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# Investigating the background using scientometric methods in Medical Education: French doctoral theses from the 19th century.

# Investigando cienciométricamente los antecedentes en Educación Médica: Tesis doctorales francesas del siglo XIX.

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**Summary.**

**Introduction.** This study presents a scientometric and historiographical review of doctoral dissertations on medical education defended at French universities throughout the 19th century, seeking to trace the origins of this multidisciplinary field. **Method**. A quantitative (scientometric) revisional study with purposive sampling was conducted. Twenty-eight bibliographic records of these dissertations were retrieved *ad hoc* from the French databases SUDOC (*Système Universitaire de DOCumentation*) and *bnf* (*Bibliothèque Nationale de France*). **Results.** Scientometric patterns are presented regarding: longitudinal production as a 6th-order polynomial function; institutional productivity, with five French universities, of which Paris is the most productive; and production by gender, with three dissertations defended by women (11% of the total). The diversity of thematic areas inferred confirms the multidisciplinary nature of medical education from its origins, which can be dichotomized into medical and non-medical disciplines. The textual analysis reveals the plurality of terms inferred from the titles, resulting in a final network analysis comprised of a central cluster of 25 theses and three peripheral ones. **Discussion.** It can be stated that the French production of doctoral theses during the 19th century is abundant, varied, and exhibits evident scientometric patterns, which denotes the relevance of French medical education as the historical vanguard of research in this multidisciplinary field.

**Keywords:** Medical education, doctoral theses, France, 19th century, scientometric review

**Resumen.**

**Introducción.** Este estudio realiza una revisión cienciométrica e historiográfica de las tesis doctorales sobre educación médica defendidas en las universidades francesas a lo largo del siglo XIX a la búsqueda de los antecedentes de este campo multidisciplinar. **Método**. Estudio revisional cuantitativo (cienciométrico) con muestreo intencional. Se recuperan *ad hoc* 28 fichas bibliográficas de dichas tesis extraídas de las bases francesas SUDOC (*Système Universitaire de DOCumentation*) y *bnf* (*Bibliothèque Nationale de France*). **Resultados.** Se ofrecen patrones cienciométricos relativos a: la producción longitudinal como una función polinómica de 6º orden; productividad institucional con cinco universidades francesas de las que París es la más productiva y producción según género con tres tesis defendidas por mujeres (11% del total). La diversidad de áreas temáticas inferidas confirma el carácter multidisciplinar desde sus orígenes de la educación médica, dicotomizable en disciplinas

médicas y no médicas. El análisis textual expone la pluralidad de los términos inferidos de los títulos para configurar un análisis de red final constituida por un conglomerado central de 25 tesis y tres periféricas. **Discusión**. Se puede afirmar que la producción francesa de tesis doctorales durante el siglo XIX es abundante, variada y con patrones cienciométricos evidenciados, lo cual denota la relevancia de la educación médica francesa como la vanguardia histórica investigadora de esta multidisciplina.

**Palabras clave:** Educación médica, tesis doctorales, Francia, Siglo XIX, revisión cienciométrica

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## 1. Introduction

Investigating the origins of a medical discipline is a pressing need for its scientific consolidation. Aristotle (1) tried to explain the origin of things through his Theory of the Four Causes, which postulates the existence of four non-mutually exclusive types of causes: the material cause (what a thing is made of), the formal cause (its essence or model), the efficient cause (the agent that produces it), and the final cause (its purpose or aim); such that we believe we have science when we know the causes.

### *1.1. The doctoral thesis as a key document in medical education*

The doctoral thesis has been shaped over the centuries since the medieval university, following the *modus parisiensis,* which was later adopted by the Society of Jesus (2). Understanding the agents who embody it (author, supervisor, and evaluators), institutions, and topics allows us to generate knowledge (science) about the original foundations of medical education according to the Aristotelian conception.

Medical education has a notable tradition of doctoral dissertations as the culmination of teaching and research training. This has been the case since pioneering dissertations in various countries, such as Horsch's German dissertation (3) of 1807, on the training of physicians as clinicians and civil servants, or Gordon Laing's British dissertation (4) of 1886, on preliminary medical education; both have been discussed as documentary case studies (3-4). This type of documentary study of a specific doctoral dissertation, whether due to its age, originality, or impact, is common practice in medicine; for example, Donkin's British dissertation (5) of 1849 in Anesthesiology on the use of chloroform, or Lawson's dissertation (6) of 1886 in Emergency Medicine on medical emergencies, unconsciousness, and sudden death.

