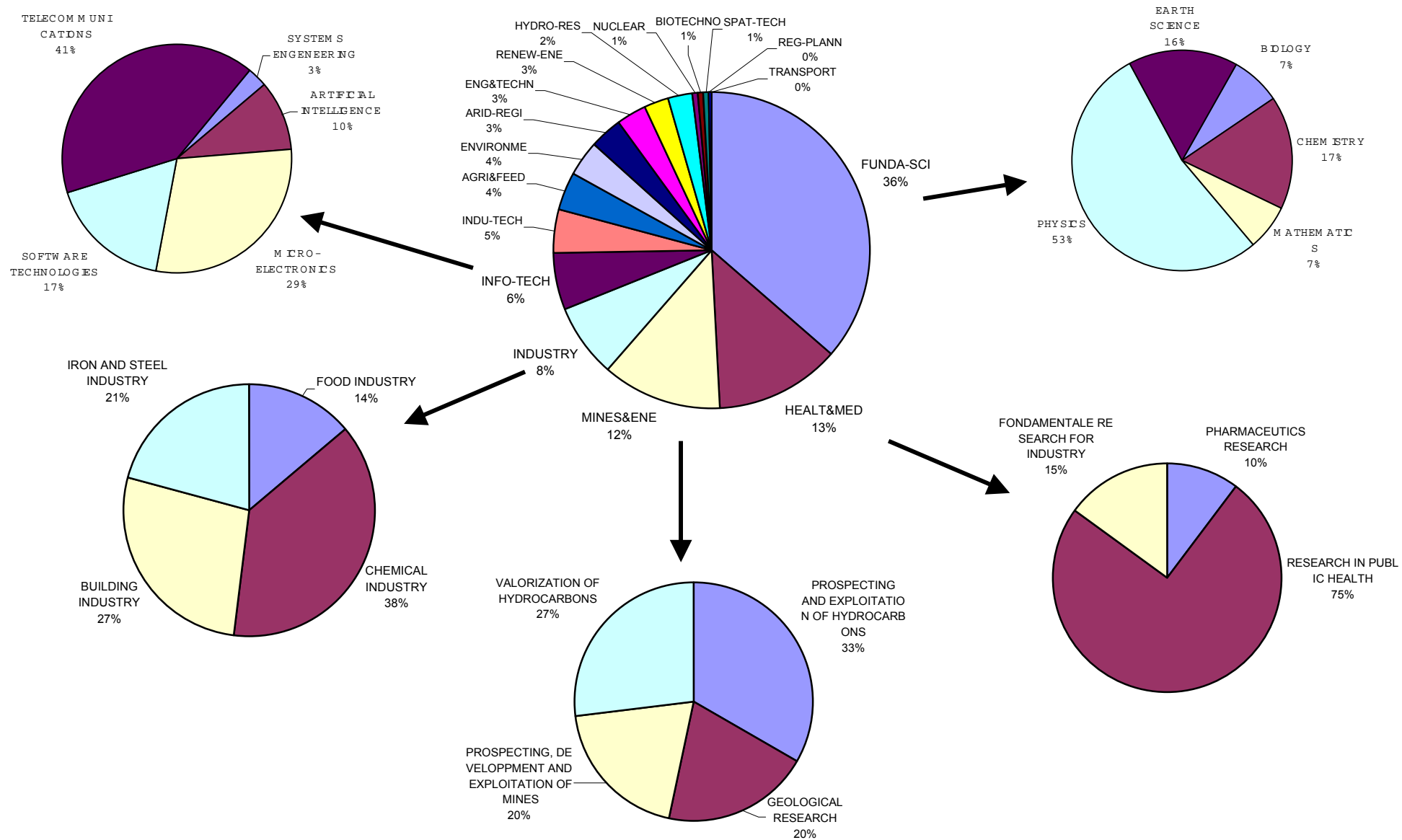


Figure 2: Share of publications for Algerian research programs

Publication language preferences of Algerian researchers (Figure 3)

