UNIVERSIDAD DE CÓRDOBA

Departmento de Matemáticas

PhD THESIS

Producción científica en educación relacionada con la legislación y la administración: un análisis cienciométrico.

Scientific production in education related to legislation and administration: a scientometric analysis.

Doctoranda:

Syrmoula Tzima

Directores:

Alexander Maz Machado

David Gutiérrez Rubio

Programa de Doctorado Ciencias Sociales y Jurídicas

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TITULO: *Scientific production in education related to legislation and administration: a scientometric analysis*

AUTOR: *Syrmoula Tzima*

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Campus de Rabanales
Ctra. Nacional IV, Km. 396 A
14071 Córdoba

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DOCTORANDO/A: Syrmoula Tzima

INFORME RAZONADO DEL/DE LOS DIRECTOR/ES DE LA TESIS
(se hará mención a la evolución y desarrollo de la tesis, así como a trabajos y publicaciones derivados de la misma).

Los Dres. D. Alexander Maz Machado y D. David Gutiérrez Rubio, profesores de la Universidad de Córdoba,

INFORMAN:
Que la tesis doctoral "Producción científica en educación relacionada con la legislación y la administración: un análisis cienciométrico/ Scientific production in education related to legislation and administration: a scientometric analysis de la que sautora Dª. Syrmoula Tzima ha sido realizada bajo nuestra direccióny ha seguido las directrices metodológicas pertinentes para dar respuesta al problema planteado.

La autora ha realizado una amplia revisión bibliográfica que sumado a unas estrategias metodológicas adecuadas y de carácter bibliométrico han permitido identificar y caracterizar la producción cientifica sobre educación relacionada con la administración y la legislación que se indexa en la base de datos SCOPUS

Se han obtenido unos resultados que son importantes para comprender cuales son los patrones de investigación sobre esta temática así como para identificar cuáles son los canales de difusión cientifica que los investigadores utilizan para socializar sus investigaciones en terminos de publicaciones periodicas de calidad.

Esta tesis cumple las condiciones tanto académicas como formales exigidas por lalegislación vigente para optar al titulo de Doctor por la Universidad de Córdoba.

Que en relación con el tema de la tesis, y derivadas dela misma, se han realizado las siguientes publicaciones:

1. **Artículos en revistas:**

Maz-Machado, A., Tzima, S., Gutiérrez-Rubio, D., & Rodríguez-Faneca, C. (2022). Análisis bibliométrico de las revistas latinoamericanas de Business, Management and Accounting en SCOPUS. *e-Ciencias de la Información*. DOI 10.15517/ECI.V12I2.48613

2. Comunicaciones en congresos

Tzima, S. (2021). Scientific Production in Education Related to Legislation and Administration. A Scientometric Analysis", comunicaicón presentada en *V Simposio Internacional EN LÍNEA de la Red Internacional de Grupos de Alto Rendimiento Académico Internacional de Doctorado [RInt-GARAID]*, celebrado en Murcía del 3 al 10 de julio de 2021.

Por todo ello, se autoriza la presentación de la tesis doctoral.

Córdoba,15 de diciembre de 2022

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MAZ MACHADO ALEXANDER - 55092071X | Firmado digitalmente por MAZ MACHADO ALEXANDER - 55092071X Fecha: 2022.12.15 09:18:20 +01'00'

Fdo.: Alexander Maz Machado

GUTIERREZ RUBIO DAVID - 30823018M | Firmado digitalmente por GUTIERREZ RUBIO DAVID - 30823018M Fecha: 2022.12.20 09:20:21 +01'00'

Fdo.: David Gutiérrez Rubio

Resumen

La evaluación de la calidad de la práctica de la investigación es un tema importante en la mayoría de los campos científicos a muchos niveles (European Science Foundation, 2012). En los últimos años, se han realizado esfuerzos para evaluar la calidad de la práctica de la investigación en una serie de entornos diferentes. Dichos esfuerzos afectan a la asignación de recursos, la actividad científica y a la propia vida académica de los investigadores de todo el mundo. El foco se centra en la calidad de dicha práctica por diferentes razones y se considera en diferentes contextos como la evaluación del profesorado para fines laborales, la evaluación de solicitudes de becas de investigación, la de temas específicos de investigación, equipos de investigación y redes institucionales, o sistemas nacionales de producción de ciencia e innovación, así como un factor relevante a la discriminar en búsquedas de manuscritos y publicaciones. Cuando se trata de medir la calidad de la investigación en la comunidad científica en general, es difícil encontrar una definición universal de lo que constituye una buena práctica científica. El enfoque en algunas universidades está solo en el número y la calidad de las publicaciones en revistas científicas, mientras que otras instituciones se centran en todo tipo de publicaciones aparte de las revistas. Sin embargo, en un número cada vez mayor de disciplinas académicas es cada vez más común que los resultados científicos se midan de maneras distintas a la simple medición del número y la calidad de las publicaciones. Recientemente se han emprendido varios proyectos de evaluación de la calidad destinados a mejorar la práctica de la investigación en las instituciones, lograr una percepción más clara de las áreas de investigación que deberían recibir financiación, determinar si es necesario mejorar la calidad de una institución determinada, y dónde en su caso, y comparar la calidad de una institución determinada con la de las principales organizaciones internacionales. Sin embargo, la literatura científica disponible sobre la calidad de la investigación y lo que realmente puede definirse como investigación es escasa. En Italia, por ejemplo, las directrices nacionales para evaluar la práctica de la investigación han abogado generalmente por un enfoque que incluya los resultados socioeconómicos, la adquisición de recursos y la gestión de recursos como criterios (CIVR, 2006). En los Estados Unidos, los criterios para evaluar las solicitudes de becas de investigación en los Institutos Nacionales de Salud incluyen breves definiciones de cinco conceptos: relevancia, enfoque, innovación, investigadores y medio ambiente (NIH, 2008).

En una evaluación reciente de las áreas de investigación en una gran universidad de Suecia, la calidad de la práctica de investigación se midió teniendo en cuenta la atención que recibió a la importancia científica, tecnológica, clínica y socioeconómica de sus publicaciones, incluida la aplicación de los resultados de la investigación. (ERA, 2010). En Canadá, se han desarrollado criterios estandarizados de evaluación de la calidad para los trabajos de investigación y estos se relacionan por separado con estudios de investigación cuantitativos y cualitativos (Kmet et al., 2004). A día de hoy, parece haber al menos tantas maneras de medir lo que constituye un buen estudio científico o publicación como hay institutos de investigación. Sin embargo, no es la intención de este trabajo distinguir ciertos tipos de métodos científicos que son inherentemente "buenos" de otros que pueden ser "malos". Prácticamente cualquier método científico puede ser apropiado, partiendo de un diseño de investigación sólido. Son las preguntas de investigación las que deben llevar a la decisión sobre qué diseño y métodos de investigación deben usarse y la calidad puede ser alta siempre que los métodos se utilicen con rigor y calidad. En nuestra opinión, las teorías pueden considerarse como "mapas" y los métodos de investigación como "redes". Ambos dependen en gran medida de cómo encuentran y capturan información para la producción de nuevos conocimientos. Las medidas de garantía de calidad y

evaluación deben ser lo más objetivas y fiables posible. Por lo general, su objetivo es crear conciencia sobre la situación actual y el estado de la investigación en curso. Sin embargo, el problema general es que casi todos los proyectos de evaluación recientes han utilizado diferentes medidas y ponderaciones para las variables aplicadas, lo que dificulta la comparación de los resultados de la evaluación de una institución con los de otras instituciones o disciplinas. Ejemplos específicos de variables de mediación utilizadas en las evaluaciones de la calidad de la práctica de investigación mencionadas anteriormente incluyen: Medidas de publicación (por ejemplo, número, calidad e impacto), número y calidad de los propios investigadores (cuantificada en grados académicos de éstos), tamaño de las redes científicas nacionales e internacionales, cantidad y número de becas de investigación recibidas, internas o externas, número de tesis doctorales producidas, y número de investigadores postdoctorales o invitados.

La falta de estándares de calidad ampliamente reconocidos para la práctica de la investigación es algo sorprendente. La consecuencia de esto es que las entidades responsables de determinar la calidad de la investigación - consejos universitarios, académicos, instituciones financieras, editores de revistas y críticos de revistas - aplican los valores y estándares de sus propias mentes, campos o disciplinas. La aplicación de los valores de uno es parte del proceso de evaluación, pero tener estándares de calidad generalmente reconocidos, en lugar de desarrollar tendencias en función de las fuentes de mayor influencia al momento de desarrollar dichos estándares, es probable que facilite evaluaciones justas. Aunque la mayoría de las evaluaciones de calidad se han llevado a cabo en universidades, empresas de investigación privadas y públicas y otros institutos científicos también han llevado a cabo evaluaciones similares. Algunas de las evaluaciones de calidad hasta ahora han cubierto universidades enteras, mientras que otras se han centrado en disciplinas específicas como las ciencias de la vida, la tecnología de la información e incluso temas de investigación más específicos como el cáncer, la diabetes y el aprendizaje permanente.

Por lo tanto, una pregunta clave que sigue es cómo evaluar la investigación realizada en un campo en particular. A las dificultades del juicio de contenido se suma la complejidad de intentar aplicar en otra zona, región o país un determinado modelo de evaluación que se ha utilizado en un entorno concreto. Además, no se puede afirmar necesariamente que un conjunto específico de criterios de evaluación y ponderaciones que funciona bien, por ejemplo, en medicina, también funcionará en las ciencias sociales o en la ingeniería. Aunque se han realizado esfuerzos para desarrollar criterios generales de calidad (por ejemplo, Lahtinen et al., 2005) y métodos para examinar los datos sobre cuestiones específicas (por ejemplo, Alborz y McNally, 2004), todavía existen retos generales a los que se enfrentan muchas universidades. Puede haber muchos campos académicos, facultades y departamentos diferentes, que quieren (o necesitan) ser comparados entre sí.

Investigaciones realizadas anteriormente sobre las dimensiones cualitativas han demostrado que se pueden utilizar muchos modelos para describir la calidad de la práctica de la investigación (p. ej., Gummesson, 1991, Keen, 1991, Mason, 1996, Maxwell, 1996, Rubin y Rubin, 1995; Sutherland et al., 1993), y que los diferentes conjuntos de dimensiones propuestos a menudo se superponen de diferentes maneras. Algunos criterios, como los de Klein y Myers (1999), se centran en evaluar un tipo particular de investigación. Los autores presentan un conjunto de principios "relativos a las normas de calidad de un único tipo de investigación interpretativa, a saber, el estudio de campo interpretativo" (p. 69). Del mismo modo, Dubé y Paré (2003) discuten la investigación de casos positivistas. Otros argumentan que algunas dimensiones son generalmente más adecuadas para algunos tipos de investigación que otras. Por ejemplo, Rubin y Rubin (1995) afirman que la validez y la fiabilidad son más adecuadas para la investigación cuantitativa, pero no para la cualitativa. A menudo se hace una distinción entre rigor y relevancia (por ejemplo, Keen, 1991), y a veces se considera, tácita o explícitamente, que hay una compensación entre estos conceptos. Robey y Markus (1998) argumentan que los investigadores deben esforzarse por producir investigación que sea tanto rigurosa como relevante, lo que ellos denominan investigación consumible.

En conclusión, no parece haber criterios específicos para evaluar la calidad de la práctica de la investigación, o al menos no están bien definidos. En el núcleo del problema se encuentra un debate en la actualidad sobre si la investigación en ciencias sociales cumple con los criterios de calidad de las ciencias naturales en cuanto a definiciones claras de la terminología, cuantificación, condiciones altamente controladas, reproducibilidad y previsibilidad, y pruebas (Berezow y Hartsfield, 2012).

La finalidad de la evaluación de un proyecto es determinar la idoneidad y el cumplimiento de sus objetivos, la eficiencia de su desarrollo, su eficacia, así como su repercusión y viabilidad. La evaluación debe proporcionar información fiable y útil, tanto para los investigadores/evaluadores como para los interesados en tener en cuenta sus resultados en el proceso de toma de decisiones tanto de los receptores como de los donantes. La evaluación también se refiere al proceso de determinar el valor o la importancia de una actividad, política o programa. La evaluación es también una valoración sistemática y lo más objetiva posible de una intervención de desarrollo planificada, en evolución o integrada. Asimismo, cabe señalar que la evaluación implica en algunos casos el establecimiento de normas apropiadas, el examen de los resultados con respecto a esas normas, la evaluación de los resultados reales y los esperados, y la extracción de conclusiones pertinentes.

Contenido de la investigación

El objetivo general de esta investigación fue analizar la producción sobre legislación y educación en la categoría " Business, Management and Accounting" a través de un estudio cienciométrico de las publicaciones indexadas en la base de datos de SCOPUS.

Las hipótesis fueron que los artículos de investigación en legislación y educación en la categoría Negocios, Gestión y Contabilidad en las revistas indexadas en SCOPUS en el período de estudio verifican las principales leyes cienciométricas: Lotka y Bradford y que la colaboración entre autores en esta producción científica es principalmente de carácter local o nacional.

El objetivo general fue desglosado en 6 objetivos específicos:

El primer objetivo fue conocer el desarrollo diacrónico de la producción científica en educación relacionada con la legislación e indexada en SCOPUS (Business, Management and Accounting). Toda la producción se encontró en el período entre 1970 y 2019, mientras que ha habido un aumento gradual en el volumen de producción hasta el año 2002, alcanzando el pico máximo en 2002, pero desde entonces, ha habido una disminución. Además, no hubo un patrón de crecimiento continuo, sino que se evidencian diversas fluctuaciones.

Al principio del periodo estudiado, no se encontró producción durante cuatro años seguidos y entre 1999 y 2000 se ha producido un descenso de la producción, con una Tasa de Variación Interanual (TVI) negativa igual a -47, y en 2008, con una Tasa de Variación Interanual (TVI) negativa igual a -45, mientras que la TVI positiva más alta (sin tener en cuenta el incremento de 1975, ya que hubo 4 años sin producción) se alcanzó en 2001 con un valor de 207. En general, se ha pasado de producir 36 documentos en 1975 a 1052 en 2020; es decir, se trata de un incremento porcentual del 4072%. La media de documentos publicados es de 711 al año. En cuanto a la tasa anual de cambio, la tasa más alta se ha identificado en 1975, seguida de 1978. Comparando nuestro resultado con los resultados de Lopera-Pérez et al (2021), quienes realizaron un análisis bibliométrico de la producción científica internacional sobre Educación Ambiental en la Web of Science (WoS) dentro de las categorías Educación e Investigación Educativa y Educación, Disciplinas Científicas para las últimas dos décadas (2000-2019). Sus resultados mostraron el acelerado incremento de la producción de conocimiento en esta área, y presentan los principales contextos de investigación, así como algunas perspectivas educativas y de investigación. Dichos resultados contrastan con los nuestros, ya que encontramos una disminución de la producción desde 2002. En la misma línea, Gantman y Fernández (2017) analizaron la producción de literatura académica en español sobre estudios de organización y gestión entre 2000 y 2010 indexada en el Catálogo Latindex.

El segundo objetivo consistió en describir e identificar las diferentes relaciones de redes de conocimiento que se generan. Se encontró que existe una colaboración relativamente baja (1,7) en la autoría en esta área, pero esta situación ha ido cambiando con los años. La colaboración entre autores y universidades fue identificada por Lopera-Pérez et al (2021), lo cual coincide con nuestros resultados, ya que se encontró que la colaboración comenzó a despegar y su incremento es notorio a partir del año 2008.

El tercer objetivo consistió en visualizar las redes de colaboración nacionales e internacionales, tanto a nivel de autoría como a nivel institucional, e identificar patrones de colaboración. Este objetivo se responde en el apartado 6.1.6, donde se ha constatado que la mayoría han sido de autoría única, y los firmados por dos o tres autores representan un tercio del total. El patrón de autoría ha sufrido cambios en el periodo, pasando de un inicio en 1975 con predominancia en la publicación de documentos con autoría única frente a los de autoría múltiple hasta invertir la relación en 2019.

El cuarto objetivo consistió en identificar los patrones de citación y colaboración. El análisis de las citas en las revistas analizadas indicó que el 39,7% de la producción no había recibido ninguna cita. Del total de documentos citados, el 12,6% sólo han sido citados una vez, y el 8,3% dos veces. El artículo más citado tiene 855 citas. Además, en cuanto a los años en los que se han realizado estas citas, el mayor porcentaje fue en 2003 con 944 citas, seguido de 2007 con 905 citas. En cuanto a los patrones de colaboración, al analizar en detalle el número de autores, se encontró que el 58,21% fueron de autoría única, y los firmados por dos o tres autores representaron el 34,37% del total. La media anual de los documentos sin colaboración resultó estar por encima de la media, lo que podría inducir que hay casi igualdad entre los documentos sin colaboración y los que sí la tienen. Sin embargo, este valor se debe en gran medida a los primeros años dentro del rango de estudio. La colaboración comenzó a despuntar y su aumento es notable a partir del año 2008. Por último, se determinaron los valores de los tres indicadores de colaboración más frecuentes en la literatura. Así, el grado de colaboración en el periodo es DC =0,66. El valor mínimo se produjo en 2002 y el máximo en 1970. Este valor fue casi similar al obtenido por las revistas de educación publicadas en Brasil (0,636) (Madrid, et al, 2017) y cercano al encontrado para el GD (0,75) en las publicaciones científicas colombianas en SciELO (Maz-Machado, Jiménez-Fanjul y Villarraga-Rico, 2016). Sin embargo, fue superior al encontrado para las categorías SSCI Demografía (0,605) y Estudios Urbanos (0,591) (Maz-Machado y Jiménez-Fanjul, 2018).

El quinto objetivo consistió en establecer valores para los indicadores de la dimensión cuantitativa de la producción científica sobre el tema. A este objetivo se responde en el apartado 6.2.1 y 6.2.2. Se verificó la Ley de Bradford con las revistas que conforman el núcleo de Bradford siendo Chronicle of Higher Education y Journal of Management Education y estas dos acumulan 11526 documentos. Además, se verificó la ley de Lotka para el conjunto de autores que publicaron en las revistas objeto de estudio.

El sexto y último objetivo fue identificar los temas abordados. Este objetivo se responde en el apartado 6.1.8. Se comprobó que los temas estaban relacionados con Gestión y Liderazgo en Educación, Educación Infantil, Educación Superior, Marketing en Educación, Educación Contable, Educación y Trabajo, Educación Turística, Educación en Salud Mental y Educación en Organización Industrial.

Conclusión

Se ha realizado un análisis cienciométrico de la producción científica Business, Management and Accounting indexada en Scopus, donde se ha constatado los cambios sustanciales durante el periodo analizado desde 1970 hasta 2019, tanto a nivel de producción, como de colaboración entre autores y universidades, así como un análisis de la dimensión cuantitativa de la producción verificando leyes habituales en un estudio de estas características como la Ley de Bradford, Lotka y Bradford.

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1.1 Significance

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Evaluation in general and research evaluation in particular are a very broad and important field. In fact, it is a separate cognitive object with rapid development. The main reason for this development is the importance of evaluation in improving and evaluating each activity. Another important reason is the development of a theoretical and methodological background to support and conduct the evaluation. However, it is characteristic that there is no clear definition of what evaluation is. The main reason is that there is no unanimity among researchers or organizations, as there are many specific ways to define evaluation.

Of course, a common recommendation of all researchers when trying to define what evaluation means, is the evaluation of the extent to which the objectives set during the design and implementation of a product, process, service, tool, etc. have been achieved.

According to EYEP-YPEPTH (2008) the word "evaluation" in the Greek language derives from the verb "evaluate" which comes from the composition of the words "value" + "I say". That is, "evaluation" generally refers to the attempt to determine the value of a thing, a process, a person, etc. "Value", however, can refer to many more specific and specific concepts, depending on the activities. It can mean quality, features, performance, efficiency, performance, suitability, etc. Therefore, any attempt or process to evaluate such specific features is an evaluation.

Another definition attempt is made by Panagiotakopoulos, Pierrakea & Pintela (2003) and is as follows: Evaluation can be defined as the systematic collection, analysis, and interpretation of information for any aspect of a product, in order to determine its effectiveness and efficiency or the assessment of any other parameters related to its implementation.

In addition, the Organization for Economic Co-operation and Development (OECD) has created a dictionary containing terms related to evaluation (OECD, 2010). This dictionary states that evaluation is the systematic and objective evaluation of a project in progress or a complete project, a program or policy, its design, its implementation, and its results.