### *1.2. France and academic medical education: Contextualizing the study*

Medical education was quickly explored by French culture and science; in fact, it is safe to say that France was the pioneering nation in considering this topic, generating various products, including doctoral theses. The seminal antecedent could well be the esoteric book[1] *The compendium and brief teaching of physiognomy and chiromancy,* written by Bartolomeo Della Rocca (7) in 1539, aimed to teach through physiognomic descriptions, drawn anatomically, and not just palmistry; although physiognomy and palmistry are now considered pseudosciences. By 1731, a thesis (8) defended at the University of Montpellier, an institution *that was a counterpoint to the Parisian university and a bastion of medicine, not only in France but also in the Mediterranean,* can be found. This thesis by Octave Delicata is the first we have record of that largely considers the need to advance medical education to consistently generate and refine medical theory. This thesis was written in Latin, as was customary until well into the 18th and early 19th centuries, until the shift to writing in the national languages of

[1]This book of Delicata (8) features illustrations, drawings and engravings that in the 16th century represented a great achievement of difficult and expensive production.

each country occurred. A more in-depth study of it would be worthwhile, as it is available on Google Play. In Paris in 1780, the physician Louis Desbois de Rochefort began teaching clinical classes at the *Charité hospital,* which closed in 1935 and should not be confused with its namesake in Berlin, which is still operating. The superiority this hospital acquired thanks to the novelty of the teaching methods employed there explains why, when the revolutionary National Convention created the schools of health in 1794, this hospital was chosen to establish the first school of clinical medicine (9).

Of particular note is the book by physician Joseph-Ignace Guillotin (10) entitled * *Observations sur le projet d'instruction publique et sur le projet de décret concernant l'enseignement et l'exercice de l'art de guérir**, published in 1791. This report by the ill-fated Guillotin, the eponymous creator of the guillotine, was submitted to the French Revolutionary Assembly as a contribution from the Third Estate [2]. In it, he proposed a reform of the teaching and practice of medicine (the art of healing), and was also an ardent advocate of the smallpox vaccine. By the 19th century, French scholarship on medical education was abundant; see Keel (11), where a list of book titles can be found in the bibliography. Even Pinell's sociological work (12) on the genesis of the field of medicine in France from 1795 to 1970 considers the academic subfield among the various disciplines or specialties it cites, and includes it in what were called auxiliary sciences ( *sciences accessoires* ) to medicine. Also noteworthy are the reports contained in the yearbooks and memoirs of French medical societies; some specifically focused on medical education (13-14). The current state of medical education in France, both initial training in medical schools and continuing *post-service training for practicing professionals,* is a delicate and pressing issue. The report *of the Academie Nationale de Medecine* prepared by commission XV (teaching, research and training) and coordinated by Deugnier and Vuitton (15) suffers, among other characterizations, from the fact that medical education in France is a fragmented training, without a global vision, with insufficient supervision of theses and dissertations, where investment in research activities and publications is insufficient, and a general elitist and truncated perception of research by students.

### *1.3. Study Objectives*

There are no specific studies on French doctoral dissertations in medical education defended during the 19th century, although there are studies on 19th-century French dissertations in Literature (16-17), on French medical dissertations (18) defended between 1993 and 1998, or on the evaluation of doctoral dissertations in Medicine defended at specific universities, such as Angers (19), Lille (20), or Brest (21). This study aims to analyze the production of French dissertations in medical education defended during the 19th century in search of scientometric patterns that allow for the comparison of medical education in its origins with other sciences; for it is quite obvious that knowing where one started makes it likely to know where one is headed. Although the article addresses a relatively unexplored topic, it investigates medical education in 19th-century France from a historical and scientometric perspective, thus connecting it to the scientific consolidation of the field. Perhaps the audience interest is somewhat limited, but the etymological multidisciplinarity of medical education is highlighted, which may be relevant to Spanish-speaking and global audiences.

### *1.4. Theoretical and conceptual framework*

The theoretical and conceptual framework underpinning this study is scientometrics, understood as the quantitative analysis of scientific products, agents, and institutions; in this case, doctoral dissertations. Scientometrics should not be confused with bibliometrics, as the latter only considers written products, primarily scientific articles, and is therefore a subfield of scientometrics. The purpose of scientometric studies is to investigate the diachronic evolution of a scientific discipline, its agents (in this case, dissertation authors, supervisors, and evaluators), institutions

[2] The Third Estate (le *Tiers État* ) in revolutionary France represented the common people, 96% of the population, unlike the nobility and the clergy, the first and second estates respectively.

(primarily universities), research topics, thematic areas, and the various impacts of the research (mainly citations). Since historical and publicly available data over 120 years old are used, ethical review is not required, as the work involves century-old documents to which copyright does not *apply.*

## 2. Methods

The methodology of this study is scientometric, the quantitative measurement of science, through the quantification of indicators that have been progressively generated over time; in this study, indicators related to doctoral theses in medical education. Scientometric studies have been conducted in Medical Education for some time now: to investigate the thematic structure and conceptual dynamics of research (22), in the mapping and analysis of medical scientific networks (23), in gamified learning (24), or in the use of portfolios (25). However, it can also be considered a documentary historiographical review since it works with doctoral theses that are more than 120 years old.