The choice of language of publication is a sign of an important scientific strategy; two languages, all over the world dominate the expression of scientific fields: English and French. However, the language choice for Algerian community has a lot to do first with, the ability to master French language and second with the traditional establishment of scientific relationship and the different bilateral agreements France had with the Algerian government since independence, (1st government agreement (protocole d'accord) signed in 1962-63, and the second in 1968; both agreements occurred when research activities were located in the research centres far from universities; in the 1970s reform, agreements were signed with the ex ONRS to decide upon common subject fields which had to do with the development of Algerian National Science and its scientific community). So for the reasons cited previously French language is more present in subject fields dealing with Nature and Environmental sciences and medical sciences. These latter were the first research programs that both Algerian and French scientific communities developed before and after the seventies thanks to the cooperation agreements.

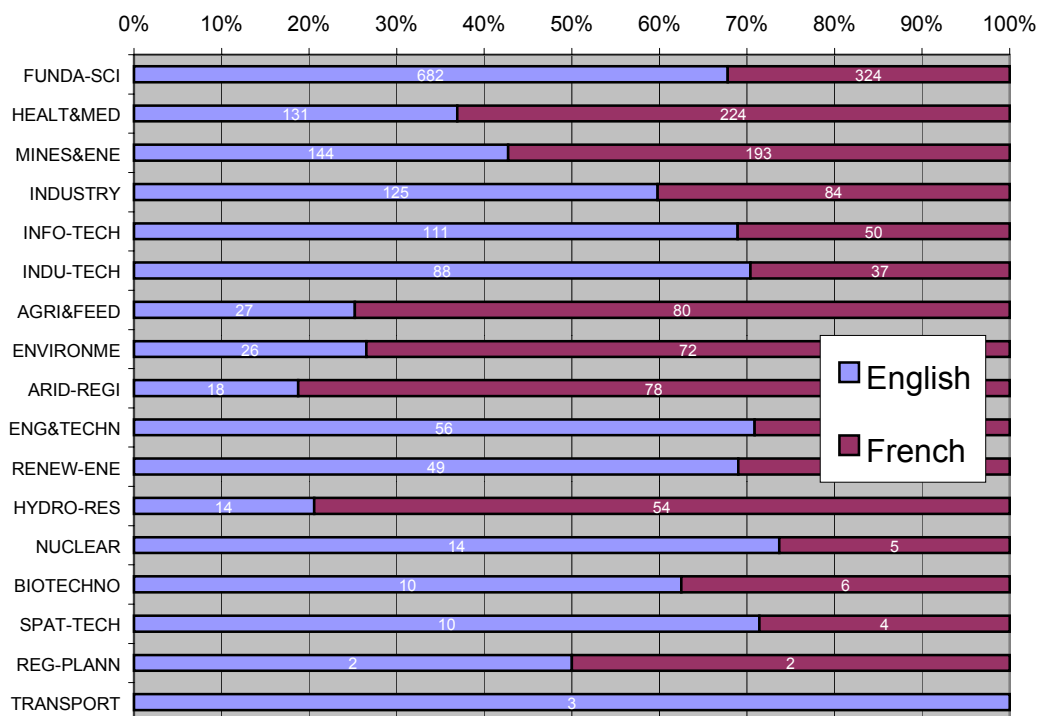


Figure 3: Publishing language preferences for each research programs

Thus, as concerned Algerian production, French language seems to impose itself as the official language of Algerian scientific research until 1996; this practice appears like a tradition all over the years when strong relationships with French research laboratories and French speaking countries has been built and sustained until the mid 1990s. However these traditional practices had been broken for the benefit of English language used frequently on Basic Sciences and Technology. In effect, English language is gradually taking the first important place before French.