1.1 Significance

Evaluating the quality of research practice is a really important issue in most scientific fields and at many levels (European Science Foundation, 2012). Increasingly, we are also seeing these evaluation efforts at disciplinary and national borders. In recent years, more or less elaborate efforts have been made to evaluate the quality of research practice in a number of different settings. These efforts affect the allocation of resources, scientific activity and the very lives of researchers around the world. Quality is the focus for many different reasons and is considered in different contexts such as evaluation:

- Research grant applications
- Search for manuscripts and publications
- Specific research topics
- Research teams and constellations
- Institutions
- National science and innovation production systems

When it comes to measuring the quality of research in the wider scientific community, it is difficult to find a universal definition of what constitutes good scientific practice. The focus in some universities is only on the number and quality of publications in scientific journals, while other institutions focus on all types of publications. However, in an increasing number of academic disciplines it is becoming increasingly common for scientific results to be measured in ways other than simply measuring the number and quality of publications.

Several costly quality assessment projects have recently been undertaken to improve the quality of research practice in authors' institutions, to identify the research areas that should receive funding, to find out if and where quality improvements are needed and to compare quality of a particular institution compared to those of leading international organizations. However, the available scientific literature on the quality of research and what can really be defined as research is rare. There are some examples. In Italy, for example, national guidelines for evaluating research practice have generally advocated an approach that includes socio-economic outcomes, resource acquisition and resource management as criteria (CIVR, 2006). In the US, the criteria for evaluating research grant applications at National Institutes of Health include brief definitions of five concepts: relevance, approach, innovation, researchers, and environment (NIH, 2008). In a recent evaluation of research constellations at a large university in Sweden, the quality of research practice was measured taking into account the attention it received to the scientific, technological, clinical and socio-economic importance of their publications, including the application of research results. External Research (ERA), 2010). In Sweden today, however, there seem to be at least as many ways to measure what constitutes a good scientific study or publication as there are research institutes. In Canada, standardized quality evaluation criteria have been developed for research papers and these relate separately to quantitative and qualitative research studies (Kmet et al., 2004).

However, it is not our intention to distinguish certain types of scientific methods that are inherently "good" from others that may be "bad". Our claim is that almost any scientific method may be appropriate, given a sound research design. It is the research question (s) that should lead to the decision as to which design and research methods should be used and the quality can be high as long as the methods are used with rigor and quality. In our view, theories can be thought of as 'maps' and research methods as 'nets'. Both depend to a large extent on how they find and capture information for the production of new knowledge.

Quality assurance and evaluation measures must be as objective and reliable as possible. They generally aim to raise awareness of the current situation and the state of ongoing research. However, the general problem is that almost all recent evaluation projects have used different measures and weights for the applied variables, making it difficult to compare the evaluation results of one institution with those of other institutions or disciplines. Specific examples of mediation variables used in evaluations of the quality of research practice mentioned above include:

- Publication measures (eg number, quality and impact)
- Number and quality (academic degrees) of the researchers themselves
- Size of national and international scientific networks
- Amount and number of external research grants received
- Amount and number of intra-organizational grants
- Number of doctoral dissertations produced
- Number of postdoctoral or invited researchers

The lack of widely recognized quality standards for research practice is somewhat surprising. The consequence of this is that the judges of the quality of research - university councils, scholars, financial institutions, journal editors and journal critics - apply the values and standards of their own minds, fields or disciplines. Applying one's values is part of the evaluation process, but having generally recognized quality standards, rather than developing temperaments, is likely to facilitate fair evaluations. Although most quality evaluations have been carried out at universities, private and public research companies and other scientific institutes have also carried out similar evaluations. Some of the quality evaluations so far have covered entire universities, while others have focused on specific disciplines such as life sciences, information technology and even more specific research topics such as cancer, diabetes and lifelong learning.

Therefore, a key question that follows is how to evaluate research conducted in a particular field. In addition to the difficulties of content judgment, it is a complex process for attempting to apply a particular evaluation model that has been used in a particular setting in another area, region, region or country. In addition, it does not necessarily apply that a specific set of evaluation criteria and weights that work well, for example, medicine will also work in the social sciences or engineering. Although efforts have been made to develop general quality criteria (e.g. Lahtinen et al., 2005) and methods for examining data on specific issues (e.g. Alborz and McNally, 2004), there are still general challenges that faced by many universities. There can be many different academic fields, faculties and departments, all that want (or need) to be compared to each other.

Previous research on qualitative dimensions has shown that many models can be used to describe the quality of research practice (eg Gummesson, 1991, Keen, 1991, Mason, 1996, Maxwell, 1996, Mensrtensson, 2003, Mensrtensson and Mårtensson, 2007; Rubin and Rubin, 1995; Sutherland et al., 1993), and that different proposed sets of dimensions often overlap in different ways. Some criteria, such as those of Klein and Myers (1999), focus on evaluating a particular type of research. The authors present a set of principles "concerning the quality standards of a single type of interpretive research, namely the interpretive field study" (p. 69). Similarly, Dubé and Paré (2003) discuss positivist case research. Others argue that some dimensions are generally better suited to some types of research than others. For example, Rubin and Rubin (1995) argue that validity and reliability are better suited to quantitative research as they are not suitable for qualitative research. A distinction is often made between austerity and relevance (e.g. Keen, 1991), and it is sometimes considered, tacitly or explicitly, that there is a trade-off between these concepts. Robey and Markus (1998) argue that researchers should strive to produce research that is both rigorous and relevant, and call it consumable research. In conclusion, there appear to be no specific criteria for evaluating the quality of research practice, or at least they are not well defined. At the heart of the problem is a contemporary debate about whether social science research meets the quality criteria of the natural sciences in terms of clear definitions of terminology, quantification, highly controlled conditions, reproducibility and predictability, and testing (Berezow and Hartsfield, 2012).

1.2 Purposes of the evaluation

The purpose of evaluating a project is to determine the appropriateness and fulfillment of its objectives, the efficiency of its development, its effectiveness, its impact and its viability. Evaluation should provide reliable and useful information, both for researchers / evaluators and for those interested in taking into account its results in the decision-making process for both recipients and donors. Evaluation also refers to the process of determining the value or importance of an activity, policy or program. Evaluation is also a systematic and as objective an evaluation as possible of a planned, evolving or integrated development intervention. It should also be noted that evaluation in some cases involves setting appropriate standards, examining performance against those standards, evaluating actual and expected results, and drawing relevant conclusions.

1.3 Legislation and education system

If the argument set out in the riddle is indeed valid, then the law of education is of the utmost importance to teachers. Successful teachers in our new democracy, where the human rights of all concerned must be protected, must know the context of the education law within which they must perform. The focus of my search was the training modules (EDL 401 and OWR 721). For the purposes of my research, I explored the educational modules of education law in the ACE Education Management and BEd (Hons) Education Education Law and Policy programs offered by the University of Pretoria through distance education (DE). It is important to note that these two courses were used as a tool and that any other course on educational law could have been used in other higher education institutions. The focus of the research was to investigate whether teachers' awareness of legislation and education law specifically affects their practice. The intention was not to evaluate these modules as such, but to understand the change in teacher practice as a result of the exposure to the content of educational law in these modules.

The law, by its nature, commands the world in which we live, such as rules related to traffic, contracts, marriages, etc. and the School Board (Xaba, 2011). Oosthuizen & Botha (2009) point out that the law of education creates order and harmony in these multiple relationships. Assists with the structures of the administration and management services of education, while it has functions, tasks, duties and responsibilities. Gives and limits power while delimiting the various areas of power.

A simple but effective way of understanding the need to know the educational law would be the analogy of the game. The question is: How does knowing the rules change the way the game is played? Every game that children or adults play, whether it is hop-scotch, marble, hockey or rugby, has a set of rules. These rules create harmony in the game as they guide players in what they can or cannot do. Regulates the relationship between the players themselves as well as between the players and the game. One can imagine the chaos it creates when a player enters the game and plays the game without following the rules. Not playing by the rules creates tension and frustration.

The teaching profession is no different. There is a "game" in which teachers engage - their practice. There are rules that govern practice. When teachers engage in their practice, without knowing the rules of the "game" it creates tension and frustration! These tensions and frustrations come in many forms, such as issues of discipline with students or staff or conflict between the school and DoBE or the school body (Joubert 2009: 240). Our fundamental duty would be to protect the rights of students. Our understanding of the educational law will force us to create a safe environment for our students and to create a learning environment. Therefore, knowledge of the "rules of our game" will affect the way teachers plan and perform their tasks or "play the game".

Students due to their age have a unique status in terms of their ability to anticipate danger or to be fully responsible for their actions. This unique regime requires a different level of accountability from that of teachers, said Van Vollenhoven:

The position of power exercised by teachers has many legal implications regarding possible liability for negligence. Teachers work with young, immature people, who, due to lack of experience and judgment, are not always able to predict the consistency of their actions. Potentially dangerous situations must therefore receive the teacher's indivisible appreciation. It is therefore clear that school rules, formal safety measures and regulations are part of the educational law (Van Vollenhoven, 2008).

Europe is characterized by a very wide variety of education and training systems. In order to properly assess this diversity, EURYDIKI, the information network for education in Europe, the European Center for the Development of Vocational Training (CEDEFOP) and the European Training Foundation (ETF) work together periodically to update national monographs. title Structures of Education Systems and Vocational Training and Adult Education Systems in Europe (Structures of Education, Vocational Training and Adult Education Systems in Europe).

1.4 Educational research and research evaluation

Educational research refers to the systematic collection and analysis of data related to the field of education. Research can include a variety of methods (Lodico et al, 2010; Anderson & Arsenault, 1998; Yates, 2004) and various aspects of education, including student learning, teaching methods, teacher training, and classroom dynamics. (Kincheloe, 2004).

Educational researchers generally agree that research should be rigorous and systematic (Anderson & Arsenault, 1998; Kincheloe, 2004). However, there is less agreement on specific research standards, criteria and procedures (Lodico et al, 2010). Educational researchers can rely on a variety of disciplines such as psychology, sociology, anthropology and philosophy (Lodico et al, 2010; Yates, 2004). The methods can be derived from a number of disciplines. The conclusions drawn from an individual research study may be limited by the characteristics of the participants studied and the conditions under which the study was conducted (Yates, 2004).

There is no "right" way to conduct research in education.

Gary Anderson described ten aspects of educational research (Anderson & Arsenault, 1998):

1. Educational research tries to solve a problem.
2. Research involves collecting new data from primary or first-hand sources or using existing data for a new purpose.
3. The research is based on observable experience or empirical data.
4. Research requires precise observation and description.
5. Research generally uses carefully designed procedures and rigorous analysis.
6. Research emphasizes the development of generalizations, principles or theories that will help in understanding, predicting and / or controlling.
7. Research requires expertise - familiarity with the field. proficiency in methodology; technical proficiency in data collection and analysis.
8. The research seeks to find an objective, impartial solution to the problem and makes great efforts to validate the procedures applied.
9. Research is a deliberate and non-hasty activity that is directional but often improves the problem or questions as the research progresses.
10. The research is carefully recorded and refers to other people who are interested in the problem.

The ever-increasing volume of educational research being published, and the growing tendency of administrators to rely on research in policy-making, raises the problem of how best to evaluate what is being published. Evaluation will be one of the biggest problems of the empirical era of education, which is probably just beginning.

The need for careful evaluation becomes clear in the 1962 American Educational Research Study in Wandt (1965). This study looked at a sample of 125 of the 827 articles published in 1962. Reviewers, highly qualified and experienced researchers and professors accepted that only seven percent of the articles were worth publishing unchanged and 41% were worth publishing. after review. The remaining 52% of the sample was rejected as unfit for publication. For those who are involved in research or have experience in teaching research, the problem may not be so great. But for administrators and teachers who do not have such experience, applying research findings can be risky unless a good evaluation method is found. In the past, various individuals have created checklists that guide research evaluation. For example, there are the checklists of Bixler (1928), Johnson (1957), Van Dalen (1958), Farquhar and Krumboltz (1959), and Suydam (1968), as well as the unpublished list of Lesser criteria. The 1962 AERA study also listed twenty-five evaluation criteria. The rationale behind all these lists is that a list can be constructed because the principles of educational research are objective and clearly defined in practice, and that their use allows for more valid and reliable research evaluations than those without any objective structure.

2. Scientometrics and its role in research evaluation

2.1 Historical development of scientometrics

Shapiro (1992) presents Bibliometrics to us as a topic that has been neglected by historians of information science. The use of benchmarks has been around for many years, as early as 1743, and many articles have been published in legal texts, at least since 1817. Weinberg (1997) notes that Hebrew benchmarks are even older and date to about the 12th century. The idea of conducting research and examination of the literature has its roots in the beginning of the century. In 1917, scientists FJ. Cole and Nellie Eales published a statistical analysis of the history of comparative anatomy. This date marked a milestone in the history of bibliographic analysis, as Cole and Eales were among the first to use published research to create a quantitative picture of the progress being made in a research field. Their work describes the contribution of Bibliometrics as well as the problems it poses - some of which have not yet been resolved -.

Further work was carried out by Hulme (1923), this time using patents. By linking patents and the scientific literature to measure social progress in Britain, Hulme pioneered a modern methodology for the history of science.

Next, Cole (1926) showed the distribution frequencies of scientific production. He was arguably one of the first to link the concept of productivity to counting, using indicators from the Chemical Abstracts Service (CAS) every decade as part of the American Chemical Society. Auerbach textbook, Geschichts Tafelnder Physik. He also introduced a quality measure of the scientific work, based on data and data that made it possible to select the contributions, which were considered outstanding and distinguished.

However, the one who developed the statistics on the publication was S.W. Fernberger of the University of Pennsylvania. Fernberger (1936) studied the evolution of researchers and placed increasing emphasis on publication as a criterion for eligibility. He also examined the financial and organizational issues of the Psychologists Association's journals and their conferences. He edited the number of papers presented at each Psychology conference since 1892. He recorded the productivity of universities in these meetings and described what he called "the coherence of publication and areas of interest." It also found that 53% of all publications were produced in 19 universities. Fernberger was the one who imposed the concepts of productivity and the index for measuring the productivity of science.

In 1906, Cattell (1906) launched the biographical catalog of American scientists, which was published every five years and collected information on thousands of scientists working in the field of research. It developed statistics on the number of scientists and their geographical distribution, as well as the ranking of scientists according to their performance. Cattell can therefore be credited with initiating the systematic measurement of science. He then introduced two dimensions for measuring science, quality and quantity. Quantity or productivity, as he called it, was simply the counting of the number of scientists belonging to a nation, while quality or performance was defined as the contribution of each to the progress of science and was measured by the ranking of his colleagues, according to the number of their tasks. Catell was followed by other researchers such as psychologist Buchner who, in his review of psychology, included a discussion of recent articles, the number of psychologists, a list of new journals, and statistics on publications. Buchner also referred to the percentage distribution of articles in the index, as well as to the interests of psychologists.

In 1971, an Italian economist, Vilfredo Pareto (1971) observed what was later called the Pareto principle or the 80-20 rule, since according to her, in most cases, about 80% of the results come from 20% of causes. Thus, it can be expected that 80% of the reports relate to a core of 20% of journal titles. Similarly, 80% of journal articles belong to about 20% of authors. That is, bibliometric phenomena have a deeply asymmetric distribution, since publications, reports, etc. reproduced by a small proportion of sources, authors, magazines, institutions, in contrast to most phenomena observed in nature, which follow the normal distribution. The main feature of the normal distribution is the formation of the "bell" that makes it highly symmetrical. The result is that the mean is equal to the median and the prevailing value (maximum frequency point), i.e. all the values of the position parameters coincide. This regularity allows the use of basic statistical techniques such as correlation, regression, as well as tested statistical tests.

In 1926, Alfred.J. Lotka (1926) published his pioneering study on the frequency distribution of scientific productivity determined by the ten-year index (1907-1916) of Chemical Abstracts. Lotka concluded that "the number of authors producing n publications is inversely proportional to n2 - multiplied by a constant calculated by Lotka himself - while the percentage of those producing a single publication is about 60 percent." This result can be considered as a general rule, even today, 90 years after its publication. At about the same time, in 1927, Gross and Gross (1927) published a study focused on citations to help decide which Chemistry journals would be best purchased from small college libraries. In particular, 3633 citations from the volume of the 1926 issue of the Journal of the American Chemical Society were considered.

Eight years after the publication of Lotka's article, Bradford, in 1934, published his study on the frequency distribution of journal publications. Bradford (1934) discovered that "If the scientific journals of a subject are arranged in descending order of productivity, they can be divided into a core of journals with several groups or zones containing the same number of articles as the core, then the journal numbers in the nucleus and in the successive zones increases with the ratio κ0: κ1: κ2 ». An important consequence of the law is that in a search for a particular topic, a large number of relevant articles will be concentrated in a small number of journal titles (Nordstrom, 2005).

These laws usually make estimates of reference indexes, as well as the various services of libraries. For example, the Science Citation Index tracks only about one-fifteenth (1/15) of all journals, but records more than three-quarters (3/4) of all citations (Price, 1976). Additionally, libraries use Bradford's law to identify the least painful magazine cuts when they need to cut back.

Otlet was then the one who used the term *Bibliometrie* to describe the technique by which he sought to quantify science and scientists. Otlet (1920), a pioneer in the science of information and its theory, insists on the difference between Bibliometrics and Statistical Bibliography, arguing that science from its birth is measured or quantified by applying statistical methods to information sources.

Otlet's view is that Bibliography is established as a general science that systematically collects and classifies the totality of data relating to the production, maintenance, circulation and use of writings and documents of all kinds. In his treatise on information science, Otlet puts forward a number of ideas for Bibliometrics, among which the following are the most important:

a) In every form of knowledge, the measure is the higher form that this knowledge forms. Measures related to books and documents can form a set of coordinates, Bibliometrics. Although Otlet later used the term *Bibliometrie*, Pritchard (1981) introduced the term "bibliometrics" and broadly defined bibliometrics as "the application of mathematical and statistical methods to books and other media".

b) Measures relate to objects, phenomena or events, relationships or laws. The measures of the main relations of a science become indicators (for example, when geographers study the relationship of water and rain with the earth, they create an index of drought).

c) When dealing with Bibliometrics, we must take into account the findings of metrics (in a general context) and metrics in the social sciences (in a specific context).

The quote "everything in moderation" has become the guideline of every science, which tends to move from the quantitative to the qualitative stage. López-Yepes (1995) emphasizes Otlet's ability to organize his knowledge and ongoing search for a complex explanation of how concepts are created and developed. Recognizes in Otlet his ability for rational organization.

Otlet analyzed the reasons why sciences such as Astronomy, Biology, Sociology and others tend to have a quantitative character. They have established measurement methods, which give results. Regarding the books, he stressed that:

1) Objects related to books cannot be easily measured, either in the sense of their material and functionality, or in the sense of subjective reality. Efforts, therefore, are desirable in this direction.

2) The sciences related to books should introduce the idea of measurement in the research they promote. To the extent that books are the subject of study in Psychology, Sociology or Technology, their data can be measured.

3) Bibliometrics will be part of the Bibliography, which will deal with the application of quantity or measure in books (numerical or mathematical bibliography).

4) Every element that the Bibliography deals with must in principle be measurable. It is appropriate for research to deal with data accurately, that is, in the form of numbers, so that it passes from a qualitative or descriptive stage to a quantitative one.

Otlet proposes a number of basic principles for the field of Bibliometrics, taking into account a number of factors that influence or surround the text. These include the language, the intervals contained and the coefficients mentioned among others, in the format, layout and price of the unit as well as coefficients belonging to the statistics, such as benchmarks. It also pays attention to the frequency with which a given author or his work is read. From this data it follows that a "frequency of use" curve can be plotted, taking into account the number of editions of a text depending on the author and its content or the context of the social extensions in which it appears.

Despite his importance in relation to books, Otlet believes that the field of Statistics fulfills a very different goal from that of Bibliometrics.

Book statistics are often confused with Bibliometrics because until now they may have been used mainly to list the amount of books published. However, the use of Statistics is now beginning to spread to the numbers of copies that are printed, to the circulation of books, to libraries, to bookstores, to prices and more. In addition, many works have been written on book statistics, which have to do with absolute prices as well as contributions. Of course, we should not overestimate the importance of these numbers, as the lists presented are far from being complete, accurate and comparable. On the other hand, the coefficients we take are just measures that compare any kind of change with a wide variety of variables. However, existing data, as temporarily valid, should show us a way to more accurate and complete numbers. It is clear that, according to Otlet, while Bibliometrics measures the content of the book, statistics deals with the main body and its conditions.

Then, in 1949, Zipf (1949) formulated an interesting law of quantitative linguistics, which was discovered by studying the frequency of words in a text. According to Zipf, the relation $r \cdot f = C$ holds, where r is the ranking of a word in relation to its frequency in the text, f is the frequency of the word in the text and C is a text-dependent constant which is analyzed. The philosophy of the law focuses on the principle of minimal effort, which means that an individual will try to solve his problems in such a way as to minimize the overall work he has to spend to solve both immediate and potential future problems. of. So, he will use the same word, instead of a synonym, when possible.