### *2.1. Design*

The design used is primarily quantitative, revisional, and descriptive, seeking to quantify a past reality (19th-century French theses on medical education); therefore, it is also retrospective. Given that it works with documentary theses (written documents), it could also be classified as documentary analysis.

### *2.2. Operant sample*

The working sample consists of 28 doctoral theses extracted from the French databases SUDOC ( *Système Universitaire de DOCumentation* ) and *bnf* ( *Bibliothèque Nationale de France* ) using purposive sampling; evidently, not probabilistic. To this end, an advanced search was conducted in these French databases, SUDOC and *bnf,* using a broad search sequence in the *"Mots du titre* " (Title Words) field with the terms: ( *thèse et medic** ) and filtered *by "année de publication* " (publication year): 1800-1900. The search yielded 380 medical thesis titles symbolized by the doctoral cap (  ). Subsequently, the search was refined by scrutinizing each doctoral record retrieved through visual inspection by two experts to verify its relevance as a medical-educational thesis (content validity), and by eliminating the remaining theses, until a working sample of 28 theses was formed by consensus between these two experts. All of them are written in French. Such a quantity would only allow for comparison with that of other countries. Searching the CISNE-UCM database, Spain has only one thesis (26-27) in which the descriptors educat* and medic* appear. However, it is worth highlighting the remarkable production of more than 50 Spanish theses throughout the 19th century with two terms very specific to medicine: health and hygiene, associated with educac*; and which deserve future study.

Another possible advance of this study would be to carry out a comparative analysis, as an exercise in comparative medical education, between the production of countries and of which Germany has a notable precedent of pioneering thesis (3, 28).

A search in the *Bibliothèque Nationale* de France ( *bnf)* yielded more titles matching the previous search criteria, 695, for " *Thèses et écrits académiques" (Theses and Academic Writings* ). However, after visual inspection, theses from other medical disciplines and academic writings—primarily books that were not initially theses—had to be excluded. Nevertheless, the *bnf database* was used for cross-validation of the sample using titles extracted from SUDOC.

*2.3. Data analysis techniques*

After a thorough inspection of the recovered records, the available data was migrated to a personal Excel spreadsheet, which was then subjected to quantitative analysis using numerical descriptive statistics and graphs. Time series analysis was also performed to identify a plausible pattern of temporal development, along with textual analysis of terms or descriptors using word clouds and network analysis. Various software packages were used for data analysis, including *XLSTAT*. Excel for statistical calculations, *Statistics Kingdom* for determining confidence intervals, *TagCrowd software* for word clouds, and *Code Interpreter* from ChatGPT Artificial Intelligence for network analysis.

## 3. Results

*3.1. Diachronic Production*

The diachronic analysis of the production of 28 French doctoral theses in medical education throughout the 19th century is shown in Figure 1. The line of best fit is that of a 6th-order polynomial equation with a correlation coefficient of determination given by $R^2 = 0.91$ ($p < 0.001$), which is statistically significant, with a 95% confidence interval of [0.66, 0.98], even for such a low number of degrees of freedom (9) given by a sample size of ten decades. This correlation rejects a null hypothesis that excludes the trend from being a consequence of "white noise" in the time series, or a mere product of chance, but rather a clear pattern. Two peaks are denoted in the graph corresponding to the decade 1830–1839 (5 theses; and four of them in 1831) and the last decade (11 theses). It can be stated that the graph offers an explanatory pattern, as observed in the overlap of the linear diagram with its fitted trend line. Following Price's (29) arguments, until 1870 thesis production followed an almost constant, monotonous trend. From that year onward, according to Price, a plausible period of exponential growth began, which would need to be verified by continuing this study to include production after 1900. This would then be another advance of this study.