As a consequence of world publication practices, and for Algeria, the historical background, one can consider that the Algerian scientists communicate their research works exclusively in two languages: French and English. However, we should not neglect the fact that the official national language in Algeria is Arabic (in education, administration and university studies except for medical sciences area of research); for this reason some explanations could shed light on the absence of this language from the research practice; Besides the fact that Arab

language has not been taken into account by the Pascal database, publications in this language, are relatively rare either locally or with other arab regions (Maghreb) except for Social and Human Sciences. Algerian scientists over fifty years old are not yet ready to publish scientific fields in Arabic since they do not have the necessary background for it. Nowadays, The general trend indicates a change of practice preferring communications in English language (46% in 1990 and 66% in 1999); during this decade we observe a rapid increase of English publications from 1995 to 1999. This change also finds its explanations in the desire of the scientific community to enter the realm of the mainstream sciences through the most prestigious international scientific journals where publishing in English language is a must and is seen as a result of fifth national plan 1990-1994 encouraging algerian scientific output to emerge and to get an interesting position in international science; (we register only two publications in German in 1998)

The Figure 3 confirms that research activities are communicated in the Nature and Environmental science programs oriented towards Arid zones development, Hydrous resources, Agriculture and feeding, Environment, Health and medical Sciences; These prime fields of Sciences initiated under the ONRS supervision (1973 to 1983), with the university reforms establishment of, have been subject to cooperation and collaboration agreements for a long time between Algeria, France, and in less important way with European countries. Technology with its most Technical aspects are programs constituting the new style of science, Algeria wanted to develop with the 1990-94 and 1995-1999 national scientific plan; the language used for these latter is english. Basic Sciences publications and all fields deriving from technology are easily published in English, (Basic Sciences, Nuclear Energy and Technics, Engineering and technologies, Industrial technologies, Information technologies, Spatial technologies) because prestigious scientific Journals communicating articles on Technological fields are biased towards English. That is why, even when algerian researchers share their research work with their french colleagues the preference is oriented towards english publications instead of french, a common ambition shown by both scientific partners whose aim is their ambition to enter and stabilize in the mainstream science.

Collaborations preferences in Algerian scientific publications (Figure 4)

The specificity of Algerian research and researchers is the one of diversification of practical trainings, grades and diplomas, got from the postgraduated studies in the home country and abroad. This specificity has led the former to maintain their relationship with their supervisors and doctoral research laboratories in order to develop partnership with their own laboratories at home. This has been a successful consequences on the publication productions, since international cooperations efforts were established in some important fields of Science and Art and has been developed all along the decade 90-99. So, the collaborations preferences in scientific publications are the ones which has a lot to do with the researchers' choices which have made concrete through government agreements with foreign countries.

In general, the international scientific collaborations are established mainly with the French researchers and institutions (nearly 23% of contributions in all research programs). Its evolution through the decade shows a high increase from 1996 to 1999; the french scientific collaboration, practically insignificant in the beginning of the 90s, takes its revenge over the years by the end of the decade. We can explain this development by the historical relationship existing between both countries, the geographical situation and adding to that the scientific government agreements since the 1990-94 national scientific plans.

However, **figure 4** reveals for the decade under study, that 64% of the scientific contributions are published without any international scientific collaboration (the affiliation field shows only algerian affiliation) this score represent more than half of the whole scientific productions;