The situation changed dramatically in the early 1960s, when science historian Derek de Solla Price published his fundamental work on Bibliometrics, which is analyzed in two books, the first on "Science from the Babylonian Age" (1961) and the second for "Small Science, Large Science" (1963). Price (1976) launched an interest in the science of science, based on accurate quantitative analysis, on the one hand of the rates of scientific production, i.e. the number of scientific books and journals per unit time, and on the other hand of the number of people employed in science. Price (Bountouridis MA, 1999) owes the finding that most of the total scientific work is produced by a relatively small number of scientists.

Another of his beliefs was that while we may not be able to read all the scientific books, papers, etc., we can only by counting draw many conclusions about science.

Thus, Price was led to his model of the exponential rate of development of science over time, according to which, he claimed, world science was expanding from the seventeenth century onwards at an exponential rate (plus 5% to 7% each year). so that scientific production doubles every ten to fifteen years. In addition, he argued that this exponential pace in which science is developing must have an end. In 1963 he stated that: It seems that it is not right to climb two more levels just as we have climbed in recent years. If we do not comply, we will have to have two scientists for every man, woman, child and dog in the population and we will have to spend twice as much money as we have. Therefore, the day of judgment for science would be less than a century away" (Price, 1963, p. 19).

Following his detailed research, he presented a series of quantitative evaluation techniques. He was the first to examine the growing trend of collaboration between Chemistry researchers, using Bibliometrics. Since then, Bibliometrics has developed as a research field in itself, resulting in the appearance in the scientific community of experts called bibliometers. In scientific development, Price sees on the one hand, what he calls the archival body of the research literature, and on the other hand, what he calls the research front of the literature. Archival material is the part of the bibliography of a scientific area that has been written relatively earlier, e.g., for the last six or seven years.

On the front of the research there is a part of the whole bibliography, which has been created recently and which reflects the latest research works. In other words, science seems to be growing like a tree that is constantly sprouting new branches, while its growing vegetation hides a stable but less active structure. For this reason, she used the term developing skin for the research front and described the development of science, arguing that the thinner her skin is, the more structured and clear her growth is and the faster the whole process. Price in particular believes that the forehead skin of research is created by an average of fifty (50) research papers and then it is imperative to activate feedback by creating a review research paper that will obviously vary depending on the research field. However, for dynamically developing areas, the fact that the research skin is thin means that there is a rapid rate of obsolescence of the works and their incorporation into the previous material, so that references to them are taken for granted and therefore not even made. In contrast, in slow-growing areas, the research front is a much larger part of the overall literature, making it difficult to separate it from older archival material. In these cases, there is a periodic return to unsolved problems or their semi-acceptable solutions, so that the topicality of the older literature is constantly kept constant.

Price also formulated in 1976 the general theory of characterizing methods of scientific communication as the beginning of cumulative advantage as follows: "Success seems to reproduce success. A document that has been cited many times is more likely to be cited again than another, which is rarely cited. A multi-tasking writer is more likely to republish than someone less productive. "A magazine that frequently reports on an issue is more likely to be reactivated than one that was rarely used before." The above principle is also known as "according to Matthew influence" - because whoever has, will be given and will continue to have in abundance, while whoever does not have, will be deprived of what he has - (Evangelist Matthew 25:29). Matthew's influence explains the increase in recognition for specific scientific offerings to scientists with a recognized reputation and the non-retention of recognition by scientists who have not yet made their mark.

While this definition focuses on recognition, the sociologist of science Merton recognized that other factors also tend to differentiate scientists (Cole, 2004). Merton and his school were deeply concerned in the 1960s and 1970s as to whether science really lived only under the ideal rule of universality, that is, of equality and equality in the scientific community, or whether the particular factors that differentiate scientific community play a role, such as the age, university or institution that a scientist serves. Merton, then, had argued that the Matthew phenomenon occurs mainly in cases of collaboration and independent multiple discoveries (Merton, 1973). He pointed out that one effect of Matthew's influence is that when a high-level scientist makes a scientific contribution, he is more likely to be identified by a lower-level scientist. Regarding the Phenomenon according to Matthew there is another term that sometimes appears in science, "the halo phenomenon" (Crane, 1967). This term describes the advantage that a scientist accumulates through his / her efficiency of having studied in high-ranking universities.

Margaret Rochiter, commenting on the Matthew phenomenon, noted that the non-recognition or difficulty in recognizing a female scientist in comparing her to her male colleagues adds to the issue of her gender, which is another additional barrier. in her career, which in fact is more difficult to overcome than silver. She defined the parallel but opposite phenomenon, the "Matilda Phenomenon", which refers to the prevailing trend in science that women should be ignored or not given the recognition they deserved in their time. The name Matilda comes from Matilda Gage, a nineteenth-century author and well-known feminist who had faced indifference and marginalization to such an extent that her name was adopted by the theory that racist treatment of women by men. The time was now ripe for the acceptance of the above ideas related to the globalization of science communication, the development of knowledge and published results, the growing specialization, as well as the growing importance of interdisciplinarity in scientific research. At that time, basic models for scientific work were also developed. Among these models are the first for the basic concepts of scientific communication, as well as for the development and aging of information.

Although bibliometrics was used as a standard for measuring the production of scholarly publications almost a century ago, the term was first introduced, as mentioned above, by Alan Pritchard in his work "Statistical Bibliography or Bibliometrics?" published in 1969. However, what greatly enabled the quantitative analysis of scientific publications was the work of Eugene Garfield in the 1960s and the indexes he introduced under the name Social-Arts- and Humanities Science Citations Indexes, through of the Institute for Scientific Information (ISI). Garfield's original idea and goal was to provide researchers with a quick and efficient way to find published articles that dealt with their various areas of research (Garfield, 1968). Soon, however, he expanded his study and work, as he dealt with the evaluation of the reports that were written, thus: "The reasonable conclusion is that, as the scientific enterprise becomes larger and more complex and its role in society becomes more and more and the more critical, the more difficult, costly but also necessary will be the evaluation and clear identification of the largest and most important contributions ”(Garfield, 1979b). Garfield sought to portray the analysis of reports as a legitimate and practical tool for evaluating scientific production.

The existence of the Social Science Index (SCI) was not only the driving force for a large number of bibliometric studies, but also favored the emergence of a new generation of scientists - researchers of bibliographic analysis, supporting, characterizing and establishing the scientific with the term "Science of Science" (Price, 1965). Derek de Solla Price, a proponent of this methodology, with a large sphere of influence, tried to adopt and follow an approach to science that was independent of that which scientists adopted and applied. According to Price, science could be measured based on published material and could be analyzed independently by scientists. According to him, the scientists were experts who, however, were still not considered experts when dealing with objects other than their respective fields of research. He wrote: "Just as the science of economics has become a valuable tool for decision-making in the hands of government and the industrial world, as well as an independent subject of academic study, it may mean that we are witnessing the birth of a similar scientific evaluation and analysis. of the world of science "(Price, 1964). Price predicted that in the near future, the analysis of reports could be used in the peer review process.

In this field, Russian researchers - looking back to the 1930s - linked scientific analysis with the social sciences, in order to provide methodological descriptions of the various disciplines. The measurement systems they developed led to the creation of a new field, called Naukometrica (literally meaning "the measurement of science"), which was a forerunner of Bibliometrics.

Garfield, to return to the founder of the Institute for Scientific Information (ISI), also credited co-citation as a measure of similarity between two or more articles. That is, if two articles often appear together in co-cited lists, they are likely to have some similarities. This means, simply put, that if collections of articles are ordered according to their number of co-references, this should produce a template that reflects the relationships between cognitive scientific areas.

In 1973, Robert Merton founded the theory of sociology of science, in which he proves that references are the way in which scholars recognize the influence of previous work. Based on this, the report is used as an indicator of the scientific value of the research.

In the 1970s and 1980s, Bibliometrics rose sharply and found a new direction. From the beginning of the eighties, Bibliometrics was able to develop into a separate scientific entity with a specific research profile, many subfields and the corresponding scientific communication structures. Scientometrics was first published in 1979 as the first journal to specialize in bibliometric issues, the first relevant international conferences began in 1983, and the Research Evaluation magazine was first published in 1991. The main reason for this development may be one sees it in the availability of large bibliographic databases in machine-readable form, as well as in the rapid development of computer science and technology. This made it possible for science measurements to be activated and managed outside the United States. At first, license fees resulted in severe restrictions, at least in the 1980s, but the technology of the 1990s revolutionized. On-line bibliometrics, however, remains a dream. Funding for major projects seems to have become the normal way of funding Bibliometric research. From "Small .... metric" the research field has changed to "Large ... metric".

The publication of several books on integrated bibliometrics, including by Haitun (1983), Ravichandra Rao (1983), Bujdoso (1986), van Raan (1988), Courtial (1990), Egghe and Rousseau (1990) reflects this procedure. The fact that bibliometric methods are already applied in the scientific field "Bibliometrics" by itself also indicates the rapid development of the scientific area. In the 1970s and 1980s, Bibliometrics found a new direction:

• Bibliometrics has evolved from an invisible college, from a sub-area of librarianship to an instrument for evaluation and benchmarking. This can be seen as a "change of perspective".

• As a result of this change of perspective, new fields of application and challenges are opening up for Bibliometrics, but several tools are still being designed for use in scientific information, information retrieval and libraries.

2.1.1 Institutions of research and service centers

Germany:

One of these research centers, the Dokumentationsstelle fur Versorgungsmedizin, was founded in 1956 by Otto Nacke, who remained head of the institute until his retirement in 1980. The center was located in Bielefeld and focused on documentation. It then changed its name to "Institutfur Dokumentationund Information uber Sozialmedizinundoffentliches Gesundheitswesen" (IDIS) in 1976.

Otto Nacke coined the term Information Science in 1979. Germany's second center, the Center for Science Studies, was run by Peter Weingart at the University of Bielefeld. It was succeeded by the "Institute for Science & Technology Studies". Its director, Peter Weingart, first focused on the Sociology and Philosophy of Science (mainly in the 1970s), but later extended his research to quantitative science studies as well. Hungary:

The ISSRU in Budapest was founded by Tibor Braun at the beginning of the decade. This center is housed in the Library of the Hungarian Academy of Sciences. The first international scientific publications from this center date back to around 1976.

Netherlands:

The Center for Science and Technology Studies (CWTS) at Leiden University is headed by Atnhony van Raan. It was founded around 1982 and was originally named the LISBON Institute. His profile is similar to that of the ISSRU in Budapest (focusing on Science and Bibliometrics).

The second center of the Netherlands, the "Dept. Science Dynamics "at the University of Amsterdam was renamed and restructured many times. It is headed by Loet Leydesdorff, who published his first results in international scientific journals around 1980.

France:

The team of William Turner, Michel Callon, Jean-Pierre Courtial and their colleagues at Ecole Mines in Paris focused on structural issues, such as mapping and visualizing science (actually based on related word analysis). The group was already active in the early 1980s.

France's second center, the Observatoire des Sciences et des Techniques (OST), was established as an inter-institutional platform in 1990. The OST, headed by Remi Barre, was one of the first organizations in Europe to publish every two years. reports on Science and Technology Indicators.

Spain:

The CINDOC Center for Scientific Information and Documentation was launched shortly after the 1980s (internationally visible since about 1985). The Institute recently changed its name to IEDCYT. Isabel Gomez is its president.

2.1.2 Educational communication

Educational communication focuses on:

• regular publication of scientific articles in the Czechoslovak Journal of Physics, circa 1970.

• International scientific journals.

- Scientometrics,
- Research Evaluation,
- Journal of Informetrics,

• Editing by Otto Nacke of the books entitled "Scientometrie und Bibliometrie in Planung und Forschung" (1976) and "Zitatenanalyse und verwandte Verfahren" (1979).

• The first "Handbook of Quantitative Science and Technology Research" published by A.J.F van Raan appears in 1988.

• organization of international conferences

- International Conference for Informetrics and Scientometrics (every two years since 1987),
- International Conference for Science and Technology Indicators (every two years since 1988),
- CollNet (since 1998),
- Foundation of the International Society for Informetrics and Scientometrics (ISSI, 1993).

During this period, the development of a special scientific methodology took placeQ

1. Co-analysis with references was proposed for the structural mapping of science. The ISI issued the co-report based on the Atlas of Science.

2. About a decade later, Callon et al. (1983) developed another process of mental mapping called Leximappe, which was based on word pair analysis.

3. Later, these methods were supplemented by and in conjunction with others based on text (term frequency) and citation techniques (bibliographic links, direct citation link, co-citation author).

4. The development of consistent systems of scientific indicators for the evaluation of research performance at ISSRU (Budapest, Hungary) and CWTS (Leiden, The Netherlands).

5. The 1980s are typical of the important steps towards the establishment of Science and Informatics with important initiatives and institutionalization of the field in Europe.

2.1.3 Bibliometrics in the 90s and the new millennium

The spectacular development of Bibliometrics in the 1990s is largely due to the Information Technology revolution we have recently witnessed.

The following developments and their synergy have facilitated innovations and the popularity of our research field.

• Availability of databases

• In the 1970s and 1980s, access to electronic versions of bibliographic databases suitable for bibliometric use was the prerogative of very few institutions worldwide. That changed in the 1990s, when versions of SCI, Medline, and other databases became available in universities and institutional libraries.

• Material development

• Older information processing running on expensive servers could gradually be transferred to corporate servers and PCs (librarianship laptops).

• Use of software

• Opened Bibliometrics to a wider group of users among scientists and "non-professionals" bibliometers

• Internet and the World Wide Web facilitates collaboration between librarians and scientists ("Connected Librometers")

• The entry of Bibliometrics in European, national and local Science & Technology: The journal Science and Engineering Indicators (SEI) is published by the National Science Board (USA). The first issue appeared in 1993, and since 1996 the SEI has been issued every two years.

• The European Commission has been regularly publishing European Reports on Science and Technology Indicators since 1994.

• The Annual Performance Report (OST). This report measures institutional research results, allowing their performance to be compared with French or European institutions.

• The Dutch Science and Technology Observatory (NOWT) is a collaboration between CWTS (Leiden) and UNU-MERIT (Maastricht). The Science and Technology Index Reports have been published regularly since 1994.

• The Flemish Indicator Book on Science, Technology and Innovation covers a relatively wide range and has been published every two years since 1999. The book is published by ECOOM in collaboration with the Government of Flemish.

• Bibliometrics is used in the monitoring of public resources and in strategic decision-making processes.

• Governments use bibliometric information, not only in the form of funding, but also in monitoring and forecasting processes.

• Institutions used Bibliometrics to monitor programs and decision-making strategies.

Funding mechanisms and research evaluation exercises

• Changes to the Research Evaluation Process (RAE) in the UK are planned for future, weighted funding for higher education research quality after 2008.

• One of the main funding mechanisms for basic science in Flemish universities is the Bijzonder Onderzoeks fonds (BOF). Part of the allocation process is based on the publication and submission of data from the "Web of Science" (Thomson Reuters) by the Center for Research & Development Monitoring (Expertise centrum Onderzoeken Ontwikkelings monitoring, ECOOM). (Debackere &, 2004).

• Since 2005, the allocation process for core research funding in Norway has included an output index for scientific publications. The Norwegian model is now applied in Denmark.

Different forms of Pseudo Random Function (PRFS) funding are used today.

Further examples for PRFS's with quantitative data are currently:

• The University Grants Index, the Research Quality Framework (RQF) and the Excellence in Research for Australia (ERA) in Australia.

• Performance-Based Research Funding (PBRF) in New Zealand.

• The funding formula for the allocation of university resources in Finland.

• The Triennial Value Rating (VTR) / Quinquennale Value Rating (VQR).

Over the last decade, Bibliometrics has been part of the postgraduate or doctoral programs at many European universities. Special courses are also offered by universities and research centers, such as:

• "Measuring Science" at CWTS, University of Leiden.

• "Road show seminars" and organization of Scandinavian doctoral studies in Bibliometrics, by the Nordic Research School in Library and Information Science (NORSLIS).

• "European Summer School for Scientometrics" (esss), co-organized by the University of Vienna, the Humboldt-Universitat Berlin and the KU Leuven.

2.1.4 The Impact of Bibliometrics

• The need for measurements in information services, science policy and research management has become widely recognized.

• Bibliometrics is playing an increasingly important role in the evaluation of research and quantitative formulas with bibliometric components are increasingly used in the distribution of funding.

• The successful application of scientific methods have greatly contributed to the increase of their popularity.

• Electronic communication, the web and open access paved the way for the democratization of Bibliometrics.

However, they have devalued the sector:

• fast and untrue statistics and ratings,

• up-to-date application and

• abuse of Bibliometrics.

2.1.5 The need of research evaluation

Industrial societies were particularly positive and favorable to the development of science (Bush, 1960). Since its inception in 1957, research conducted by the National Science Foundation (NSF) has convinced the American public that the contribution of science and technology to social progress is of paramount importance (National Science Foundation, 1989, p. 170 -172).

Competition in addition to the Soviet Union was the impetus for the United States to make significant R&D efforts in the 1960s. These efforts include the creation of a variety of services, offices, organizations and institutions. This was followed by similar moves in Europe, the Soviet Union and Japan.

A change took place in the 1970s when science ceased to be considered a business in which society could invest generously and without limits. The first phase of this complete shift in public opinion was a consequence of the slowdown in economic growth. At the same time, it came from a more critical attitude that now prevailed and took into account, in essence, the negative consequences of scientific research such as that science and technology were costly sectors, while investment in research did not automatically ensure that environmental or social problems, such as the gap between industrialized countries and the Third World.

This has led to strong concerns about the effectiveness of basic research, primarily in combination with the fact that researchers are increasingly gaining ground as researchers being "science producers" who have to account for the resources they receive. In addition, the student uprising worsened the image of universities, as well as the power and prestige of scientists and alumni.

Such events have aroused the suspicion of the wider society and the distrust of public opinion towards science and technology. The new goal was to generate added value by helping to conserve natural resources, reduce pollution rates and create a more efficient research system that would make better use of existing scientific knowledge. Within this historical context, the evaluation of scientific research and scientific work in general makes its appearance.

As a result of the above, the methods of the social sciences and humanities (considered the "soft" sciences) were used to analyze the "hard" sciences. Quantitative criteria and measures were required for this purpose. In other words, methods had to be found to quantify, compile and compare the indicators. The introduction of a measure of science has become inevitable. This great change paved the way for the analysis of science and technology and favored the introduction of Bibliometrics in the sciences.

2.2 Laws of Scientometrics

2.2.1 Zipf's Law

The most powerful, broad-spectrum law of Wilometry is Zipf's law. Zipf's law applies to a variety of disciplines dealing with natural language such as linguistics and in particular quantitative linguistics and computational psycholinguistics. The law finds application in addition to natural language in a variety of other sciences such as music, computer systems, the Internet, physical and biological systems. Zipf argued that his law is based on basic prognostic human behavior: he tries to minimize effort. Therefore, Zipf's work applies to almost every field where human production is involved. Zipf's law describes the relationship between the frequency with which words appear in a body of text (corpus) and their classification. The mathematical expression of the law is:

$$r \cdot f = c$$

where r corresponds to the classification of a word, f corresponds to the frequency of occurrence of the word and c corresponds to a constant, which depends on the body of the text.

So, by placing the words of a text body in descending order, starting with the one with the highest frequency, then the second most common word will appear about half as many times as the first and the third most common word about 1/3 times as much as the first coke. So, multiplying the classification r by the frequency f of each word, the constant c should remain approximately the same for each word. There is, therefore, an inversely proportional relationship between the order and frequency of the words in a text.

In the work of Wyllys (1981) Zipf's law, in addition to its above algebraic expression, is also described as equivalent to the graphic representation:

$$\log r + \log f = \log c$$

where in the design of the resulting pairs of points, the logarithm of the order r is placed on the horizontal axis and the logarithm of the frequency f on the vertical axis and thus the points form a slightly curved line, also known as the Zipf curve (Zipf's curves).

Wyllys also states that the calculation with Zipf's law has more valid results, especially for the ranking of words with a middle order of appearance, than for words with a very high or low frequency of occurrence. He also states that Zipf's work shows that the sample size should be at least 5000 words, so that $r \cdot f$ is stable, even for the middle rankings.