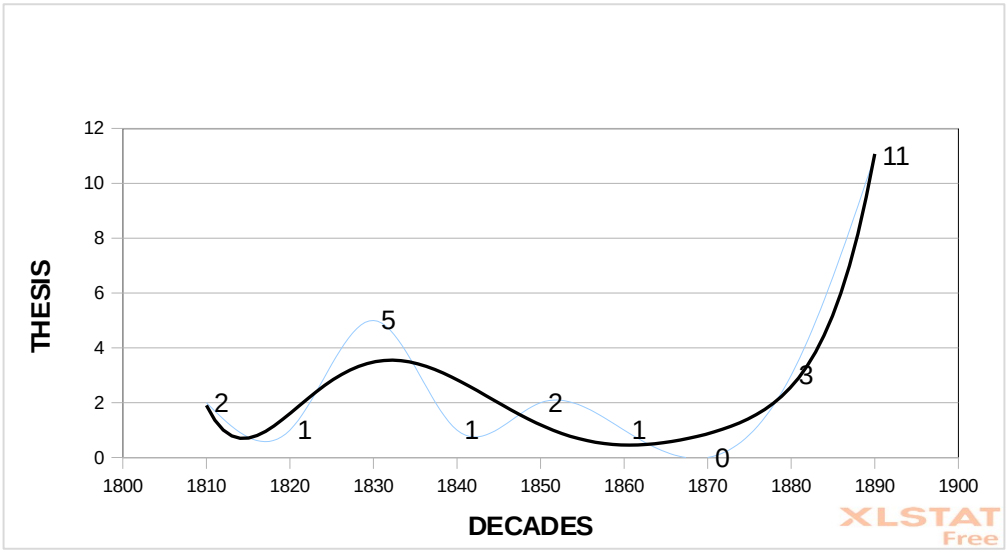



**Figure 1.** Linear diagram (blue) and best fit line (black) of French doctoral thesis production in medical education (1800-1900). Function equation: $f(x) = 0.0000001 \cdot x^6 - 0.000058 \cdot x^5 + 0.266 \cdot x^4 - 657.16 \cdot x^3 + 912019.89 \cdot x^2 - 675020906.47 \cdot x + 208162576442.12$; $R^2 = 0.913$.

*3.2. Institutional production: Universities*

Despite the traditional French academic centralism, with the Sorbonne in Paris as the main university center, doctoral theses in medical education were also defended at other universities; namely: Bordeaux with 5 theses, Montpellier with 4, and Lille and Toulouse, both with 1 thesis, compared to the 17 (60.7%) theses defended in Paris (Figure 2). Chronologically, Paris and Montpellier were the classic universities, where thesis production began earliest, while the other three started their production from the end of the 19th century onwards. In all cases, the theses were defended in five medical faculties, a far cry from the 36 French universities at the end of the 20th century where doctoral theses in medicine were defended (18).

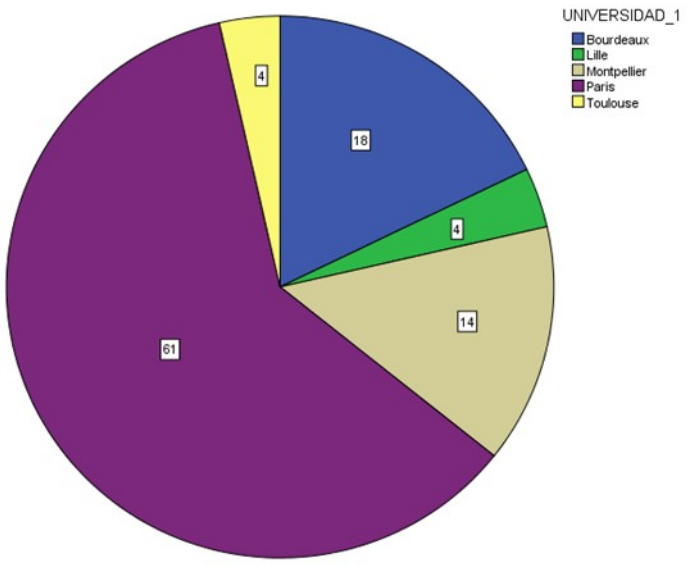



**Figure 2.** Percentage values of French doctoral thesis production by university.

*3.3. Gender of the authors*

The gender of the doctoral dissertations can be discerned based on the authors' given names, some with up to three letters and others with only the initial letter. In the latter case, parallel searches are necessary for identification, which also serves as a cross-validation function. Three female authors have been identified. Felicie Stodel, who used the name Georges, like the writer Georges Sand [3], as a form of gender-bending that French society had already accepted in the writer, wrote a dissertation on the need to teach girls basic hygiene and practical medicine; see reference 40 for the chronological list of doctoral dissertations considered. Caroline Schultze, with a thesis on the female physician, and Georgette Françoise Déga, with a thesis on the preventive cure of female hysteria through education, propose an educational therapy for hysteria quite distinct from Breuer's physiological etiology or Freud's psychological etiology (30), both contemporaries of Dr. Déga. A possible interpretation of the writings of these two Austrian physicians could be explored to determine if they influenced this thesis. The quantitative data regarding the authors' gender shows that 25 theses (89%) were written by men and 3 theses (11%) by women. This unequal proportion reveals a clear bias against women, but caution is needed to avoid falling into presentism when interpreting the past through the lens of the present. Three female PhDs represent a remarkable number, unthinkable in other disciplines and specialties. Spain can only count on three female doctors throughout the entire 19th century (31) and for the entire broad field of Medicine.