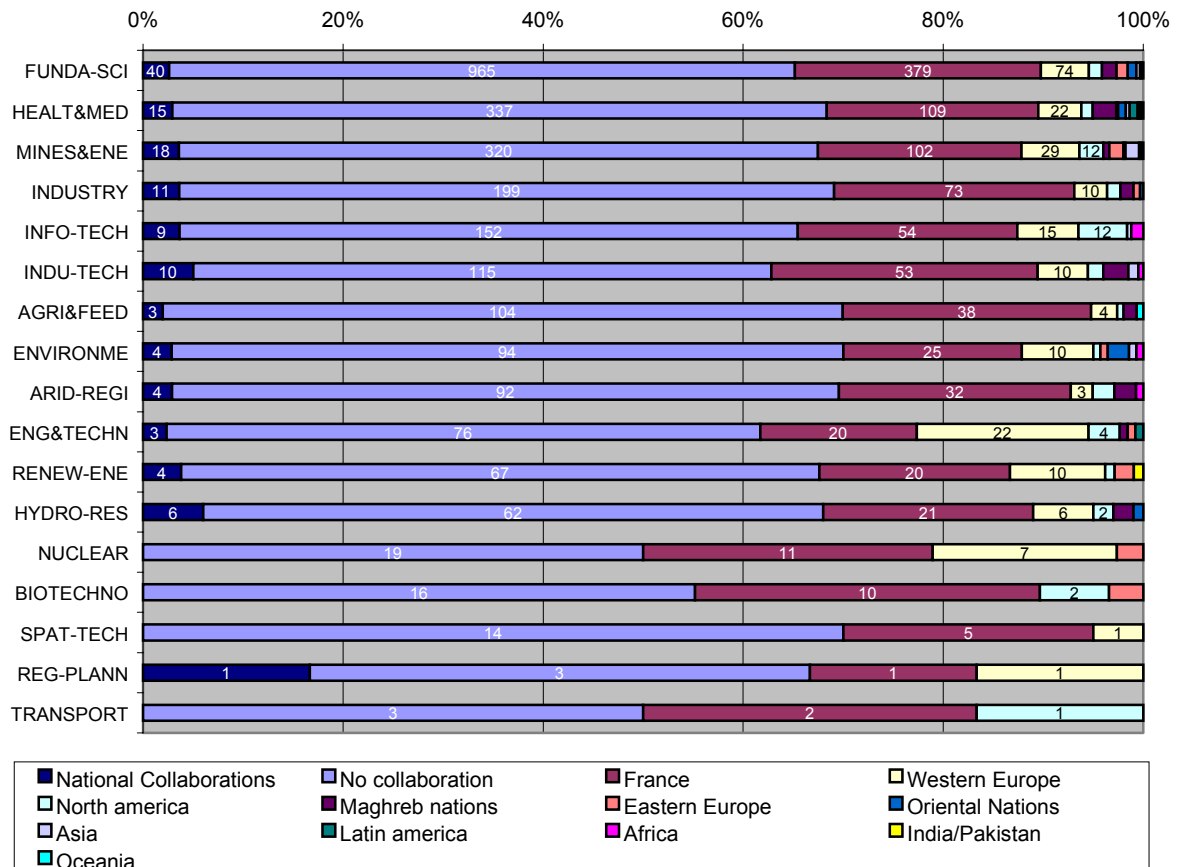


Figure 4: Scientific collaboration preferences for each research programs

Basic sciences is the one that counts the biggest part of scientific collaborations and tends to contribute in a large scale to the “mainstream sciences” with a high rate of scientific production (2006) from which 73 representing the first five years (1990-94) and 306 the five years left (95-99). It is emerging from international collaboration as single producer. It also counts 401 contributions in the first five years and 606 from 1995 to 1999)

As far as national collaboration is concerned, we observe a very small percentage (3%) of research works shared with two or several Algerian laboratories (none in Nuclear energy and techniques and Spatial technologies); this gap might reveal a lack of specialists in this areas of research, or of support for the national collaborations. It is a fact that the Algerian political speeches encourages the initiatives to create scientific teams and organize interesting national collaboration between research actors, the aim being the sharing of facilities, funds and results, but this theoretical measure has not enough concrete results on the scientific research practices.

As far as the scientific collaborations with the rest of the world is concerned, the presence of Western Europe countries in Algerian scientific research represent a little more than 5%, dealing with Nuclear Energy fields and Techniques, Engineering and Technologies, and North America with nearly 2% of publications on Information Technology; the Maghreb (count only 1% standing for Health and Medical Sciences, Industrial Technology, Arid region development and Hydrous resources); This small percentage Maghreb collaborations is a bit surprising since Tunisia and Morocco are situated geographically close to each other and consequently should be more involved into collaborations. Eastern Europe (nearly 1% being in Basic Sciences and Mines and energy) and finally, Oriental Nations (with about 0,5% standing for Basic Sciences, Health and Medical Sciences and Environment).