Table 2.1. Example of text body word distribution according to Zipf's law

Terms	**Classification of terms**	**Frequency of display of terms**	**Calculation of $C = r \cdot f$**	**Expected frequency $C = 1000$**
The	1	810	810	1000
Of	2	450	900	500
A	3	280	840	333
Information	4	270	1080	250
Is	5	230	1150	200
To	6	200	1200	167
And	7	190	1330	143
That	8	170	1360	125
As	9	160	1440	111
In	10	140	1400	100
We	11	130	1430	91
Be	12	125	1500	83
Or	13	90	1170	77
May	14	85	1190	71
by	15	80	1200	67

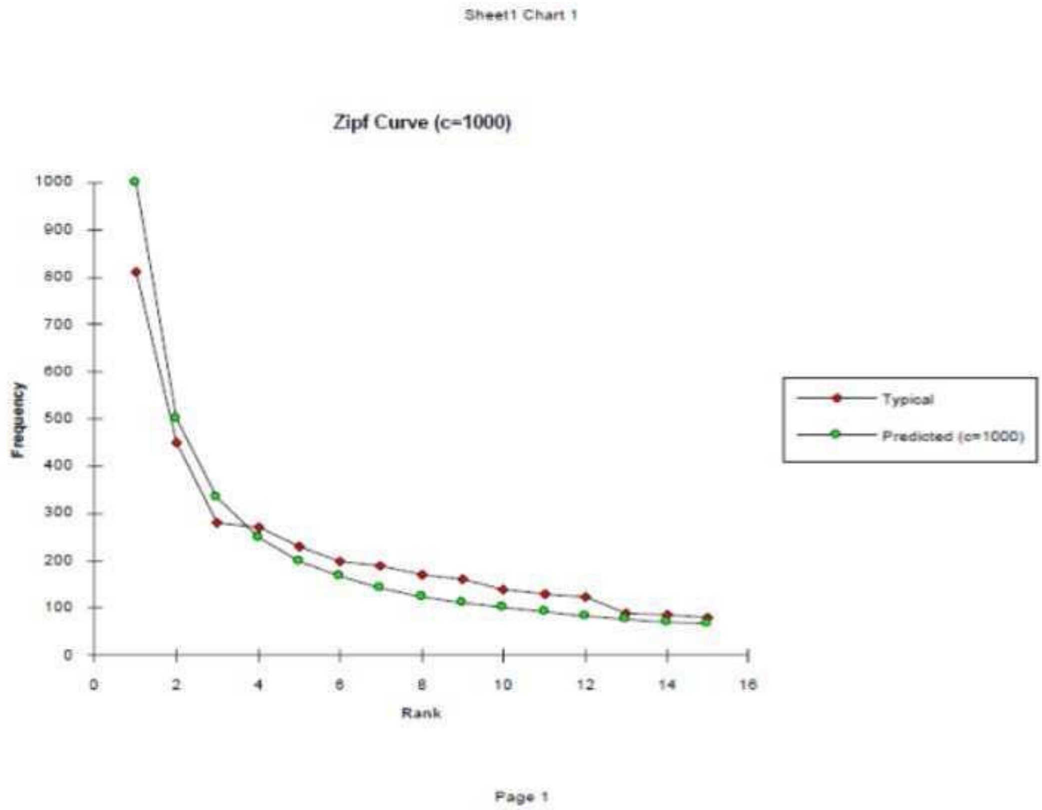

Figure 2.1. The Zipf curve for the actual and predicted values of the example

2.2.2 Lotka's law

Lotka's law describes the frequency of publication of authors in a particular field. He states that the number of authors who have produced x articles is about 1 / x2 of those who create only one and the proportion of contributors who have a contribution is about 60.8%. This means that of all the authors in a particular field, 60.8% will have only one post and 15.2% will have two posts (1/22 out of 60.8), 6.8% of the authors will have three posts (1 / 23 by 60.8), and so on. According to Lotka's law of scientific productivity, only 6 in 1000 authors in a field will produce more than ten articles (Palmquist, 2005).

Lotka's law is given by the relation $f(x) = k/xa$, where a, k are constants with positive values, $x = 1.2$, and $f(x)$ is the number (or percentage) of authors with x posts.

So, taking $a = 2, k = 0.608$ (values given by Lotka) for collections of at least 1000 authors, we can predict how many authors $f(x)$ have written x publications (how many one publication, how many two, etc.)

Table 2.2. Frequency of distribution of scientific productivity (publication of authors in a specific field)

Expected number	Number of authors	Percentage of authors of publications
1	$608 \cdot 1000/1^2 = 608$	60.8%
2	$608 \cdot 1000/2^2 = 152$	15.2%
3	$608 \cdot 1000/3^2 = 68$	6.8%
4	$608 \cdot 1000/4^2 = 38$	3.8%
5	$608 \cdot 1000/5^2 = 24$	2.4%
6	$608 \cdot 1000/6^2 = 17$	1.7%

However, Lotka does not take into account the impact, only the production numbers. In addition, in 1974 Voos found that in Information Science, the ratio was currently 1: n35 (Voos, 1974). Thus we can say that Lotca's law may not be constant in the value of the exponent of the force, but in the inverse square type. The challenge, then, for us will be to find the right exponent in different media and fields.

2.2.3. Bradford's Law

The law states how articles, in a specific subject area, are distributed in magazines. His goal is to develop a method for identifying the most productive magazines in a thematic field and to manage what he called "documentary chaos". It serves as a general instruction to librarians in identifying key journal titles in a particular subject area. It states that magazines in a particular subject area - as we have already mentioned - can be divided into three groups, each of which contains the same number of articles. The first core group consists of a relatively small number of journal titles for this field, comprising about one third of the total number of articles, the second group contains the same number of articles (1/3) as the first, but a larger number of journal titles, and the third group contains the same number of articles (1/3) as the second and first and an even larger number of journal titles. The mathematical relation of the number of journals in the nucleus of the first group is a constant κ and in the second zone the relation is κ1. Bradford expressed that the number of journals in the above three groups increases with the ratio κ^0: κ^1: κ^2, ... (eg if we have a group of 390 articles that refer to a topic, published in 39 journals and 130 are in the top three magazines -in terms of number of publications in this category- then the ratio in successive groups of 130 articles would be as follows:

The first 3 magazines out of the total of 39 increase by k^0 the next 3 by k1 the next 3 by k^2 and so on. So $3 * \kappa^0 + 3 * \kappa^1 + 3 * \kappa^2 = 39$ or $3 (\kappa 0 + \kappa 1 + \kappa 2) = 39$ or $\kappa^0 + \kappa^1 + \kappa^2 = 13$ or $\kappa + \kappa^2 + 1 = 13$ or $\kappa^2 + \kappa - 12 = 0$ or $\kappa = 3$.

So, the number of magazines per group will be: 3, 9, 27

2.3. Scientometric indices

2.3.1 Quantitative indicators of scientific production

Many bibliometry researchers stress the importance of not considering the results of any bibliometric analysis as "truths." The term bibliometric indicators is often used to denote the fact that the results describe a rather complex reality, which should be measured only by statistics or numbers. Bibliometric methods contain so many simplifications that they provide only a very limited picture of the research they are trying to describe. It is important to see bibliometric indicators as one of the many tools to be used by those in charge, with expert knowledge, graders, relevant to the research areas included in the analysis. This is evident, for example, when the publications included in an evaluation contain very unusual or new research data. This work has not yet been reported, which means that any assessment based solely on bibliometric indicators will not reveal the potential dynamics of the research teams involved.

No bibliometric index has the power to be used alone in isolation from others. Several indicators must always be combined to achieve a more complete picture of the scientific output of a unit (Visser, 2003; Nederhof & vanRaan, 2003). The Crown index should, for example, always be accompanied by the so-called top index, which indicates whether the average value of citations to unit posts is due to some very highly cited articles or the majority of citations are a little above average and one quantitative indicator to show how many publications are included in the analysis.

2.3.1.1 h-index

Hirsch created the h-index in 2005 in his article entitled "An Index for Quantifying the Scientific Research Production of an Individual." In this fundamental article, Hirsch sought to answer the question, "How can one quantify the cumulative effects and significance of an individual's scientific research results?" The index h is the number of publications (h), attributed to the unit under analysis, during the period analyzed, which has at least h citations. It is calculated by the Web of Sciense organization, finding it in the citation report area at the beginning of a search. In Scopus, the user will find the h-index by conducting a search and selecting the author's name as a hyperlink in the search section. The index has the same disadvantage as the other key indicators, as it simulates comparing research papers of different types, published in different time periods, on completely different topics. The index is biased in favor of older researchers with many articles, as they had the most time to report. However, this bias is somewhat mitigated by the fact that every new article by a writer with a high h-index must have a high level of reference in order to grow the already high h-index. Another criticism of the h-index is that it puts scientists with short careers at a disadvantage, as the h-index can not be greater than the number of published articles, as it does not matter how important and highly cited their articles are. . The h-index is intended to distinguish truly remarkable scientists as opposed to those who simply publish too many articles.

• Not affected by individual articles that have received multiple citations.

• Works correctly only when comparing scientific papers that are in the same scientific field. Because the reports differ greatly between different scientific fields.

• To compare h-indices by normalizing their values, we divide them by a second factor such as the years that have passed since obtaining the doctorate.

2.3.1.2 G -index

Because the h-Index is unaffected by articles with high or low citations, if any quantitative index is used to measure the value of a researcher, it should calculate the influence or impact or impact of its most important articles.

Imagine that three authors have the following 'performance' leading to the same h-Index number 3. This does not seem very logical and fair.

For this reason, Leo Egghe (Egghe, 2006) proposed an improved version of the h -index, the G-Index, which takes into account the performance of each author's most important articles, differentiating them into a more 'fair' ranking.

Table 2.3. Calculation of h and G indices example

Articles reports	Ranking	Cumulative reports	Squared ranking
47	1	47	1
42	2	89	4

37	3	126	9
36	4	162	16
21	5	183	25
18	6	201	36
17	7	218	49
16	8	234	64
16	9	250	81
16	10	266	100
15	11	281	121
13	12	294	144
13	13	307	169
13	14	320	196
13	15	333	225
12	16	345	256
12	17	357	289
12	18	369	324
12	19	381	361
11	20	392	400

We rank the articles in descending order starting with the one that has the most citations 47 number. In the second row in the column cumulative references we will have the number 89 resulting from the sum of the 47 references of Article 1 and the 42 of the 2nd and in the 4th column the number 4 resulting from the ranking number of Article 2 in terms of references raised to square. The h-index equals 13, because 13 articles have at least 13 citations. The g-index is 19, since it is the last rating to which it applies: number of cumulative reports greater than the order in the square, ie 381> 361 that applies to the ranking order 19.

2.3.1.3 Other indices

The question is: What additional bibliometric indicators can analysis offer? Ή how to use the data to produce the various indicators? The answer to these questions is given by the construction of the following indicators (Sachini et al., 2014):

• The Number of publications

It is the first of the most basic bibliometric indicators to show the production volume of research papers attributed to a scientist or to, a research team, or a body, or a scientific field or a country, over a specified period of time.

• The Number of citations

The next of the two (2) most basic indicators that shows the recognizability or the influence of the research publications that received reports, during a defined period of time.

• The number of publications and reports per researcher

This number is a relative measure of publications and reports per researcher. It shows the result of scientific production in relation to the resources invested by compensating, with its size.

• Share of publications (Share) publications

The percentage share of publications is calculated as the percentage of the number of research works of the country on the total number of works of other countries that are members of international organizations, such as the Organization for Economic Co-operation and Development or a scientific area on the total number of research publications country or a category of organizations on the total number of publications of organizations in all scientific fields or an organization on the total number of research publications in the category to which it belongs.

• Percentage (%) of publications receiving reports (% cited papers)

It is calculated as the percentage of articles that have received at least one reference. The calculation takes place at intervals of overlapping x years in the following categories: in the whole country, per category of organization.

• Share of citations

Calculated as the percentage (%) of the number of reports (x time intervals) received by the scientific publications: of the country on the total number of reports received by the publications of the member countries of an organization or a body on the total number of reports received the publications of the category to which it belongs.

• Citation impact index

The response rate is the average of reports per post and is calculated as the ratio of the number of reports recorded in a given period of time to the total number of publications in the same period.

• Relative citation impact

The relevant repercussion index compares the repercussions of an entity's publications (eg Ionian University) with the repercussions of the publications of a defined reference set (eg a set of Greek universities) and results from the division of the respective repercussions. When the value of the relevant echo index is greater than 1, the publications of the entity under review have a higher echo than the average of the reference set. This indicator does not take into account differences in reporting practices in different scientific areas.

• Relevant index - Field normalized citation score

The post-normalization response rate, based on the number of different scientific subject areas, compares the response of a publication to the impact of publications worldwide in the same scientific area. When the value of the relevant impact index is greater than 1, the publications of the entity under review have a higher impact than the global average. The relevant post-normalization ratios are calculated for: the total publications of a country or the publications of a category of bodies per scientific field or the total of the publications of a body or the publications of a body by scientific field.

• Number of high-profile posts (P Top X%)

This is the number of scientific publications that globally and per year are ranked high in the percentage ranking of publications in the respective scientific field. The ranking is based on the number of reports. The index is calculated for periods of five years, refers to the number of publications ranked worldwide in 1%, 5%, 10%, 25% and 50% of the publications with the highest impact and refers to: the whole country or per institution.

• Percentage (%) of high-impact publications (Top X%)

It is calculated as the percentage (%) of the number of publications of an entity per year that are characterized as high-impact publications on the total number of publications of the entity in the same year. When the percentage distribution of the high-profile publications of the considered entity approaches or exceeds the corresponding global distribution of 1%, 5%, 10%, 25% and 50%, the entity is considered to approach or exceed the global average, respectively. The index is calculated for x time intervals and refers to: the whole country or per institution. http://metrics.ekt.gr/sites/metrics/files/bibliometric_analysis.pdf

• Average Index of Influence

Publications in high-impact scientific journals are often considered to be of high quality. It is not uncommon for researchers to be asked to provide information about their "average influence", ie the average value of the impact indicators of the journals they have published, when applying for research funding or for a new position. Sometimes, a research unit or a university also displays how many publications they have in journals with very high ISIs, ie the 20th or 40th highest ISI rankings, as an indication of the quality of research produced by the authors of that particular unit. However, the impact index of a journal cannot predict the number of reports that each individual publication will receive. Often about 20% of publications in a journal receive 80% of the citations and many articles cite 0-1 times even in high index journals as we have already pioneered.

• Publications without references

The percentage of publications that remain unreported after a certain period of time can be considered the opposite of the top 5% index. If the 'crown' index of a group's posts is high, information about a large number of unreported posts means that more effort has been put into some 'flag works'.

2.3.2 Indicators of scientific cooperation

The concept of collaboration has long been accepted in science, where interdisciplinary research or with the participation of many institutions or countries is common. Scientific co-writing is seen as a reaction to the process of professionalization of research, in terms of publication (Morrison et al, 2003). Kaz and Martin (1997) report that it can occur between individuals, groups, departments, institutions, sectors, regions or countries.

There are many reasons that lead researchers to collaborate, on which the following are based (Maz-Machado & Jiménez-Fanjul, 2018):

1. Professionals seek opportunities for collaboration in order to increase their visibility in their field. it can be assumed to apply to all cognitive fields, as the sciences generally share a common reward structure.

2. Access equipment, resources or materials that can facilitate or improve research.

3. Improving the composition of research teams in order to increase the chances of obtaining financial support in open calls.

4. To know and share new methodological techniques.

5. To increase the efficiency and effectiveness, as well as the quality of research.

6. Creation of research networks with greater social and scientific prominence.

7. The possibilities of research on interdisciplinary topics that touch different fields of knowledge, due to which experts from each of them are needed.

8. To interact with institutions of equal or higher prestige or to support the development of other less established research traditions.

9. To increase the scientific productivity of either the research teams or their members.

10. Collaborate with colleagues who share the same interests, ideas, theoretical frameworks or problems.

11. Increase citations and, therefore, the impact and visibility of scientific production.

It is a fact that scientific journals are a natural means of scientific dissemination, so they are a valuable source of information that allows the emergence of trends and patterns of scientific communication from a variety of sources: production by geographical sector, gender or by journals from specific fields (Maz- Machado et al, 2014).

Bibliometry studies and analyzes behaviors and patterns that appear in scientific journals and bibliometric indicators that allow the analysis and quantification of the influence of various aspects related to collaboration, such as productivity or scientific impact (Bordons, González & Díaz, 2013). Several indicators have been developed to quantify cooperation, among which the cooperation index (CI) (Lawani, 1980), the degree of cooperation (DC) (Subramayam, 1983) and the cooperation factor (CC) are emphasized due to its frequent use (Ajiferuke, Burrel & Tague, 1988).

2.3.2.1 Crown index

The crown indicator measures the scientific impact of a group of writers. Compares the average number of citations of the group publications with the average number of citations of the publications of the same year international publications, in the same subject area, of the same document types. It is usually written as a decimal number, which indicates the relationship with the global average, ie 0.9 indicates that the reported citations are 10% less than the global average and 1.2 indicates that the citations are 20% higher.

2.3.2.2 Top 5% index

Top 5% represent the percentage of publications attributed to a group of authors who belong to the 5% of the most cited publications in the world from the same year, in the same subject area, of the same document types. It is just like the 'crown' index, it is written as a decimal number and shows the relation to the world average. A value above 1 indicates that the unit under analysis has the most posts among the top 5% of the global average, while a value below 1 indicates that it has the fewest. Top 5% is often used as a supplement to the 'crown' index. Indicates whether a high 'crown indicator' value is achieved through very highly cited articles or a larger number of articles cited above average. It can also identify particularly highly cited articles from a low 'crown indicator' group whose top posts would otherwise go unnoticed. In this field of research knowledge is required to decide which of the two publishing standards is the best indication for high quality research.

2.3.2.3 Collaborative Index (CI)

The Collaborative Index (CI) is calculated as following:

$CI = \frac{\sum_{j=1}^{k} j f_j}{N}$ = mean number of authors per paper.

CI differentiates among levels of authorships and is very easy to calculate but it has the following disadvantages: 1) it is not easily interpretable as a degree for it has no upper limit (i.e., it neither lies between 0 and 1 nor is it expressible in terms of percentage); and 2) it gives a non-zero weight to single-authored papers, which involve no collaboration.

One way of avoiding these problems is to use 1 - 1/CI as a measure of collaboration. However, this has no theoretical base, though very easy to calculate (Ajiferuke, Burrel & Tague, 1988).

2.3.2.4 Degree of Collaboration (DC)

Degree of Collaboration (DC) is calculated as following:

$$DC = 1 - \frac{f_1}{N}$$

DC is easy to calculate and easily interpretable as a degree (for it lies between zero and one), gives zero weight to single-authored papers, and always ranks higher a discipline (or period) with a higher percentage of multiple-authored papers. However, DC does not differentiate among levels of multiple authorships (Ajiferuke, Burrel & Tague, 1988).

2.3.2.5 Collaborative Coefficient (CC)

Collaborative Coefficient (CC) is calculated as following:

$$CC = 1 - E[1 - X] = 1 - \Sigma\left(\frac{1}{j}\right)P(X = j)$$

where the average credit awarded to each author of a random paper is E[l/X], a value which lies between 0 and 1, and 0 is to correspond to single authorship and its sample estimate is $1 - \frac{f_1 + \left(\frac{1}{2}\right)f_2 + \cdots + \left(\frac{1}{k}\right)f_k}{N} = \frac{1 - \sum_{j=1}^{k}\left(\frac{1}{j}\right)f_j}{N}$ (Ajiferuke, Burrel & Tague, 1988).

2.4. Scientific cooperation networks

A social network (Wasserman & Faust, 1994; Scott, 2000) is a set of individuals or groups that have some kind of connection between them. In the language of social media analysis, individuals or groups are called "actors" and connections are called "ties". Actors and links can be defined in different ways depending on the aspects of the issue that interests us. An actor can be an individual, a group (individuals) or a company (or organization, etc.). A bond can be a relationship of friendship between two people, cooperation or joint membership (membership) in two groups or a business relationship between companies (etc.).

The analysis of social networks has a prehistory of at least half a century and has produced many results on social influence, social groups, inequalities, the spread of disease, the sharing of information and almost every topic of twentieth century sociology. There has also been a significant increase in interest in social networks within the physicist community, as evidenced by the large volume of work on this topic. The techniques of statistical physics have proven to be particularly suitable for the study of social networks. Extensive use has also been made of a variety of physical modeling techniques (Watts & Strogatz, 1998; Barabasi & Albert, 1999; Kumar et al., 2000), equation solving (Kleinberg, 1999), and Monte Carlo simulations (Albert et al., 1999). , Newman et al., 2000), group scaling and rearrangement methods (Newman et al, 2000), medium-field theory (Barabási et al., 1999; Newman et al., 2000)), percolation theory (Moore & Newman, 2000; Cohen et al., 200; Callaway et. Al., 2000), small world, generator functions (Moore & Newman, 2000) as well as other techniques familiar to physicists.

Traditional social media surveys have been conducted for various field studies. Typically, by focusing on relatively autonomous communities, such as a business, a school, a religious or ethnic community, etc., the researcher generates link networks by interviewing members of the community he or she studies or by using questionnaires. Thus, respondents are asked to name the members of the community with whom they have the closest ties, possibly classifying them subjectively and perhaps additionally asking for more information about these individuals or the nature of the ties.

Such research has revealed several things about the structure of networked communities, but they suffer from two key problems, which make them poor data sources for the kind of quantitative network analysis approaches adopted by physicists. First, the data they have is not numerous. Collecting and evaluating this data is a laborious process and most of these datasets contain tens or hundreds of actors. Investigations involving more than a thousand actors are rare. This makes the statistical accuracy of most data small. Second, these surveys contain significant errors that are difficult to control, as a result of the subjectivity of the respondents' answers. The definition of friendship by one member of the group may be completely different for another member. For example, research with school students (Fararo & Sunshine, 1964) has found that some students claim to be friends with each of their hundreds of classmates, while other students report two or three as friends. people. Obviously, these respondents have a different perception of the definition of friendship.