[3] The pseudonym Georges Sand was adopted by the French writer whose legal name was Aurore Dupin.

*3.4. Related subject areas*

The retrieved theses are all clearly from the field of Medical Education, but they can also be applied to other related subject areas; this distinction provides evidence of the genesis of medical education as a multidisciplinary field. Twenty-one related subject areas were identified (Table 1), most of them concerning the teaching of other medical disciplines or specialties (Hygiene, Pediatrics, Psychiatry, Physiology, Hepatology, and others), but also including non-medical disciplines (Women's Education, History, Physical Education, Philosophy, and others).

**Table 1.** Relationship of thematic areas related to Medical Education in nineteenth-century French doctoral theses.

| Related subject area | Frequency | Percentage |
|---|---|---|
| Women's Education | 3 | 7.1 |
| Hygiene | 3 | 7.1 |
| History of Medicine | 3 | 7.1 |
| Pediatrics | 3 | 7.1 |
| Psychiatry | 3 | 7.1 |
| Physical education | 2 | 4.8 |
| Philosophy | 2 | 4.8 |
| Physiology | 2 | 4.8 |
| Hepatology | 2 | 4.8 |
| Anatomy | 1 | 2.4 |
| Surgery | 1 | 2.4 |
| Practical Surgery | 1 | 2.4 |
| Dermatology | 1 | 2.4 |
| General Education | 1 | 2.4 |
| Early Childhood Education | 1 | 2.4 |
| Statistics | 1 | 2.4 |
| Physics | 1 | 2.4 |
| Vocational Training | 1 | 2.4 |
| Gynecology | 1 | 2.4 |
| Clinical Medicine | 1 | 2.4 |
| Preventive medicine | 1 | 2.4 |
| Comparative Medicine | 1 | 2.4 |
| Elementary Medicine | 1 | 2.4 |
| Internal medicine | 1 | 2.4 |
| Obstetrics | 1 | 2.4 |
| Clinical Pathology | 1 | 2.4 |
| Public health | 1 | 2.4 |
| Vet | 1 | 2.4 |
| **Total** | **42** | **100** |

The ratio of medical to non-medical subject areas is 25:17 (59.5% versus 40.5%), which implies the dual foundation of medical education since its origins as a multidisciplinary field in which various disciplines or specialties, categorized as strictly medical and non-medical, converge, corroborating similar current findings (32-33). Examining related subject areas reveals the absence of non-medical disciplines, such as sociology, anthropology, and psychology, which are currently prevalent in the field of medical education (34-35).

### *3.5. Terminological analysis of descriptors*

Based on the words contained in the titles of each thesis, a terminological analysis was performed on the 57 terms inferred two or more times from the titles of 19th-century French theses on medical education, the quantification of which is given in Table 2. Note that the most frequent terms are "teaching" (in 12 theses) and the root "Medic*" (with 10 theses), which includes "Medicine," "physician/s," and "medicinal." A word cloud created using TagCrowd software on the terms in Table 2 allows them to be grouped into four categories or thematic dimensions (Table 3):

-The formative dimension that would include the terms: teaching, students, knowledge, faculty and reflections.

-The methodological dimension comprised of the terms: essay, study, Statistics, method, procedures and science.

-The disciplinary dimension constituted by the terms: Medic*, Anatomy, Surgery, Hygiene and Psychiatry.

-The therapeutic dimension would include the terms: abscesses, hysteria, anti-alcoholism, hospice and clinic.