Actors involved in research programs (Figure 5, Figure 6)

The results the database show that Algiers dominates the whole research activities giving to this town a supremacy in all fields of sciences that are described in the national programs. This supremacy through the decade 1990-99 indicates a high number of scientific researchers working in different fields of the national program, in this town. This is not new in itself since most of the Algerian scientists over 50 years old had been students in Algiers University.

Centralization of algerian research activities in Algiers has as origin the situation of this town as a capital of algerian state, on the one hand, the scientific resources development in that single place on the other hand. Algiers was the first town to possess a university created under the french colonialism in 1902; Latter in 1962, with the independance, the algerian students, all over the country had to follow their higher studies in the capital where all scientific and human ressources existed (with high percentage of foreign lecturers). The centralization as whole has become a tradition and affects for a long time the rest of the country. Scientific ressources with research centers and institutes situated mainly around Algiers centralizing all subject fields in a single area.

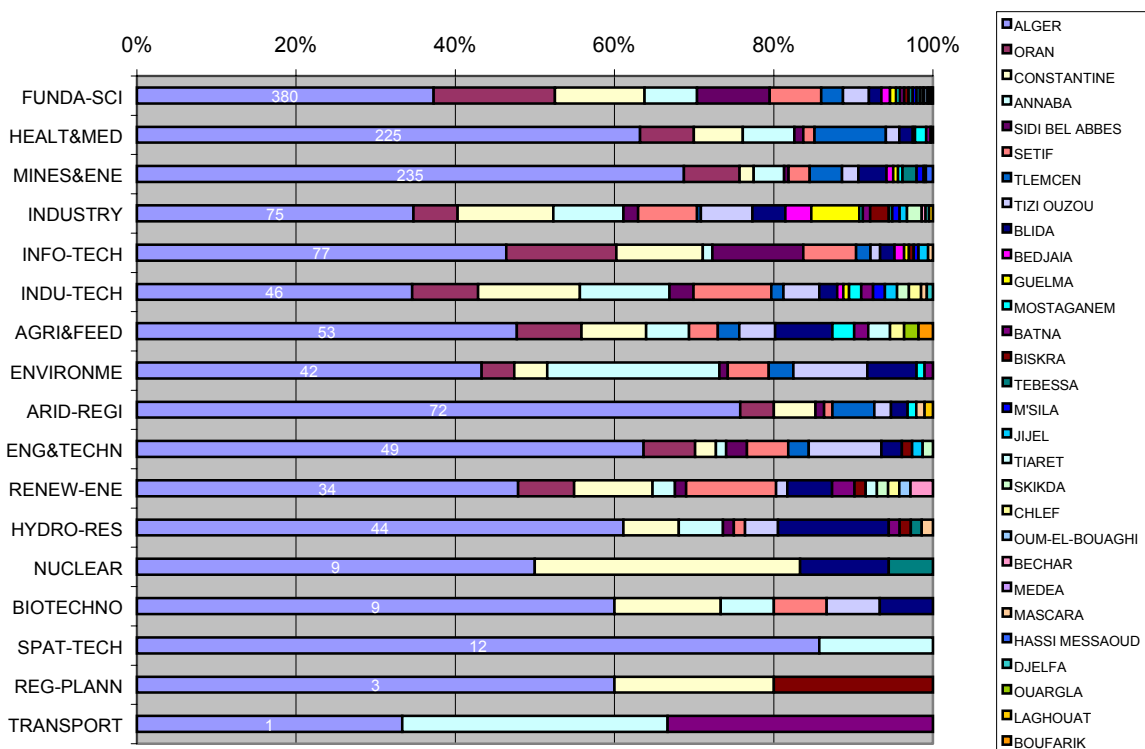


Figure 5: Algerian towns contribution for each research programs

The analysis of scientific potential of the Algerian towns (Figure 5) points out the supremacy of Algiers over the rest of the country (1366 scientific publications). The Algerian capital is taking part in all research programs with a high contributions on the first five ones, each of them having high contribution; to illustrate this statement, figure 5 shows that Algiers has contributed with 86% of publications in Spatial Technology fields, the following research areas on Arid zone development with about 76%, Mines and energy with nearly 68% of scientific publications and finally the last prolific field on Health and medical Sciences we register 63% of scientific publications. All percentages registered here and compared to rest of algerian towns show the importance and the role that Algiers plays as a central scientific pole. Algiers seems to possess the greatest part of scientific institutions and researchers in all fields. That is the reason why we have found a big difference in percentage between towns. ; the