As a solution to these problems, several researchers have turned to other more well-documented networks, from which more reliable statistics can be collected. Examples of such networks include the World Wide Web (Albert et al., 1999; Broder et al., 2000), electricity networks (Watts & Strogatz, 1998), telephone calling networks (Abello et al., 1998) and routes. of airlines (Amaral et al., 2000). These graphs are particularly interesting and, in addition, can be considered as social networks, as their structure reflects something of the structure of the societies in which they are created. However, their connection to the "real" social networks we are dealing with here is rather weak, and therefore, in relation to our purpose, they can not lead to quite interesting results.

A very promising source of data is affiliation networks, that is, networks of actors that are linked to belonging to groups of some kind, such as clubs, workgroups or organizations. Examples of such networks that have been studied in the past include: women and the social events they attend (Davis et al., 1941), corporate executives and the clubs they attend (Galaskiewicz & Marsden, 1978), corporate executives and boards in which they participate (Mariolis, 1975), actors and the films in which they appear (Watts & Strogatz, 1998). Dating network data tends to be more reliable than data from other social networks, as membership in link groups can often be determined with an accuracy that is not available when referring to friendships or other types of dating. Very large networks can be collected in this way, as in many cases group membership can be easily verified through their member lists, making time-consuming interviews or questionnaires unnecessary. For example, a network of actors has been collected from the online movie database (IMDB) (http://www.imdb.com/), which contains the names of almost half a million actors, which is a much better sample than that of social networks to make statistical analyzes, although it is unclear whether this network has any social interest.

3. Databases for Social Sciences

Greek bodies that produce scientific publications depending on their field of activity and their character are divided into 11 categories: Universities / TEI / Research centers / Other public research bodies / Public health bodies / Private health bodies / Bodies under the supervision of the Ministry of National Defense / Museums / Banks / Other public and other private bodies.

The primary sources that can support bibliographic analysis are databases, which contain bibliographic records of scientific publications, as well as data on citations between publications. The most established and widely known databases are Thomson Reuters Web of Science, Elsevier Scopus and Google Scholar.

3.1 Web of Science

Initially, the ISI Citation Indexes were the only easy-to-use source of reporting information. The data of the ISI Citation Indexes as well as the Journal Citation Reports were used by organizations and universities worldwide. This is how the transition from the Web of Citation Indexes to the Web of Science (WOS) took place. Added to this is Scopus (www.scopus.com) founded by Elsevier and Google Scholar (http://scholar.google.com) which is open access (Barllan, 2008). WEB OF SCIENCE is a complete information system that provides access to bibliographic data of articles in 8,500 scientific journals. Allows you to link a scientific publication to other work either through citations made to the publication or through citations made to it. It can also be counted how often a specific article is referenced.

More than 8,500 journals are indexed, peerreviewed and since 1990 recorded in the minutes. Bibliographic records include detailed metadata for articles, authors, and research organizations. A key advantage is its reliability, as publications and journals are strictly evaluated on the basis of criteria such as their scientific impact. In addition, it enables the user to retrieve both the summary and the bibliographic references. According to Thomson Scientific, the Web of Science provides access to interdisciplinary information from prestigious and readable journals.

On the other hand, the disadvantage is the unequal coverage of scientific publications both geographically, since the majority of the material is from English-speaking countries, but also thematically since they excel periodically in fields of natural sciences and lag behind others. Coverage dates back to 1900 (National Documentation Center) and users are provided with 3 basic indexes:

- Science Citation Index since 1900
- Social Science Citation Index since 1970
- Arts and Humanities Index since 1975.

Another disadvantage of Web of Science is that it can underestimate the impact of a scientist's citations. In this database there are two functions, that of "general search" and that of "referral reporting". By comparison, Web of Science has fewer reports than Google Scholar.

3.3 Scopus

Scopus debuted on November 3, 2004 and covers all citations from 1996 onwards and thus tends to be considered the largest base for abstracts and online citations (Barllan, 2008).

It is a database of about 19,000 journal titles, conference proceedings and books, covering from 1966 onwards. As in the Web of Science, metadata contains detailed information about articles, authors, organizations. Quality evaluation always precedes the introduction of publications. It has a wider geographical coverage. The same does not apply to time coverage. A common point with the Web of Science is that here too there is anisomeric coverage of scientific fields.

Through Scopus there is access to Sciverse Scopus which is the largest database and contains 46,000,000 files, 70% with abstracts (approximately 27,000,000), close to 19,000 titles from 5,000 publishers worldwide, as well as over 4- 6,000,000 conference minutes. It is easy to access and rich in scientific information, especially what is related to and contained in each author's published research (Barllan, 2008). In addition, it contains the index h of each. According to Pendleburg, what is additionally offered on this basis is the full text, abstracts and relevant evidence (Pendleburg, 2008), so that at the same time the course of the objectives of the department of each university institution and, consequently, of each member of the university education community. In this way, it is resolved if the redefinition of goals and the design of new strategies are required.

3.4 Google scholar

This database contains a large number of sources, mainly "gray bibliography" publications. The content is very wide but with limited metadata. Admission criteria are limited and no exact geographical or thematic coverage is available.

This is why Scholar is not considered suitable for bibliometric analyzes due to the lack of metadata used to identify publications but also criteria that ensure the quality of publications. Instead, the Web and Scopus ensure the availability of metadata analytics and the quality of the publications they include. In addition, there is a difference between the previous bases. In particular, Scopus covers a wide range of content, while Web of Science outperforms the coverage period.

According to a study by Lokman Meho and Kiduk Yang (2007), the Web covers a sufficient number of publications and few important conferences. Scopus, on the other hand, is more concerned with conferences than pre-1996 publications. Google finally covers conferences and most journals, but like Scopus it does not fully cover pre-1990 publications (National Documentation Center).

Of course, in the case of Google, there is also the difficulty of locating the body from which each researcher comes, with the result that names need to be checked for the possibility of synonymy (Meho & Yang, 2007).

Google Scholar is open access. If the publisher is willing to give at least the abstract free access, then the publisher data is included in the list. The full text is given by subscription only. But if the data is given from other sources as well, then most likely the complete text will be found in another free access source. References are also displayed automatically, but even if they are not given, the number of citations in the search results is displayed (Barllan, 2008).

Barllan notes that in 2005 Bauer & Bakkalbasi concluded: “Based on the initial survey to calculate the maximum number of reports, we recommend that users consult Google Scholar in conjunction with Web of Science or Scopus, especially if it is a recent article, either in terms of authorship or subject matter ”. Contrary to the previous report, Jacso expressed his objections, pointing out the difficulty of Google Scholar to accurately determine the year of issue, with the result that the number of reports does not always correspond to the correct version (Jacso, 2006).

Professor Anne-Wil Harzing (2007-2008) comparing Google scholar with Web of science concluded that although Google is more accessible to anyone with an internet connection, this does not mean that its information is always reliable. , while the Web of science is available only to academic organizations that can meet the cost of the subscription. Consistent with the above is the view of Peter Jasco, who published in the Online Information Review (Jasco, 2006) documents detailing failed Google Scholar reports (Harzing, 2007-2008).

3.5 Databases comparison

A significant aspect in which these services differ is their approach to document integration. The Web of Science and Scopus rely on a set of source selection criteria, applied by expert authors, to decide which journals, conference proceedings, and books should be indexed by the database. Instead, Google Scholar takes a holistic and automated approach, indexing any (obviously) scientific paper that robot crawlers can find on the academic web.

Each approach has its advantages and disadvantages. The selective approach of Web of Science and Scopus produces a meticulous collection of documents, but is sensitive to bias in selection criteria. Indeed, the data have shown that these databases have limited coverage in the fields of Social Sciences and Humanities, bibliography written in languages other than English, and scientific papers other than journal articles. For its part, Google Scholar's comprehensive and unsupervised approach maximizes coverage, giving each article "the opportunity to go up in its own value." However, it leads to the presence of technical errors on the platform, such as duplicate entries mentioned in the same document, incorrect or incomplete bibliographic information and inclusion of non-scientific material.

Martín-Martín et al (2018) have recently tested the coverage differences in these three data sources on different subject categories. For a sample of more than 2,500 documents with extensive reference to 252 topic categories released by Google Scholar in 2017, we checked whether the documents were also covered by Web of Science and Scopus. This comparison favors Google Scholar, as it is the original source of the documents, but it is nevertheless a logical test, as it seems that any scientific database should have a fairly comprehensive coverage of highly referenced documents. The results showed that, even in this highly selective set of documents (all published in English), a significant amount in the Social Sciences and Humanities is not covered by the selective databases. In most cases, the reason was that the database did not cover the journal at the time the article was published.

Discovering the puppy in this issue, Martín-Martín et al (2018) compiled the complete list of citations provided by each of the three databases and identified the overlapping and unique citations. This new sample, which amounted to just under 2.5 million citations, gave us a more detailed picture of the relevant differences in coverage in all three databases, not only at the broad area level, but also for each of the 252 categories issues.

Results from wide areas showed that Google Scholar was able to find the most citations to Social Science articles (94%), while Web of Science and Scopus found 35% and 43%, respectively. In addition, Google Scholar appeared to be a superset of Web of Science and Scopus, as it was able to find 93% of Web of Science reports and 89% of Scopus reports. Last but not least, over 50% of all Social Science citations were found by Google Scholar alone. The same analysis was applied to the 252 specific theme categories and can be viewed in this interactive web application.

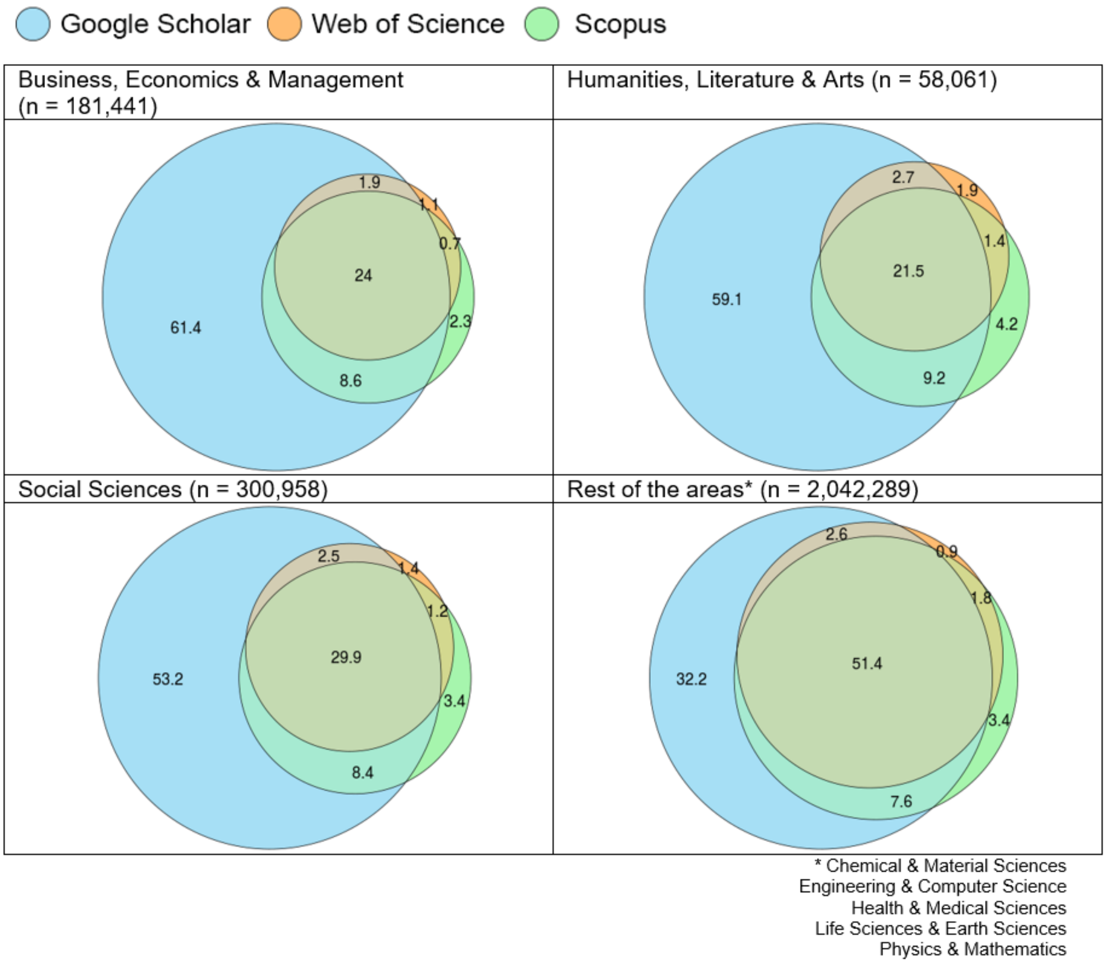

Figure 3.1. Number of citations of each database

Most of the reports found only by Google Scholar, especially in Social Sciences, Humanities and Business, Economics and Management, raise the question of what types of resources Google Scholar covers that are not used by other databases. To provide an answer, we identified the document types and citation languages in our sample and compared the proportions of document types and citation languages found only by Google Scholar on one side (unique citations to Google Scholar) and citations found from two or more databases to each other (overlapping references). The results were collected at the level of large areas.

The majority (~ 60%) of reports found only by Google Scholar come from sources outside the journal: among them we find dissertations and dissertations, books and book chapters, non-typically published articles such as printouts and working papers (especially important in Business and Economics), and conferences. Nevertheless, there is still a large percentage of citations to Social Science and Humanities articles from journals not included in the Web of Science or Scopus. There is also a significant minority of citations to Social Science and Humanities articles that can only be found by Google Scholar, from documents published in languages other than English that are not covered by selective databases.

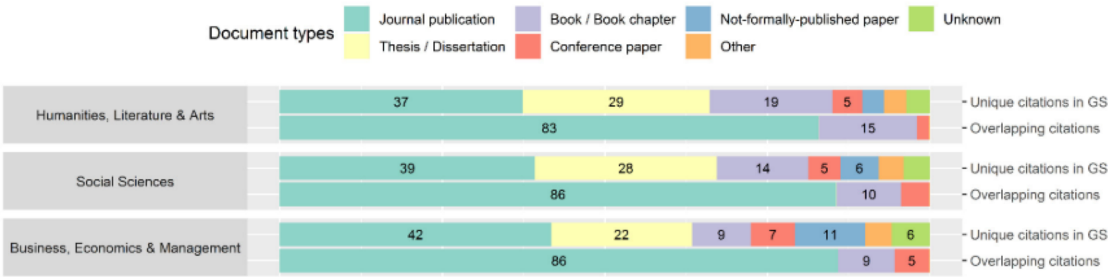

Figure 3.2. Publications per type

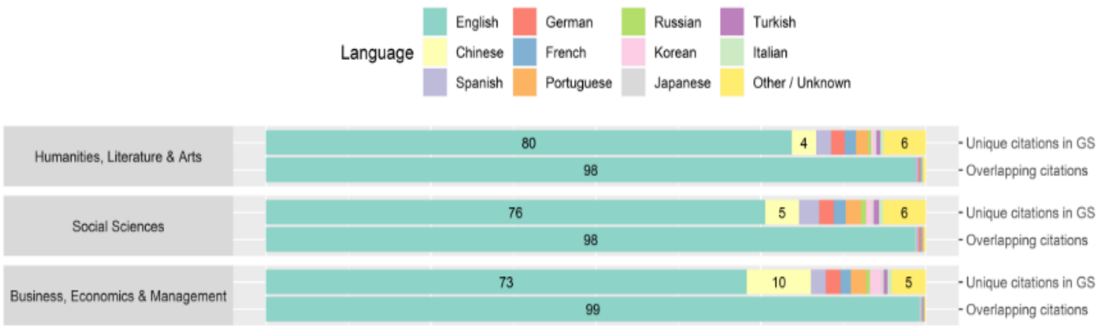

Figure 3.3. Publications per language

Interestingly, despite the significant differences in coverage, and despite the known errors that may exist in the data from Google Scholar, which we did not attempt to eliminate (e.g., inflated reports caused by duplicate entries), Spearman of reference numbers is very strong in all areas and databases (in most cases over 0.90, although sometimes lower in some fields of humanities). Therefore, if Google Scholar referral metrics were used for research evaluations, then its data is unlikely to cause major changes in results. It would be especially helpful when there is reason to believe that documents not covered by Web of Science or Scopus are important for an evaluation.

In conclusion, the comprehensive example of document indexing disseminated by Google Scholar makes it easy to discover not only the most well-known sources, but also areas of scientific communication that were previously hidden from view. This can be useful in bibliographic searches as well as in those who need to gather evidence of research impact for a collection of results, but at the same time it has created some of its own problems. The question is whether we are ready to accept a compensation: to exceed the comfortable and regular limits of elaborate databases in exchange for a different coverage.

3.6 Scopus Business, Management and Accounting category

Scopus Business, Management and Accounting category contains 1742 journals from USA, UK, Netherlands, Germany, Denmark, Spain, Russian Federation, Singapore, Spain, Switzerland, India, Taiwan, Australia, Slovenia, China, Poland, Egypt, Lithuania, France, Bulgaria, Austria, Turkey, Indonesia, Portugal, Canada, Italy, Argentina, Bahrain, Belgium, Bosnia and Herzegovina, Brazil, Bulgaria, Chile, Colombia, Croatia, Czech Republic, Greece, Iran, Japan, Ireland, Malaysia, Mexico, Montenegro, New Zealand, Pakistan, Philippines, Poland, Romania, Serbia, Slovakia, South Africa, South Korea, Sweden, Ukraine and Venezuela.

4. Background in the evaluation of educational scientific production related to legislation.

The study of the evaluation of academic legal research in Europe is a recent phenomenon. Since the 1980s and increasingly since the 1990s, a transnational evaluation debate has taken place and procedures for evaluating legal research units are being explored and devised. In other (European) countries, several studies have addressed the issue of evaluating academic legal research. The object of research in these studies is usually the evaluation of research produced by entire units and / or individual researchers. In general, these reports do not contain information that allows conclusions to be drawn about the success of the process developed. In most cases, the research evaluation aimed to distinguish the "best" research work from the others (benchmarking). The work evaluated shows that there is no clear consensus on quality criteria in the research community (Lienhard et al, 2016). Several projects that have been executed have still faced significant resistance and criticism from the research community and / or have not been completed (Gutwirth, 2009). Therefore, it can be said that the legal scholarship lacks an intensive discussion on the criteria and indicators that prove the quality of legal research.

Evaluation of research projects is not an autonomous function, but depends on the evaluation framework. The concept of quality is linked to the context and purpose of evaluation (Reichert, 2013). Research product expectations will vary depending on the discipline, the medium of publication (for example, articles or monographs) or the expectations of those involved. The evaluation is ultimately determined by the objectives and results of the query research and the extent to which these requirements are met and applied. While the debate over the quality of legal research is generally broad and includes the evaluation of further issues (for example, the performance of researchers and research institutes), the quality of publications, as the main product of research, always plays a central role.

In particular, this includes the evaluation of scientific articles carried out by journal publishers in order to decide whether the work for publication will be accepted, as well as the evaluation of publications by professors. The aim is to get an overview of the practical evaluation of academic legal publications as well as to explore appropriate procedures and criteria for the evaluation of academic legal publications.

4.1 Properties of academic legal research

4.1.1 General remarks

The object of the research is the quality of the academic legal research. The following observations provide a brief explanation of this term: on the one hand, only scientific research is considered. Defining what is scientific is the subject of an ongoing communication process for researchers (Herbert and Kaube, 2008).

In continental European legal science, there is an occasional debate as to whether traditional dogmatic legal research can actually be considered scientific at all (Larenz and Canaris, 1995). For the purposes of this contribution, a broader definition of what research is considered scientific has been chosen. Research can be considered scientific firstly if it is conducted independently and secondly if it demonstrates some degree of abstraction (Lienhard et al, 2016). This distinguishes scientific research from legal practice in particular. However, it covers both "traditional" dogmatic research on the content of the law and its application, as well as research using empirical or other methods (Larenz and Canaris, 1995). In short, we define academic legal research as research on the subject of law, regardless of the method, academic discipline or the author (professor, lawyer, etc.) as long as it is of a scientific nature (ie the research is conducted independently and demonstrates a certain degree of subtraction).

On the other hand, determining the quality of academic legal research is fundamental to the development of quality criteria. Here, "quality" is defined as the degree to which research is considered "good" by various stakeholders. The definition of what is "good" depends on those concerned. In the humanities, with which certain types of legal research have close similarities, there is not yet a generally accepted definition of what good research is or good scientific quality (Lack and Markschies, 2008). However, this does not mean that there is no concept of quality. Quality evaluations are also based in part on the subjective and unexpressed notions of evaluator quality (their tacit skills; Herbert and Kaube, 2008).