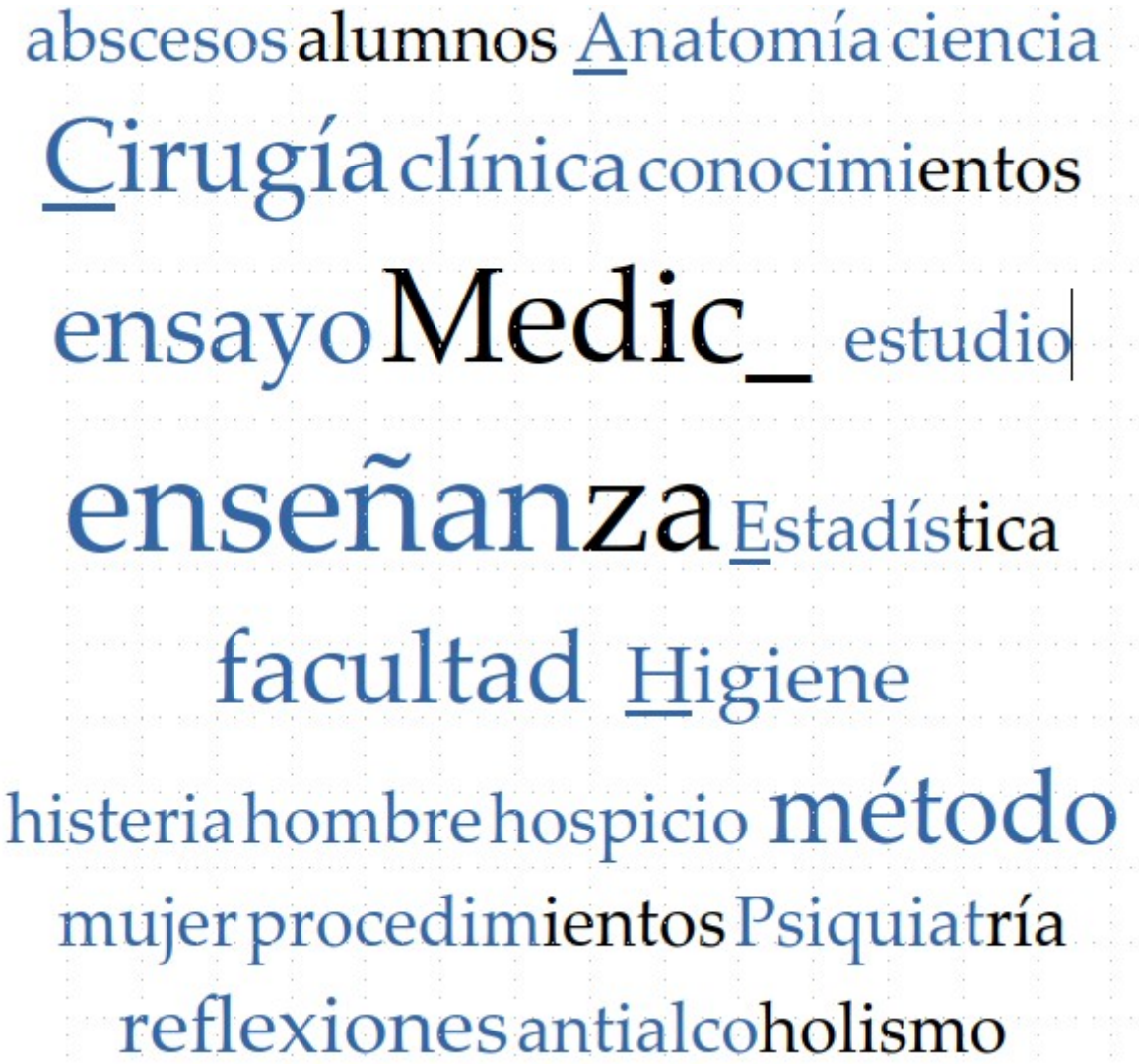
The terms man and woman cannot be assigned to any category.

**Table 2.** Relationship of the 25 inferred terms.

| Term | Frequency |
|---|---|
| teaching | 12 |
| Medic* | 10 |
| Surgery | 4 |
| rehearsal | 4 |
| faculty | 4 |
| method | 4 |
| clinic | 3 |
| Hygiene | 3 |
| reflections | 3 |
| abscesses | 2 |
| students | 2 |
| Anatomy | 2 |
| antialcoholism | 2 |
| science | 2 |
| knowledge | 2 |
| Statistics | 2 |
| study | 2 |
| until 1841 | 2 |
| hysteria | 2 |
| man | 2 |

| | |
|---|---|
| hospice | 2 |
| women | 2 |
| procedure | 2 |
| Psychiatry | 2 |

**Table 3.** Word cloud with descriptors inferred from doctoral thesis titles.




From this terminological analysis, it can be deduced that, based on its doctoral theses, early Medical Education was already a fertile and diversified field of research with a remarkable thematic richness made up of four major categories: formative, disciplinary, methodological, and therapeutic.

*3.6. Analysis of the thesis network according to descriptors*

Based on the available descriptors for all theses, a co-occurrence network analysis was performed using ChatGPT and its *Code Interpreter plugin.* This plugin utilizes the TF-IDF (termination frequency-inverse document frequency) metric, generated by the *prompt* : "Perform a thesis network analysis based on the given descriptors for each thesis, labeling the nodes with the doctor's last name." The AI provides us with Figure 3.

The network structure reveals a cluster of 25 theses with a central, massive commonality, centered around a core theme dominated by the descriptors *teach*, *medic*, *educac*, and *metod*. High connectivity exists among the theses within this core commonality, comparable to a principal component of factor analysis, as they share enough high-level common descriptors to be linked by the TF-IDF measure, which weights the frequency of the descriptors. All these core theses address "how" medical science should be taught. The significance of this commonality confirms that the primary context of the theses is the teaching of medicine and its associated methodologies, which serve as a common ground for almost the entire sample. Within this commonality, the central node of the oldest thesis (Dagorne, 1806) on the teaching of anatomy stands out, with ten connections (edges) to other theses; a perennial topic and possibly the most fundamental in medical education. This thesis by André M. Dagorne is contemporaneous with that of the German Philip J. Horsch (1772-1820) defended at the University of Würzburg in 1807 (3); both can be considered the pioneers of European medical education.