percentage registered depend on the number of scientists involved in research activities, institutions and technological or multidisciplinary universities existing in the different towns. With 1970s reforms, scientific research and researchers were spread throughout the country to create other research centers and universities in order to develop scientific activities and potentialities. An important number of universities and scientists emerged from this reform and post graduation studies (created in 1986). Oran, being the second university after Algiers, contributes to 155 publications, less than Algiers, and is involved in almost all fields of science even if sometimes the percentage is weak.

Some research programs only concern a few number of towns as Spatial technologies (2 towns), Nuclear energy and techniques (4 towns), Health and medicine (11 towns), Environment (11 towns) and Arid zones development (11 towns). One can notice that some cities (excluding Algiers) take an important part in some fields: Annaba in Environmental sciences and Spatial technologies, Constantine in Nuclear energy and techniques, Blida in Hydrous resources, Oran and Sidi Bel Abbes in Information technologies.

As for **Figure 6**, the scientific and technological specialization for the top 25 Algerian institutes seem. It allows assessing the potential assigned to the research programs for each institute.

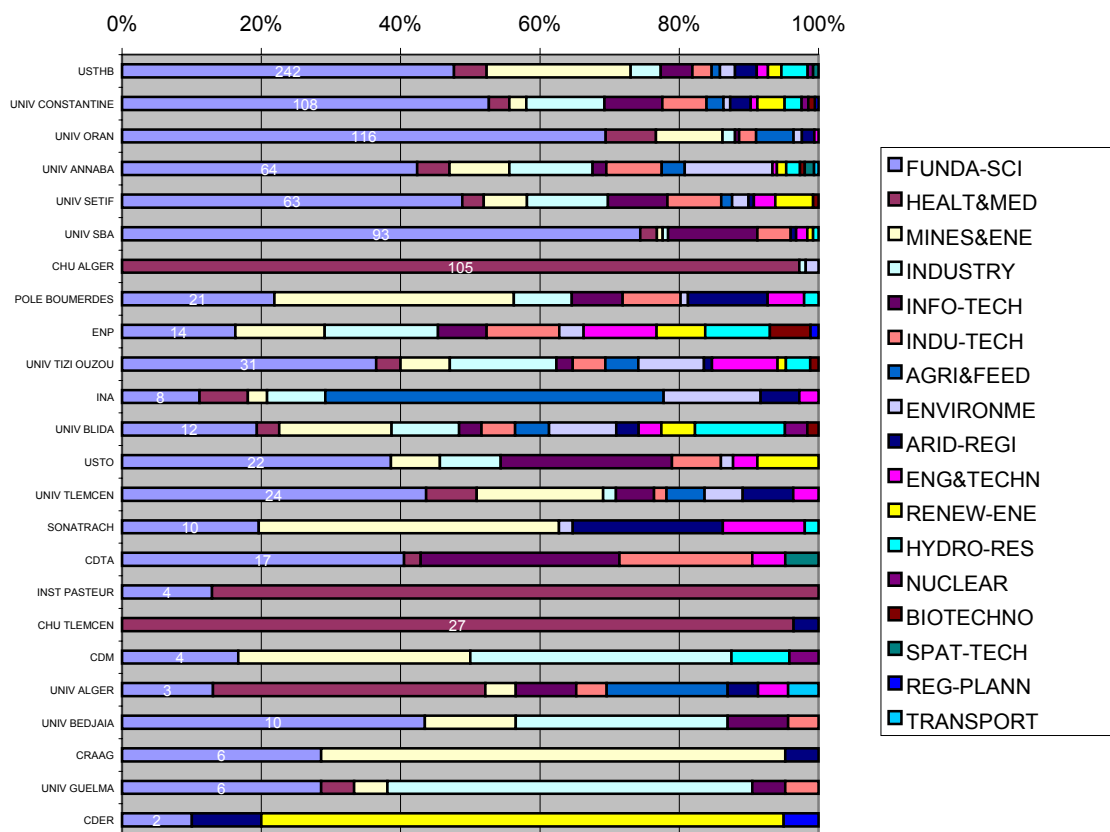


Figure 6: Scientific and technological specialization for the top 25 Algerian institutes

Results shown on technological specialization for the top Algerian institutes position USTHB as the prime technological institutions involved in research. This university dominates all other institutions with its diversity of field research, and the most important one is basic sciences with 242 contributions, followed by Oran and Constantine university with respectively 116 and 108 publications.