Different countries have different legal systems and legal traditions. There are efforts to standardize legal systems and assign national legal systems to these types (Glenn, 2014). This legal system also affects the way research in the field of law is conducted and its scope. However, there is currently a lack of proper analysis and comparison of publishing practice and the evaluation of academic legal publications across Europe.

The following description of the specifics of academic legal research is based on the practice of law in Switzerland. The Swiss legal system is often characterized as a civil law system with close similarities to other German legal systems (Kunz, 2006). In general, this means that the following specificities do not apply to all legal systems, but similar features may (and will) exist in academic legal research in many legal systems.

4.1.2 Segmentation

As mentioned, the production of academic legal research depends on national culture and legal systems (Lienhard, Amschwand and Herrmann, 2013). In Switzerland, for example, academic legal research is influenced by legislation at the various federal levels (Community, Canton, Federal and International). It is also subdivided into various, more or less widespread, specific areas such as private, criminal and public or international law (Lienhard and Amschwand, 2010). The consequence of this segmentation is a plethora of different research (in the sense of research topics, questions and areas of application) and a large number of publication types (monographs, articles, textbooks, comments, notes, etc.), normally with low data but little competition.

4.1.3 Language

In addition to the cultural and organizational structure of a country, national languages are also a determining factor in determining how academic legal research is conducted. Unlike research in economics or science, academic legal research focusing on the national context is rarely published in English, rather than in a national language - usually the authors' native language. In Switzerland, for example, German, French, Italian and Roman are the four national languages. Publications aimed at an international readership are usually written in English and, in the case of famous authors, are published abroad (Pichonnaz, 2014). An interesting question is whether and how language is related to the quality of a legal version. It can be argued that articles written for the general public, published in high-frequency English language magazines, are necessarily better than articles written in French or German for a specialized magazine that has fewer readers and appears less frequently (Lienhard et al, 2016).

4.1.4 Publication behavior and types of publication

The specific publishing behavior and the usual types of publications (articles, monographs, textbooks, comments, notes, etc.) on topics of academic legal research. Again, the choice of publication type depends on the legal system and the legal culture. The status of individual types of publications varies from country to country (Pichonnaz, 2014). In Switzerland, academic legal researchers publish a significant portion of their research results as books. Most individual publications (Gutwirth, 2009) tend to appear in the form of monographs, critical reviews and commentary rather than in "rated journals" (Grapatin et al, 2012). Festschrifts, anthologies and symposium papers are also part of the academic legal production. Monographs are usually reviewed and then republished (new editions) (Lienhard and Amschwand, 2010). In addition, research publications appear not only in relevant legal journals but also in journals of professional and specialized associations as well as in non-legal scientific journals. The "basic journals", typical of the natural sciences, are less widespread in the legal sciences. In fact, magazines are less important than monographs. Finally, there is also a significant amount of academic legal research to produce legal opinions (Lienhard and Amschwand, 2010).

4.1.5 Classification

While law journals may have a good or bad reputation among legal scholars and professionals for the quality of their content, there is no generally recognized ranking of legal journals or legal publishers in Switzerland and Europe. This is not surprising: because legal scholars often publish in their national language, there is no language in legal research. Most European law journals are not published in English. This restricts the access of foreign scholars and therefore limits their impact.

A periodic ranking of common European law involves comparing journals written in different languages for different types of audiences (general interest versus specialized or theoretical journals) with different quality evaluation methods (peer-review versus editorial review or student edited) by authors of different situations versus professionals) and legal cultures (common law versus civil law countries) (Van Gestel, 2015). In addition, research among legal scholars in Switzerland has shown that they are very critical of measuring the quality of research through rankings, referrals and other quantitative evaluation methods (Lienhard et al, 2016). The same seems to be true at European level (Stolker, 2014).

4.1.6 References

A characteristic of legal publishing behavior in Switzerland is the way references are used: in academic legal publications, court decisions are often cited, while court decisions are cited in the academic legal literature (Lienhard and Amschwand, 2010). The reference to academic legal research shows that case law is included in addition to the legal literature. References are made - more so than in other specific areas - with a critical focus on the literature and / or court decision.

4.1.7 Independent databases

There is no uniform or complete national bibliographic database for academic legal articles that could serve as a basis for bibliometric analysis. Swiss specialized bibliographies, library catalogs and various unrelated university research databases provide an incomplete picture of knowledge production. This is due in part to the number of publications analyzed, to language bias, to the lack of attention given in some cases to monographs and anthologies, to the fragmentation of communication in various specialized fields, to the vague state of popular science and gray literature, and to small number of statistically analytical and comparable entries (Hornbostel, 2008). As a result, contributions to Swiss legal research rarely find their way into Thomson Reuters' Web of Science or comparable international databases.

4.1.8 Academic methods of legal research

Academic legal research uses specific methods. In Switzerland and other continental European countries, academic legal research is widely regarded as similar to the humanities, because academic legal working methods are largely a process of understanding, the method of legal interpretation (Tschentscher, 2003). The aim is to structure the law, identify (in) coherence and enrich the existing law through research (De Jong et al, 2011). This constant scientific debate on the subject leads to the creation of dogmatic legal theories that combine different assessments of interests (Arzt 1996: 89). The results in academic legal research are inferred from a logical argument based on a qualitative approach. The results of academic legal research are repeatedly challenged during further research work. Unlike the natural sciences and together with the humanities and social sciences, the goal is not to achieve a "final" research result. Knowledge does not become obsolete (CEST, 2007), but is constantly expanding through scientific discourse. However, empirical research, which examines the application of the law and the effects of the law on society, as well as legal history, legal philosophy and other disciplines, is also part of the legal science in the broadest sense.

4.1.9 Connecting with society and legal practice

Legal research at universities is not conducted in a room sealed by society, politics and professional practice. On the contrary, it has strong ties to them. A continuous detailed exchange takes place with various non-university actors (Shapiro, 1992). For example, judges and trainee lawyers make extensive use of the academic legal literature (Lienhard and Amschwand, 2010). The case law regularly refers to areas of academic legal research of practical importance that focus on social developments outside the university environment. Whether a professional is a producer of knowledge or a consumer can be difficult to determine in individual cases. Usually one and the same person can be active in both legal research and legal practice. Many legal academics have jobs in universities and in the private or public sector, for example, in courts or legal counseling centers (De Jong et al, 2011; Gutwirth, 2009). At the same time, judges and trainee lawyers also publish articles or scholarly articles in journals or teach law at a university. This makes it difficult to categorize publications into research or practice categories. In legal science, there is no clear line between popular scientific publications, gray literature and research literature aimed at the academic community.

In some countries (especially in the US), there is a debate about a perceived growing separation between legal practice and legal scholarship (Edwards 1992; Posner, 1992). In the US, a significant volume of legal literature includes theoretical papers that have no or no relevance to legal practice (Edwards, 1992). One of the reasons for this appears in the important place of interdisciplinary approaches (such as law and economics or critical legal studies). In contrast, in many continental European countries, academic legal publications (still) deal mainly with practical legal issues and have a significant impact on jurisprudence by courts and legal practice (Kischel, 2015).

4.2 Identification of evaluation methods and criteria

Various procedures are used to evaluate publications. In general, a distinction is made between peer review and bibliometric data. Peer review is the oldest process in scientific evaluation (Kronick, 1990). It is a quality assurance process in which scientific works are commented and evaluated, ie examined by people of equal professional position (peers). Peers include scholars working in the same field [pure peer review (Kozar, 1999)] and scholars from another discipline [extensive peer review

(Kozar, 1999)]. A distinction can be made between simple peer review procedures and individual blind rating or indeed double blind review.

Unlike peer review procedures, bibliometrics only makes indirect comments about the quality of scientific publications, for example, by evaluating numerical articles published during peer review procedures. Bibliometrics is defined as the application of mathematical and statistical methods to bibliographic information (Havemann, 2009), such as articles in scientific journals, dissertations, gray literature and references (Gingras, 2014). It is, however, based on a categorization that is qualitative in its roots.

The evaluation criteria are characteristics for which the subject of the research can be valued. A criterion can be described using aspects and operated using indicators. Most quality indicators therefore do not measure quality itself (Donovan, 2008), but are indicative factors (mediation variables).

The decision on the appropriate procedures, criteria and indicators for evaluating the quality of (academic legal) research can be taken by different stakeholders in order to achieve different different objectives. Here, a bottom-up approach is used. This means that evaluation procedures and criteria must first be determined by the researchers themselves. This course of action can be justified for the following two reasons:

On the one hand, according to the Swiss Federal Constitution, the principles of scientific freedom and university autonomy must be respected. Therefore, the fundamentals and content of quality assurance, and in particular evaluations, must be decided by the researchers and the universities themselves. Therefore, in the national accreditation process, universities only need to prove that there is a quality assurance process (Article 30a (1) HEdA). the method, regularity, criteria or scope of the research evaluation are not specified. Quality assurance itself is therefore the responsibility of universities (Lienhard et al, 2015).

On the other hand, members of the research community are also of the opinion that researchers should decide how the evaluation of research projects is organized or that they should at least be adequately involved in the process (Hug, Ochsner and Daniel, 2014; Seckelmann, 2012). Researchers should be consulted when devising relevant methods and tools. The analysis of the content of high quality research and the adoption of qualitative criteria for its evaluation are an integral part of this process. It is therefore the duty of the academic community to decide and keep these criteria up to date. This approach offers the advantage on the one hand that each industry can adopt its own appropriate quality criteria and on the other hand that the level of acceptance of the applied quality criteria within the research community increases (Hug, Ochsner and Daniel, 2010). Hug et al (2014) suggest that in designing and implementing criteria, the concept of quality should be used in the research community and efforts should be made to reach a consensus on appropriate quality criteria in the research community.

As far as we know, the legal research community has so far not been systematically asked how they evaluate the quality of academic legal research and how it could be adequately measured or evaluated. As mentioned, academic legal publications are not produced and evaluated only by legal scholars. An important part also includes lawyers or publishers of legal journals. They are also part of the research community that determines the quality of academic legal research and must define appropriate methods and criteria / indicators for evaluating academic legal research. Therefore, their preferences must also be taken into account.

4.3 Review of previous studies

The field that is our object of study, *Business, Management and Accounting* (BMA), is quite broad and includes various specific topics. So much so that the *Scimago Journal Rank* breaks down the field into 10 different themes. This has allowed the field to be analyzed from various perspectives under a scientometric prism.

Arbaugh & Hwang (2015), using *Perish* and other descriptors, compiled a list of the 100 most cited articles in *Business and Management Education Research*, since the 1970s. This study found that more than half of the production has been published after of the year 2000. In another similar study, the citation of articles in the journals of the SCCI, *Business Ethics Quarterly* (BEQ) and the *Journal of Business Ethics* (JBE) was analyzed for the years from 2001 to 2008 (Ma et al., 2012), concluding that business ethics has created its own literature and has gained a reputation as a legitimate academic field, with some specific journals on this subject.

Along the same lines, the bibliometric analysis in *Business* , Fetscherin & Heinrich (2015), analyzed 392 articles from 101 *Web of Science* (WOS) journals to determine the impact on the area of consumption, concluding that it is dominated by journals of management and business.

Cortés-Sánchez (2020) carried out, for his part, a bibliometric study of the production in Ibero-America on BMA in SCOPUS, taking the authors of the documents as a reference. This research indicated that Spain presented the largest number of publications and at the same time was the one that received the largest number of citations, followed by Portugal, Brazil and Mexico. In turn, Gantman & Fernández (2017) analyzed the production of academic literature in Spanish on organizational and management studies between 2000 and 2010 indexed in the Latindex Catalog. In their conclusions, they point out that in this field there was an increase in publications with a prominent presence of Spanish authors and that, in addition, Latin American countries show a low presence in this index, although Mexico and Colombia stand out.

Other branches of BMA have also been analyzed through bibliometric studies. Thus, the scientific production in Accounting in the Spanish language has also been studied (López et al., 2016), finding that very few articles in Spanish focused on trends in accounting research. In addition, it was found that this production had little or almost no impact, since no article had been cited more than twice.

The reviewed studies point out not only the usefulness and relevance of bibliometric analyses, but also the existing interest in various aspects related to the flow of scientific communication in the BMA area, through publications in specialized magazines. In this sense, it is important to point out that various authors have pointed out that, due to language bias, scientific production published in languages other than English is not extensively analyzed in some international databases (Narvaez-Berthelemot & Russell, 2001).

As Cortés-Sánchez (2020) points out, the study of BMA publications is important for several reasons, such as the diagnosis and identification of the determining factors of high productivity and the impact of studies, magazines, business schools and institutions (mainly universities).

5. Methodology

5.1 Objectives

5.2 Working hypotheses

5.3 Research design

5.4 Validity of the design

5.5 Population and sample

5.6 Data collection

5.7 Variables

5.8 Initial considerations and standardization

5.9 Data processing

5.10 Determination of collaboration indexes

This research is exploratory and descriptive, of mixed type using qualitative and qualitative analysis. In addition, it is a bibliometric documentary study using statistical and mathematical techniques to establish frequencies and find certain bibliometric indexes. Network analysis will be used to identify and represent some of the types of collaboration found. For the latter, both Pajeck (de Nooy et al., 2011) and VosViewer (Van Eck and Waltman, 2020) software will be used.

This research aims to answer the following questions:

What are the indicators that characterize the scientific production on education related to administration and legislation in the context of the SCOPUS database?

What are the main fields or thematic areas investigated? What patterns characterize scientific collaboration in this type of research? Are there differences in the topics of interest according to geographical regions? Does this research reflect the new social patterns of work organization in relation to the educational system and legislation?

5.1 Objectives

The general objective of this research is to analyze the production on legislation and education in the *Business, Management and Accounting* category through a scientometric study of the publications indexed in the database of SCOPUS.

This study will allow us to obtain a global vision of the research landscape in this field of knowledge and thus complement the knowledge we have about the scientific production in this field.

To achieve this general objective, we propose the following specific objectives:

1. To know the diachronic development of the scientific production in education related to legislation and indexed in SCOPUS (*Business, Management and Accounting*).
2. To describe and identify the different knowledge network relationships that are generated.
3. To visualize the national and international collaboration networks, both at the level of authorship and at the institutional level.
4. To identify citation and collaboration patterns.
5. Establish values for the indicators of the quantitative dimension of scientific production on the subject.
6. To identify the topics addressed.

5.2 Working hypotheses

The hypotheses we set out in this work are detailed below:

H1. The research articles in legislation and education in the Business, Management and Accounting category in SCOPUS-indexed journals in the study period verify the main scientometric laws: Lotka and Bradford.

H2. The collaboration between authors in this scientific production is of local or national character.

5.3 Research design

The study we present is descriptive-retrospective and exploratory from a scientometric point of view of the international scientific production related to legislation and education at the international level and indexed in the SCOPUS database. In addition, it is a bibliometric documentary study with statistical and mathematical techniques to establish frequencies and find certain bibliometric indexes.

This research does not manipulate variables, which does not allow the contrast of causal relationships in a deterministic manner and is therefore ex post facto (León & Montero, 1997). Moreover, because it establishes relationships between variables for situations that have already occurred in the past.

In terms of temporality, it is a longitudinal study (Cohen, Manion, & Morrison, 2007), since it analyzes international scientific production in education and legislation and its evolution over a period of 50 years, from 1970 to 2019.

5.4 Validity of the design

Bibliometric studies face the epistemological debate about whether the literature of a specialty or scientific field itself adequately reflects the progress of that discipline (Spinak, 1996). Some authors have pointed out that in the sociology of science there is little interest in methodological aspects "such as the range of application of different empirical approaches, the reliability and validity of methods, or generalization strategies" (Gläser and Grit, 2001: 411), but at the same time they affirm that in scientometrics there is interest in this and there are richer methodological debates. Likewise, Fraenkel, Wallen, and Hyun (2012) point out some of the threats that haunt studies in Education. Below we will indicate the two that we consider of greatest importance and how they were addressed in this study:

- *External validity:* this was controlled by the authenticity and relevance of the data that were analyzed. By taking the data directly from SCOPUS through the Web (https://www.scopus.com/s), it is guaranteed that they correspond to those published in the scientific journals.
- *Internal validity:* This refers to the degree of precision of the data obtained in each documentary record. Several standardization processes were carried out

for certain fields in order to guarantee a good acceptance of the degree of precision.

5.5 Population and sample

The Business, Management and Accounting category of SCOPUS has 1852 journals indexed in the SCIMAGO Journal Rank (SJR). All the journals with the words *educat** or *teach** in their titles were taken into consideration.

5.6 Data collection

In February 2020, the list of journals present in the Business, Management and Accounting category was consulted on the Scimago Journal Rank website (Fig 1). All the journals that include in their title the terms *Education** or *Teach** were selected.

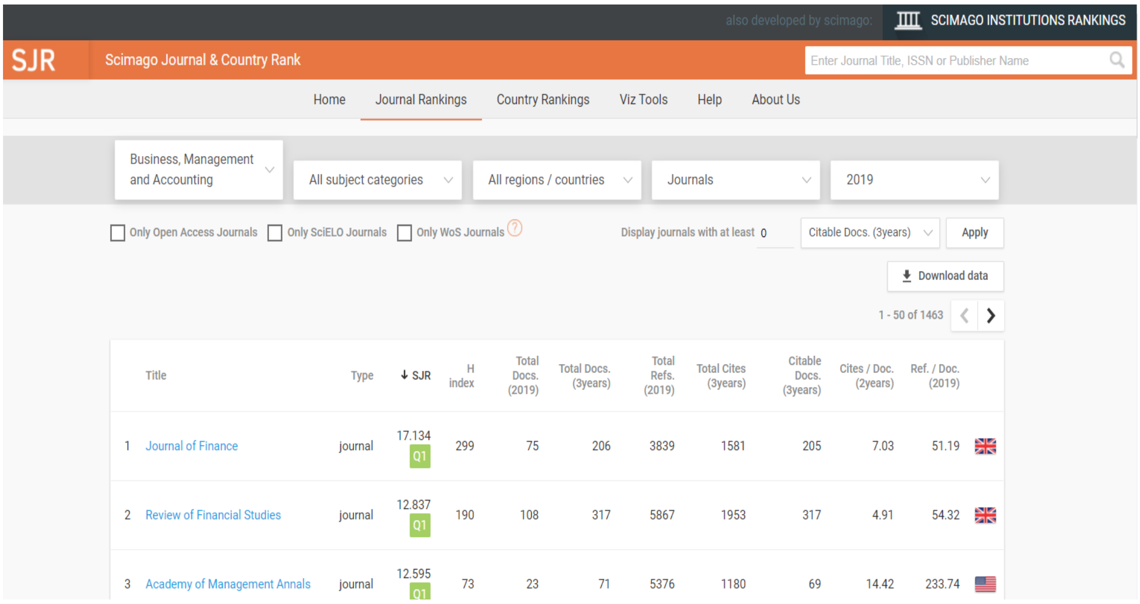

Figure 5.1. Search in Scimago Journal Rank.

Finally, 45 journals were obtained that met the requirements and will be analyzed:

1- Accounting Education

2- Advances in Accounting Education: Teaching and Curriculum Innovations

3- Issues in Accounting Education

4- Journal of Accounting Education

5- Journal of Marketing Education

6- Journal of Marketing for Higher Education

7- Journal for Advancement of Marketing Education

8- Journal of the Australasian Tax Teachers Association

9- Journal of Teaching in Travel and Tourism

10- Journal of Teaching in International Business

11- Journal of Teaching and Learning for Graduate Employability

12-Management Education

13- Management in Education

14- Sport Management Education Journal

15-International Journal of Management Education

16-International Journal of Management in Education

17-Journal of Management Education

18-British Journal of Education & Work

19-International Journal of Educational Management

20-International Journal of Educational Organization and Leadership

21-International Journal of Leadership in Education

22-Journal of Hospitality and Tourism Education

23-Journal of Hospitality, Leisure, Sports and Tourism Education

24-Journal of Education and Work

25-Journal of Education for Business

26-Tuning Journal for Higher Education

27-Industry and Higher Education

28-Journal of Advertising Education

29- Journal of Mental Health Training, Education and Practice

30-Journal of Professional Issues in Engineering Education and Practice

31- Contemporary Educational Technology

32- World Journal on Educational Technology

33-Journal of Entrepreneurship Education

34-Journal of Industrial Organization Education

35-Journal of International Education in Business

36-Childhood Education

37-Decision Sciences Journal of Innovative Education

38-Education and Training

39-Education, Business and Society: Contemporary Middle Eastern Issues

40-Educational Assessment, Evaluation and Accountability

41-Educational Management Administration and Leadership

42-Engineering Science and Education Journal

43-Tertiary Education and Management

44-Transactions on Education

45-Chronicle of Higher Education

Each journal was searched by name in the "Source title" field on the SCOPUS website and limiting the time frame to 2019 (Fig. 2). It was decided to perform the search individually, because SCOPUS only allows the download of 2000 data at a time and in some cases a single journal contained more than these records. In these cases, the search was narrowed down by periods until the entire time range was completed.