The network shows a central group around Dagorne, Velpeau-Cloquet, and Legrand, in which these three doctors may have had some relationship, either working in close collaboration, sharing mentors, or being in the same academic circles or institutions, such as university hospitals; this seems evident between the latter two, who carried out their theses in Paris and defended them in the same year, 1831. The figure of Dagorne appears more remote, having done his thesis in Montpellier and defended it in 1806.

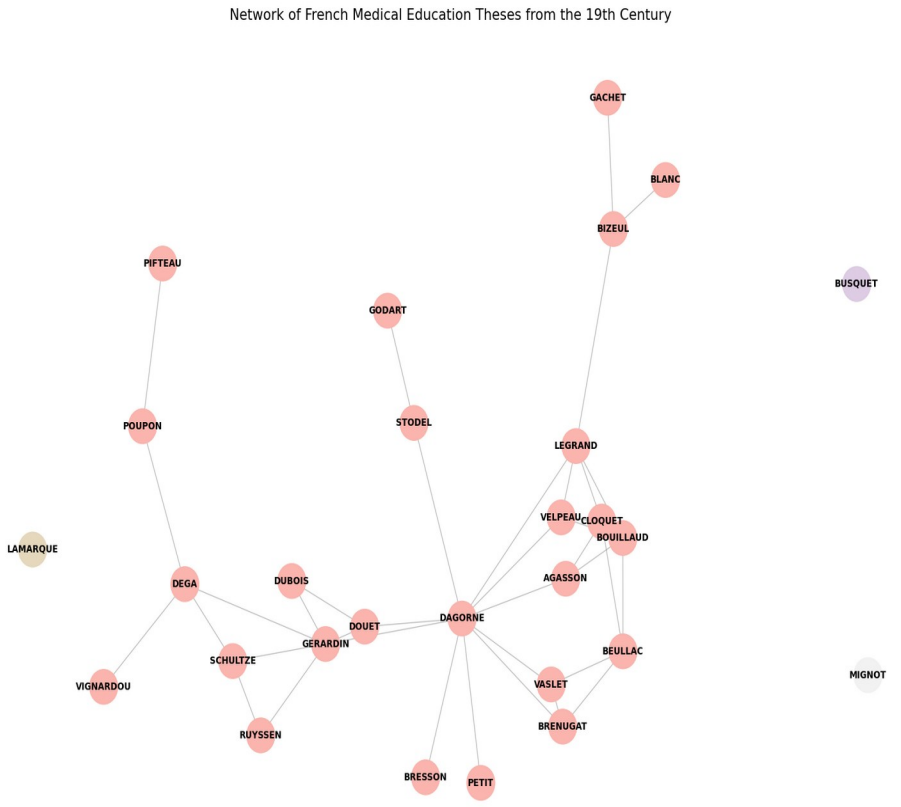



**Figure 3.** Network of French doctoral theses in medical education defended in the 19th century.

On the other hand, three isolated theses are denoted by weak connections and a lack of terminological relationship between them. These theses refer to highly specialized clinical areas such as dermatology (Busquet, 1881), surgical statistics (Lamarque, 1889), and neonatology (Mignot, 1851). Busquet's thesis (1881) focuses primarily on a single condition (dermatosis) and a specific technique (occlusion treatment). It does not use the general teaching language necessary to link it to the central

commonality. Lamarque's thesis is a statistical study on surgery in a specific hospital, its primary link being contextual/historical data without any connection to the other doctors. Mignot's study delves into a very specific medical area: neonatal pathology. These three theses focus on highly specialized topics that lack the necessary descriptors to connect with the core.

The network primarily reveals the duality between Paris (central cluster), with high academic influence and abundant relationships/edges, and Montpellier-other universities (peripheral/isolated nodes) with few or no relationships/edges.

In conclusion, it can be stated that this network structure accurately reflects a seminal collection of research focused on a general theme (Medical Education), three peripheral theses to be considered as studies in specialties, which represent the thematic boundaries or specialized applications distanced from the central commonality.

In summary: there is a core group of theses addressing the theory and practice of medical education, and peripheral theses dealing with specific medical topics that do not overlap sufficiently with the core themes to be considered interconnected. The network illustrates the structure of French medical education in the 19th century, revealing patterns of influence and collaboration. From its origins and through its doctoral theses, Medical Education is established as a central macro-discipline surrounded by more specific medical disciplines; hence, further evidence of the multidisciplinary nature of Medical Education.