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Appendix A: Geographical regions by countries grouping

Geographical region	Countries belonging to Geographical region
AFRICA	BENIN, CAMEROON, GUINEA-BISSAU, MALI, NIGERIA, SENEGAL, SOUTH-AFRICA, TANZANIA, UGANDA, ZAMBIA
ASIA	CHINA, HONG KONG, HONG-KONG, INDONESIA, JAPAN, MALAYSIA, PEOPLES-R-CHINA, PHILIPPINES, SOUTH-KOREA, THAILAND
EASTERN EUROPE	BULGARIA, CROATIA, CZECHOSLOVAKIA, CZECH-REPUBLIC, HUNGARY, POLAND, ROMANIA, RUSSIA, SLOVAKIA, SLOVENIA, UKRAINE, USSR
FRANCE	FRANCE, MARTINIQUE, NEW-CALEDONIA
INDIA/PAKISTAN	INDIA, PAKISTAN
LATIN AMERICA	ARGENTINA, BOLIVIA, BRAZIL, CHILE, COLOMBIA, CUBA, JAMAICA, MEXICO, PANAMA, PARAGUAY, VENEZUELA
MAGHREB NATIONS	LIBYA, MOROCCO, TUNISIA
NORTH AMERICA	CANADA, USA
OCEANIA	AUSTRALIA, NEW-ZEALAND, ZEALAND
ORIENTAL NATIONS	ARABIA, EGYPT, EMIRATES, IRAN, ISRAEL, JORDAN, LEBANON, OMAN, SAUDI-ARABIA, SYRIA, YEMEN
WESTERN EUROPE	AUSTRIA, BELGIUM, CYPRUS, DENMARK, ENGLAND, FED-REP-GER, FINLAND, GERMANY, GREECE, ICELAND, IRELAND, ITALY, NETHERLANDS, NORTH-IRELAND, NORWAY, PORTUGAL, SCOTLAND, SPAIN, SWEDEN, SWITZERLAND, TURKEY, UK, WALES

Appendix B: the Algerian research programs

The 17 retained national research programs	
Subject	Code
Agriculture and feeding	AGRI&FEED
Arid region development	ARID-REGI
Biotechnologies	BIOTECHNO
Environment	ENVIRONME
Fundamental sciences	FUNDA-SCI
Health and medicine	HEALT&MED
Hydrous resources	HYDRO-RES
Industrial technologies	INDU-TECH
Industry	INDUSTRY
Information technologies	INFO-TECH
Mines and energy	MINES&ENE
Nuclear energy and techniques	NUCLEAR
Regional planning	REG-PLANN
Renewable energy	RENEW-ENE
Spatial technologies	SPAT-TECH
Transport	TRANSPORT
New created subject	
Engineering and technologies	ENG&TECHN

The remaining national research programs
Housing
Education and formation
Youth and sport
National language
Translation
Culture
Economy
History, prehistory and archeology
Right and justice
Population and society
Social sciences
Communication
Linguistics