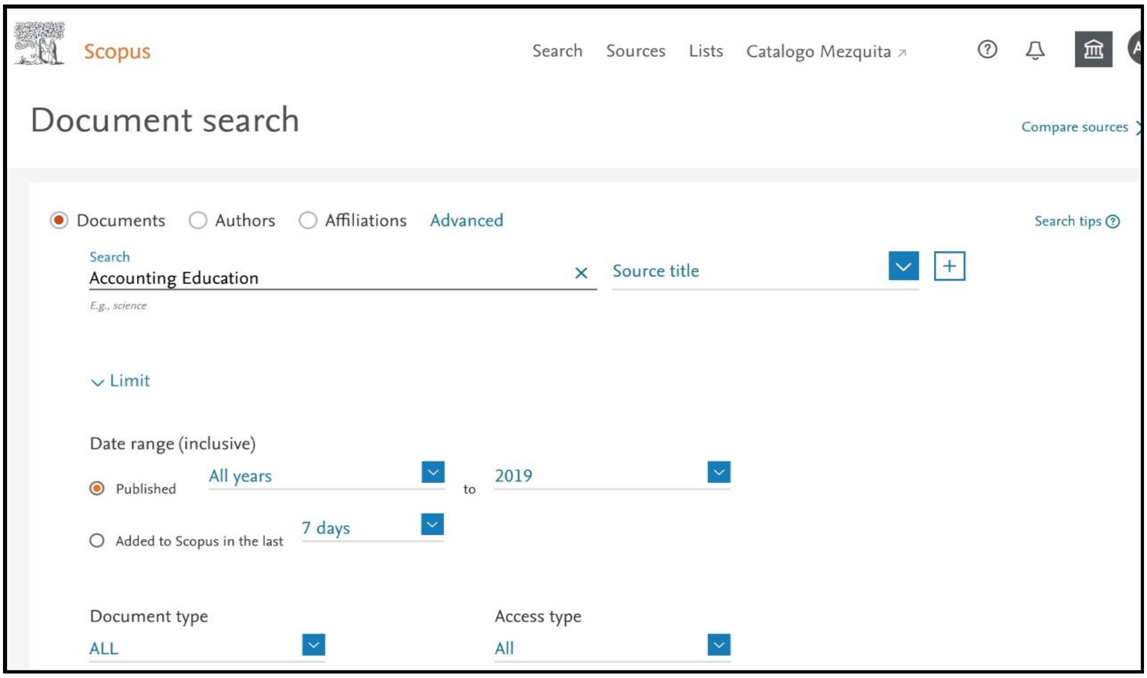

Figure 5.2. Example of type of search in SCOPUS

In the download criteria, all the "Citation information", "Bibliographical information", "Abstract & keywords" and only "Include references" from the "Other information" field were chosen (Figure 5.3).

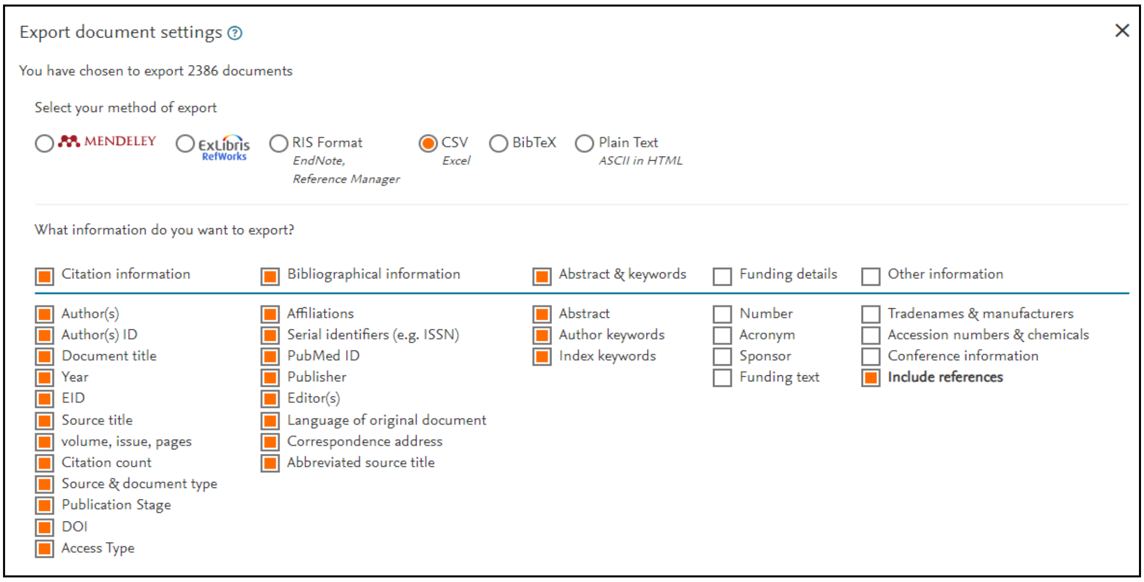

Figure 5.3. SCOPUS data download criteria.

The files were downloaded in CSV format and numbered and subsequently grouped into a single file using the Excel Power Query extension (Figure 5.4).

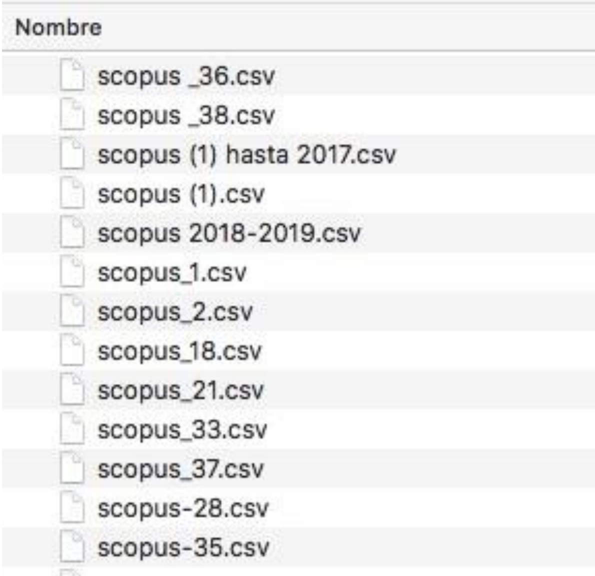

Figure 5.4. Grouped data

Once all the data had been dumped and grouped, we obtained 32715 records of documents indexed in SCOPUS, which from now on we will refer to generically as documents without distinguishing their type. This is the population that will be subjected to study and analysis.

5.7 Variables

For the study we chose as variables some of those proposed by Jimenez-Fanjul (2016):

Table 5.1. Variables of the study

Nª	Variable	Description	Character	Range
1	Year of publication	Four-digit numerical data.	Discrete	[1970, 2019]
2	Number of authors	Number of authors in digits	Discrete	[1, n]
3	Identity of the authors	Name of each author.	Nominal	[1, n]
4	Gender of authors	ccording to the proper names of the documents.	Discrete	[M, W]
5	Number of author countries	Total number of nationalities of the authors signing the paper. If there is more than one author from the same country, this will be counted only once.	Discrete	[0, n]
6	Author countries	Name of the countries of reference of the authors signing the document.	Nominal	[1, n]
7	Number of records per author country	This variable will contain several subvariables, as many as the number of countries of origin of the authors. Each country subvariable will be assigned the number of documents per authors of that nationality. These subvariables, as a	Discrete	[1, n]

		whole, will be indicative of the nationalities of the authors.		
8	University institutions	Name of the university institutions of reference of the authors signing the article.	Nominal	[1, n]
9	Number of university institutions	Total number of reference institutions of the authors signing the article. If there is more than one author from the same institution, it will be counted only once.	Discrete	[1, n]
10	Title of the journal:	Name of the journal registered in SCOPUS	Nomimal	[1, n]
11	Type of document	Type of document	Nominal	[1, n]
12	Number of citations received	Total number of citations received in SCOPUS	Discrete	[1, n]
13	Index Keywords	Descriptor assigned by SCOPUS	Nominal	[1, n]
14	Language	Language in which the document was published	Nominal	[1, n]

To find the collaboration indexes, a count and authorship assignment will be made for each of the co-authors of the articles, as well as for the country of the signatories. In order to count the authors of each document, we opted for the complete computation system, as suggested by Cronin and Overfeld (1994), attributing the total authorship to each co-author, considering them equally. A process of standardization of names of authors and institutions will be carried out in order to identify the collaboration networks.

5.8 Initial considerations and standardization

When working with different databases, the validity of these studies is determined by the integrity and consistency of the downloaded data (Jiménez, 2016). Different researchers have pointed out that in databases errors or confusions can often be found in some of the data that they offer and that are of vital importance for bibliometric studies (Costas and Bordons, 2007; Ruiz-Pérez, Delgado, and Jiménez-Contreras, 2002; Serrano-López and Martín-Moreno, 2012).

On many occasions these discrepancies or errors are due to the translation of the institutions, the use of different names for them and also because certain authors vary their academic signature during their lifetime. In Spain, in order to try to minimize these errors attributable to authors, a series of recommendations have been established for both authors and the journals themselves in relation to good practices for adequate standardization of information (EC3 and CINDOC-CSIC, 2007).

From all the information obtained, we proceeded to determine the fields of interest in this study are those of scientific articles, namely: authors affiliation, title of the article, language, name of the journal, SCOPUS keywords, type of document, abstract, references and total number of documents cited, citations received. This information was downloaded into an Excel and an *ad hoc* database.

With the information already in the database, a process of standardization of the names of the educational institutions was carried out since, on occasions, several variants were found for the same university. The process required an exhaustive review of the different names given by the authors for the same university, so the results differ from those offered by SCOPUS through the results analysis option.

5.9 Data processing

Once the data have been collected, they are processed with the Microsoft Office spreadsheet, Excel and Access. The SSPS program for the statistical treatment of the data and the Pajeck, Ucinet 6 and VOSviewer programs for the study and representation of the collaborative networks.

5.10 Determination of collaboration indexes

To determine the collaboration indicators, the number of authors was counted for each of the articles and the following were taken into account: The collaboration index (CI) (Lawani, 1980), which is a measure of the average number of authors; the degree of collaboration (GD) (Subramanyan, 1983), which is a measure of proportion of multiple authorship; and finally the collaboration coefficient (CC) (Ajiferuke, Burrel, & Tague, 1988), which was designed to eliminate some related problems that these authors pointed out in relation to the CI and GD.

To find the collaboration indices, a count and authorship assignment was made for each of the co-authors of the articles, as well as for the country of the signatories. In order to count the authors of each document, we opted for the complete computation system, as suggested by Cronin and Overfeld (1994), attributing the total authorship to each co-author, considering them equally. A process of standardization of names of authors and institutions will be carried out in order to identify the collaboration networks.

6. Results

6.1 Bibliometric indicators

6.1.1 Diachronic production

All production is found in the period between 1970 and 2019. The diachronic analysis reveals that there has been a gradual increase in the volume of production until 2002, reaching the maximum peak in 2002, but since then, there has been a decrease.

Table 6.1. Year of publication

Year	Frequency	%	Cumulative percent
1970	1	,0	,0

1975	36	,1	,1
1976	28	,1	,2
1977	17	,1	,3
1978	9	,0	,3
1979	125	,4	,7
1980	86	,3	,9
1981	62	,2	1,1
1982	77	,2	1,3
1983	152	,5	1,8
1984	154	,5	2,3
1985	92	,3	2,6
1986	173	,5	3,1
1987	243	,7	3,8
1988	273	,8	4,7
1989	337	1,0	5,7
1990	284	,9	6,6
1991	314	1,0	7,5
1992	330	1,0	8,5
1993	365	1,1	9,7
1994	398	1,2	10,9
1995	403	1,2	12,1
1996	973	3,0	15,1
1997	1016	3,1	18,2
1998	1074	3,3	21,5
1999	570	1,7	23,2
2000	534	1,6	24,8
2001	1640	5,0	29,9
2002	2844	8,7	38,5
2003	2385	7,3	45,8
2004	1325	4,1	49,9
2005	1549	4,7	54,6

2006	1387	4,2	58,9
2007	1408	4,3	63,2
2008	780	2,4	65,5
2009	830	2,5	68,1
2010	881	2,7	70,8
2011	913	2,8	73,6
2012	970	3,0	76,5
2013	972	3,0	79,5
2014	979	3,0	82,5
2015	949	2,9	85,4
2016	978	3,0	88,4
2017	1102	3,4	91,8
2018	1195	3,7	95,4
2019	1502	4,6	100,0
Total	32715	100,0	

Source: Own elaboration, 2022.

Figure 6.1 graphically represents scientific production over the 20 years analysed. It is observed that there is no continuous growth pattern, various fluctuations are evident. At the beginning of the period, no production was found for four years in a row. The best fit to the data is a polynomial trend line ($R^2 = 0.5442$).

It can be seen that between 1999 and 2000 there has been a decrease in production, with a negative Interannual Variation Rate (TVI) equal to -47, and in 2008, with a negative Interannual Variation Rate (TVI) equal to -45, while the highest positive TVI (not taking into account the increase in 1975, since there were 4 years with no production) was reached in 2001 with a value of 207. In general, it has gone from producing 36 documents in 1975 to 1052 in 2020; that is, it is a percentage increase of 4072%. The average number of published documents is 711 per year.

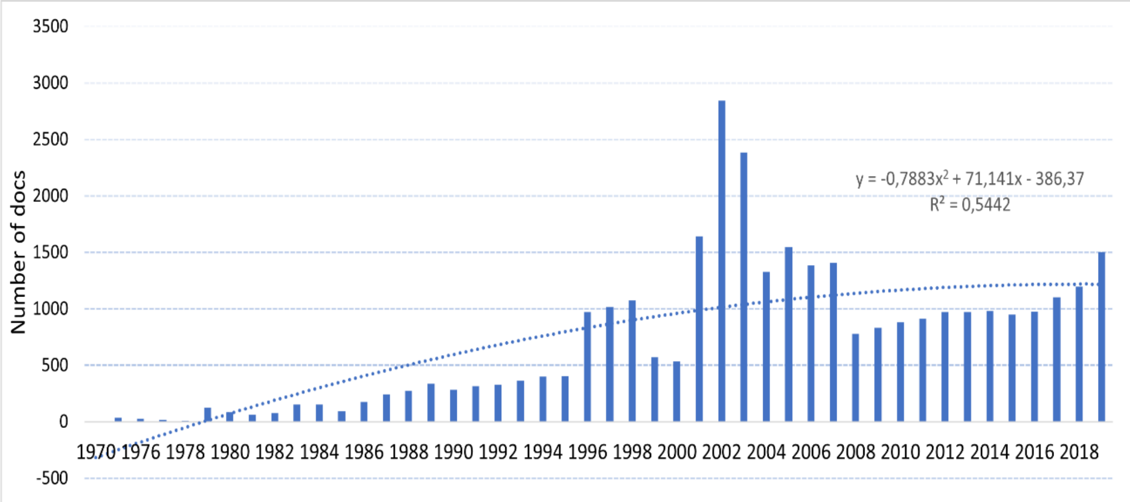

Figure 6.1. Diachronic production in education on Business, Management and Accounting in SCOPUS

6.1.2 Type of documents

32715 publications of different types were found, with a predominance of research articles (67.9%) and a lower presence of notes (12.2%), reviews (7.6%) and short surveys (6.9%). The other types of documents have a minimal representation, i.e. editorials (2.9%), letters (1.9%), erratum (0.3%), conference papers (0.2%), book chapters (0.1%) and articles in press (~0%).

Table 6.0.2. Type of document

	Frequency	Percent	Valid percent	Cumulative percent
Short Survey	2257	6,90	6,90	6,90
Review	2486	7,60	7,60	14,50
Note	4000	12,20	12,20	26,70
Letter	607	1,90	1,90	28,60
Erratum	90	0,30	0,30	28,90
Editorial	949	2,90	2,90	31,80
Conference Paper	72	0,20	0,20	32,00
Book Chapter	20	0,10	0,10	32,00
Article in Press	15	0,00	0,00	32,10
Article	22219	67,90	67,90	100,00

Total	32715	100	100

Source: Own elaboration, 2022.

6.1.3 Annual rate of change

Regarding the annual rate of change (which is the change on the number of publications per year), the highest rate has been identified in 1975, followed by 1978.

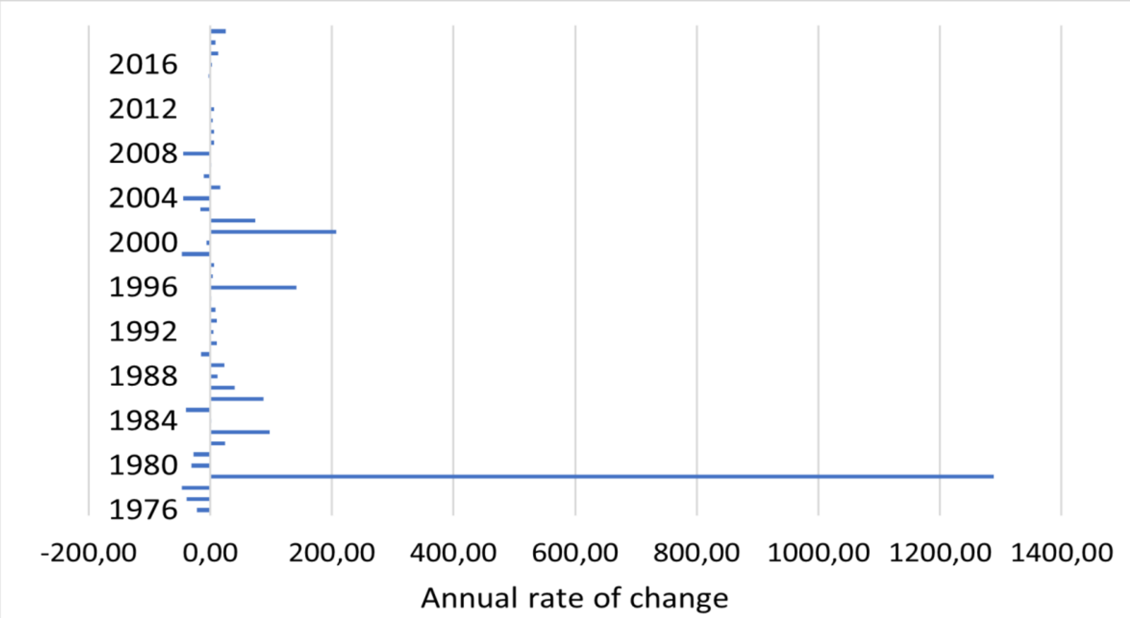

Figure 6.2. Annual rate of change

6.1.4 Language

Most of the documents (99.96%) were written in English, 0.02% were written in Spanish and 0.01% in English (Table 6.3).

Table 6.0.3. Language of publication

Language	Nº	%
English	32701	99,96
Spanish	7	0,02
French	2	0,01
No date	5	0,02
Total	32715	100,00

Source: Own elaboration, 2022.

6.1.5 Authorship

All the documents were written by 31833 different authors. These authors generated 55721 signatures on all documents with an average of 1,7 authors per publication.

Figure 6.3 shows the distribution of authors grouped into three levels of productivity: LP=0 (log 1), authors who publish only one document; 0 < LP < 1 (log1 + to log 9), authors with 2 to 9 published papers; and LP ≥ 1 (log 10+), authors with 10 or more published documents. There are 24186 authors with only one published paper, 7001 authors with 2 to 9 published papers, and 656 authors who have published 10 or more documents

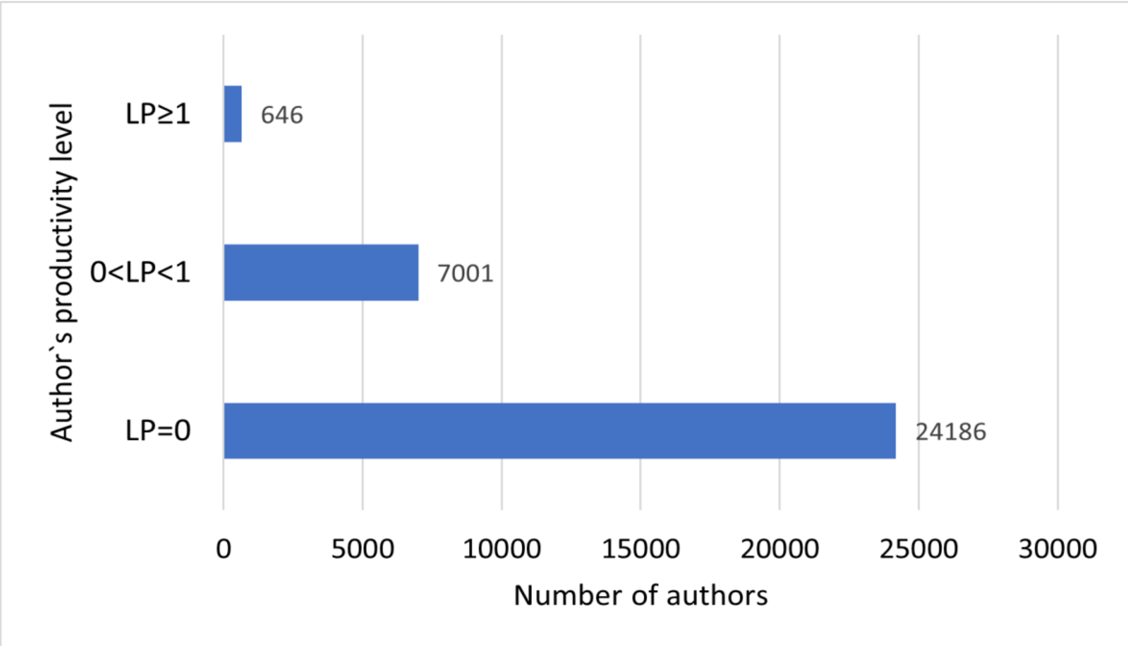

Figure 6.3. Productivity levels of authors in education on Business, Management and Accoutning.