### *3.7. Formal Analysis*

The theses examined here were all previously published as books for presentation in defense. The manuscript format of the thesis was not acceptable in nineteenth-century French theses, as it was in Spain, where, for example, Ramón y Cajal's thesis (36) of 1877 was handwritten.

French thesis books typically share two editorial characteristics that vary in their formal structure: format and number of pages. Thirteen theses were quarto in format and two were octavo; the remaining editions ranged from 24 to 30 centimeters. Eighteen different publishers (printing houses) are recorded, notably the Parisian Didot family, which published five titles.

The correlation between the age of the thesis and the number of pages in each thesis yielded a Spearman's *rho value of* $\varrho = 0.497$ with statistical significance ($p = 0.007$). For a sample size of $N = 28$, a 95% confidence interval of [0.15, 0.73] was determined, thus rejecting the null hypothesis. The underlying pattern inferred is that the number of pages in theses has increased over the years, suggesting that the research conducted has grown in both the quantity and, consequently, possibly in quality.

## 4. Discussion

The scientometric analysis of 19th-century doctoral theses provides a remarkable insight into French medical education, based on 28 retrieved theses—a number that aligns with the longitudinal mathematical model of a sixth-degree polynomial function. Although scientometric studies typically use large samples to apply the law of large numbers, this study, even with a small sample size [4](N=28), allows for statistically acceptable scientometric inferences. These include the diversity of thematic areas and terminology, indicators of diachronic, institutional, and gender-based productivity among the thesis authors. Of particular note is the compact nature of a general

[4]In statistics, a sample with fewer than thirty units of analysis/cases is considered small. This small sample size led William Gosset to develop the Student's t-statistic.

multidisciplinary field, as well as other commonalities defined by medical specialties, which appear as isolated cases (islands).

Contrasting this study with similar studies in other countries or with current trends, we have located specific literature on the subject in medical education, specifically the meta-analysis or tertiary study (37) that integrates 963 syntheses of knowledge in Medical Education published from 1999 to 2019 as articles in scientific journals. In comparison with this study of 28 nineteenth-century French theses, the small sample size of the latter is quite obvious compared to the international study (37). However, both studies share two findings: the pattern of growth and the diversity of thematic areas.

*4.2. Study progress*

The study of the series of French theses could be further developed by expanding it to include subsequent years, from 1900 to the present, and by country. In addition, in-depth analyses of specific theses could be conducted as documentary case studies that highlight or at least comment on the findings of each. Within the French context, there is the possibility of compiling other documents that address Medical Education. Specifically, it would be necessary to investigate the competitive theses [5], a format similar to Spanish teaching projects for accessing and advancing to university positions, which were written as a preliminary step to obtaining a professorship *in* a university subject. These theses can be located by linking to the SUDOC database using the search term: *Thèse de concours.* This link provides titles of these competitive theses and books, although the search would need to be refined to retrieve only those related to medical education. This could be another avenue for expanding this study.

Another broad field of study would be to conduct revisionary studies not only on the training of physicians, but also on the medical education of the general public. Here, French research has been more than abundant, even reaching a somewhat excessive optimism such as proposing the cure of tuberculosis through education or hygiene (38). Along these lines, a further step is proposed: to synthesize bibliometric studies in Medical Education, that is, to conduct a tertiary study like the one carried out by Fernández-Guerrero et al. (39) on doctoral theses on scientific-medical information in Spain. Therefore, it is advisable to present the reviewed theses in each study, citing their bibliographic references (40) as justification for the sample used and as raw material for future studies.

Another possible development of this study would be to conduct a comparative analysis, as an exercise in comparative medical education, between the output of different countries, for which Germany has a notable precedent of pioneering theses (3, 28). The possibilities for advancing this study are encouraging; thus, one reviewer proposes conducting a similar study for Spanish works and carrying out a historical-comparative study of European systems specifically focused on Medical Education in order to avoid biased interpretations.

Finally, and although already mentioned, the 19th-century Spanish theories on the thematic triangle of education, hygiene, and health deserve special consideration. Historical studies supported by comparative and scientometric methodologies can be of considerable help in understanding and improving contemporary practice and knowledge in medical education.

## 5. Conclusions

- Investigating pioneering doctoral theses allows us to understand a medical field or discipline from its origins, providing scientometric patterns accepted by the scientific community.

[5] The competition theses have some relation to the current Spanish university promotion and evaluation as a teaching project, although each university has discretion to impose it in the competitive examination.

- This study raises an optimistic view of French medical education, possibly the most fruitful nation in defending theses of Medical Education throughout the 19th century; in the absence of an in-depth and extensive international comparative study that strengthens the validity of such a hypothesis, accepted here for now.

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