The most productive authors are presented in Table 6.4. The 25 most prolific authors publish 5.8% of the total scientific production.

Table 6.0.4. Authors with the highest production

Author	# docs
Burd S.	169

Brainard J.	158
Young J.R.	151
Foster A.L.	149
Carnevale D.	146
Bush T.	134
Blumenstyk G.	131
Carlson S.	130
Wilson R.	123
Suggs W.	118
Bollag B.	113
Schmidt P.	113
Field K.	106
Hoover E.	105
Glenn D.	102
Read B.	102
Mangan K.S.	101
Hebel S.	95
Monastersky R.	94
Selingo J.	91
Farrell E.F.	88
Fogg P.	83
Monaghan P.	80
Kiernan V.	75
Smallwood S.	75

6.1.6 Collaboration

When analyzing in detail the number of authors, it is found that 58.21% have been of sole authorship, and those signed by two or three authors represent 34.37% of the total. The pattern of authorship has undergone changes in the period, going from a start in 1975 with predominance in the publication of documents with single authorship (80.56%) compared to those with multiple authorship (19.44%) until reversing the relationship in 2019 with only 23.04% sole authorship compared to 75.96% co-authorship. In the last year, 22.70% of the documents had four or more authors (Table 6.5).

Table 6.0.5. Patterns of authorship in Education on Business, Management and Accounting.

	Single author	Two authors	Three authors	Four authors	Five authors	Six or more authors
1970	0	1	0	0	0	0
1975	29	6	0	1	0	0
1976	19	6	2	1	0	0
1977	15	2	0	0	0	0
1978	3	4	2	0	0	0
1979	101	19	4	1	0	0
1980	54	23	8	1	0	0
1981	45	14	2	0	0	1
1982	51	19	5	2	0	0
1983	103	38	8	3	0	0
1984	97	45	9	2	0	1
1985	50	33	6	2	1	0
1986	92	64	14	3	0	0
1987	177	43	19	4	0	0
1988	178	69	16	7	0	3
1989	237	67	27	5	1	0
1990	173	78	25	7	1	0
1991	216	70	22	4	1	1
1992	224	65	28	8	3	2
1993	226	90	37	9	1	2
1994	259	93	38	4	2	2
1995	236	117	38	5	5	2
1996	709	166	72	20	2	4
1997	728	211	55	14	6	2

1998	781	203	59	24	4	3
1999	298	186	61	11	11	3
2000	261	166	76	16	9	6
2001	1269	244	85	32	7	3
2002	2513	221	82	16	9	3
2003	2030	248	70	23	7	7
2004	987	188	106	27	8	9
2005	1233	197	82	24	9	4
2006	981	267	93	32	7	7
2007	970	273	113	37	10	5
2008	293	256	139	34	9	2
2009	309	290	153	45	21	12
2010	346	317	146	52	12	8
2011	336	311	172	71	12	11
2012	359	329	198	64	9	11
2013	341	319	193	348	21	11
2014	292	338	215	82	34	18
2015	290	306	224	84	27	18
2016	248	358	212	106	30	24
2017	326	359	228	111	48	30
2018	340	375	266	128	42	44
2019	346	478	337	182	95	64

The annual average of the documents without collaboration is 58.44%, this could induce that there is almost equality between the documents without collaboration and those that do have it. However, this value is largely due to the early years within the study range. Collaboration begins to take off and its increase is noticeable from the year 2008 (figure 6.4).

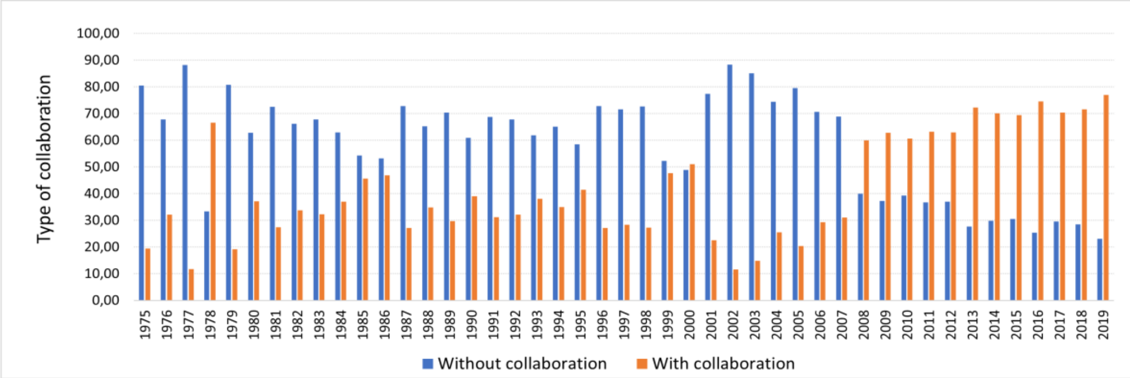

Figure 6.4. Type of collaboration

From the data, the values of the three most frequent indicators of collaboration in the literature were determined. Thus, the Degree of Collaboration in the period is DC=0.66. The minimum value occurred in 2002 and the maximum in 1970 (Table 6.6). This value is almost similar to that obtained by education journals published in Brazil (0,636) (Madrid, et al, 2017) and close to that found for GD (0.75) in Colombian scientific publications in SciELO (Maz-Machado, Jiménez-Fanjul and Villarraga-Rico, 2016). However, it is higher than that found for the SSCI categories Demography (0.605) and Urban Studies (0.591) (Maz-Machado & Jiménez-Fanjul, 2018).

Table 6.0.6. Collaboration measures per year.

Year	IC	DC	CC	Year	IC	DC	CC
1970	1,00	1,00	0,50	1997	0,48	0,48	0,36
1975	0,31	0,31	0,07	1998	0,48	0,48	0,78
1976	0,51	0,51	0,12	1999	0,69	0,69	1,49
1977	0,00	0,00	2,08	2000	0,73	0,73	1,69
1978	0,91	0,91	3,73	2001	0,42	0,42	0,28
1979	0,34	0,34	0,19	2002	0,24	0,24	0,14
1980	0,57	0,57	0,18	2003	0,30	0,30	0,60
1981	0,41	0,41	1,85	2004	0,47	0,47	2,01
1982	0,54	0,54	0,86	2005	0,39	0,39	1,40
1983	0,52	0,52	0,44	2006	0,51	0,51	0,84
1984	0,56	0,56	0,50	2007	0,53	0,53	1,01
1985	0,66	0,66	1,35	2008	0,79	0,79	1,60

1986	0,66	0,66	0,78	2009	0,82	0,82	1,43
1987	0,47	0,47	0,32	2010	0,80	0,80	0,59
1988	0,56	0,56	0,49	2011	0,82	0,82	0,60
1989	0,50	0,50	0,65	2012	0,82	0,82	0,61
1990	0,60	0,60	0,80	2013	0,89	0,89	0,53
1991	0,51	0,51	0,90	2014	0,87	0,87	0,64
1992	0,54	0,54	0,66	2015	0,87	0,87	0,63
1993	0,60	0,60	0,76	2016	0,89	0,89	0,59
1994	0,56	0,56	0,72	2017	0,87	0,87	0,53
1995	0,63	0,63	0,75	2018	0,88	0,88	0,48
1996	0,48	0,48	0,38	2019	0,91	0,91	0,50

Table 6.0.7. Collaborative measures for the period 1970-2019

Years	IC	DC	CC
1970-2019	0,66	0,66	0,73

The 31833 authors who have signed any of the documents in the sample generate an extensive collaboration network (Figure 6.5). It can be seen in the graph that there is a high number of authors who are not connected with other authors.

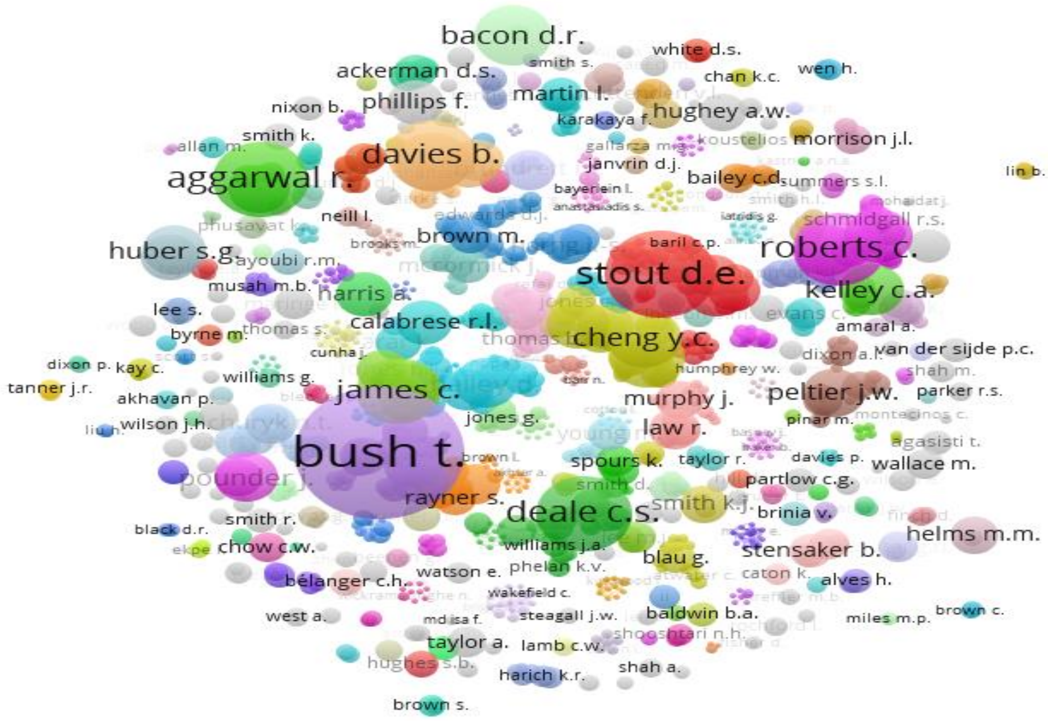

Figure 6.5. Global network of co-authorship collaboration between authors

On the following table 6.8 it can be seen that the average degree is 4,39, which means that on average, an author has collaborated with 4,39 authors in the studied time span. Additionally, density is 0,004, which means that from all possible combinations of collaborations between these 31833 authors (a lot!), 0,441% have been actually done. If this density were 1, it means that ALL authors collaborated with ALL other authors!

Table 6.0.8. Global authorship network indicators

Network indicators	
Average Degree	4,39317954
Density	0,00441082

Let's represent the network that is generated only with those authors (38 authors) who are connected to the largest subnetwork.

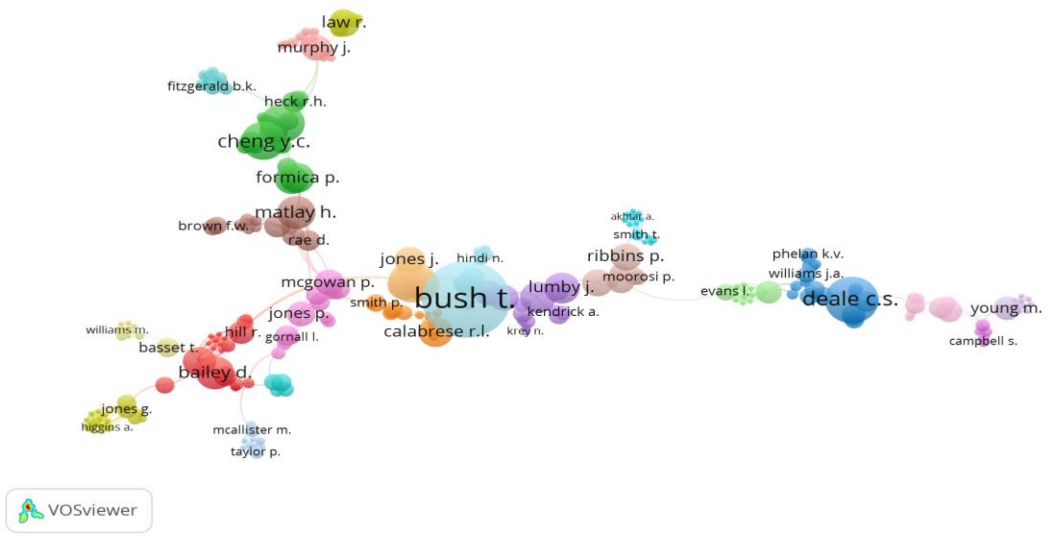

Figure 6.6. The largest collaborative subnetwork in authorship

In Figure 6.7 we show the collaboration network generated by the author with the highest production on the subject Burd, S.

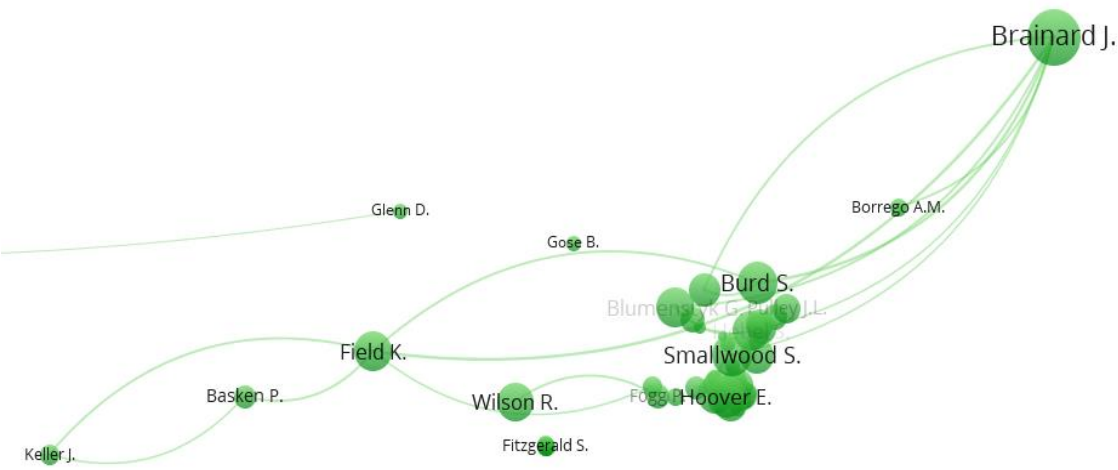

Figure 6.7. Most productive author collaboration network

Authors from 135 countries have published on the subject under study. The greatest production corresponds to authors from the USA followed by those from the United Kingdom, between them producing 47,14% of the total number of documents.

Table 6.0.9. Production by countries

Country	Number of publications	%

United States	11610	35,49
United Kingdom	3901	11,92
Australia	1533	4,69
Canada	800	2,45
China	592	1,81
New Zealand	357	1,09
Spain	263	0,80
South Africa	256	0,78
Finland	215	0,66
Germany	204	0,62
Malaysia	203	0,62
India	202	0,62
Ireland	195	0,60
Netherlands	189	0,58
Norway	181	0,55
Sweden	180	0,55
Israel	178	0,54
Arab Emirates	170	0,52
Russia	148	0,45
Greece	143	0,44
Singapore	140	0,43
Italy	139	0,42
Taiwan	123	0,38
Denmark	117	0,36
Portugal	116	0,35
Switzerland	115	0,35
Turkey	114	0,35
France	104	0,32
Indonesia	104	0,32

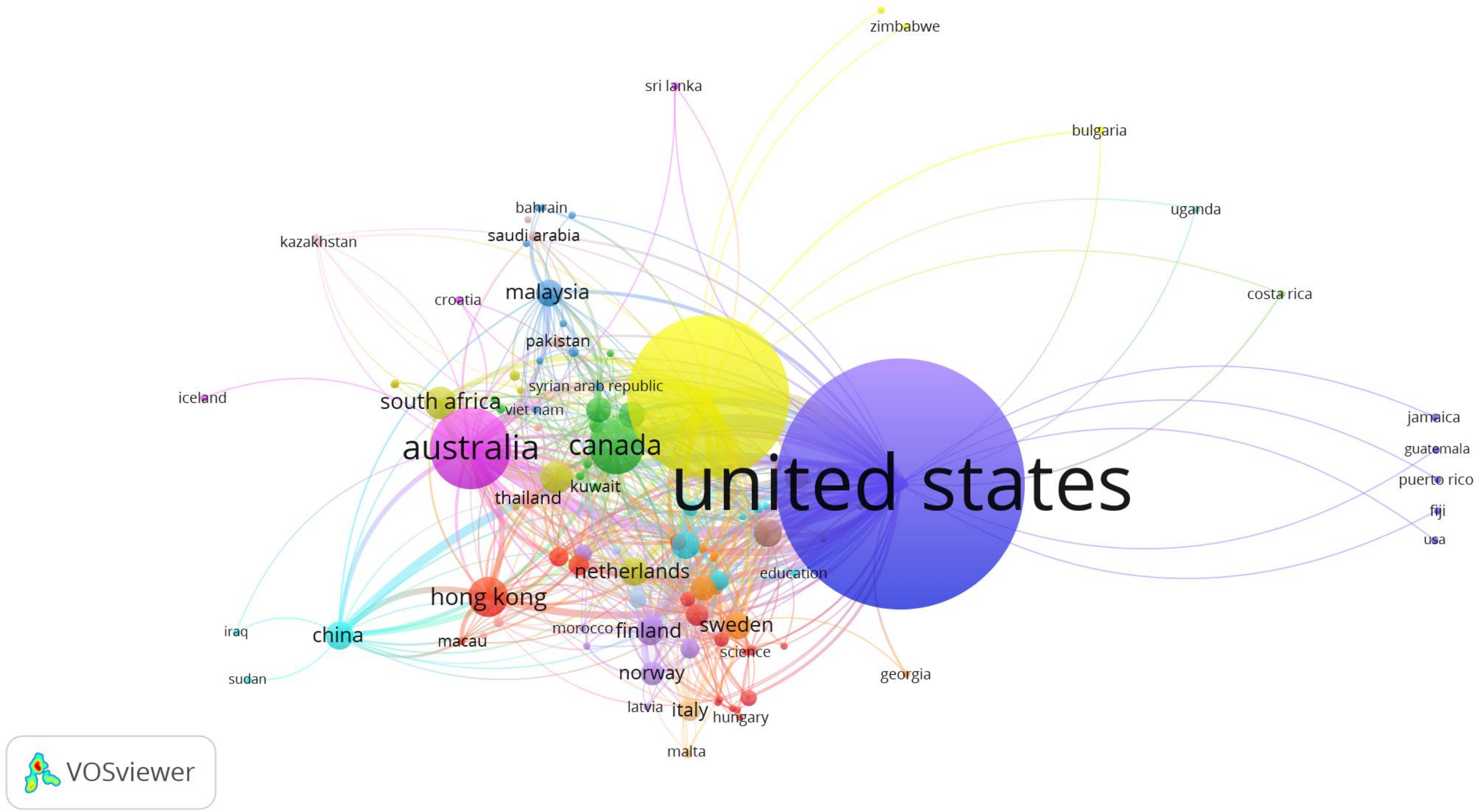

Figure 6.8. Authors' country collaboration network

We found 6401 different index descriptors. The most frequent keyword is Student followed by Education (Table 6.10).

Table 6.0.10. Most frequently used keywords

Keyword	nº	%
Students	1103	4,5
Education	990	4,0
Societies and institutions	735	3,0
Professional aspects	476	1,9
Engineering education	470	1,9
Laws and legislation	441	1,8
Social aspects	430	1,7
Teaching	428	1,7
Civil engineering	302	1,2
Curricula	250	1,0
Public policy	248	1,0
Project management	229	,9
College buildings	215	,9
Construction industry	177	,7
Finance	162	,7
Research	142	,6
Biomedical and Behavioral Research	132	,5
Economic and social effects	122	,5
Engineers	122	,5
United States	121	,5
Decision making	116	,5
Contracts	115	,5
Personnel	115	,5

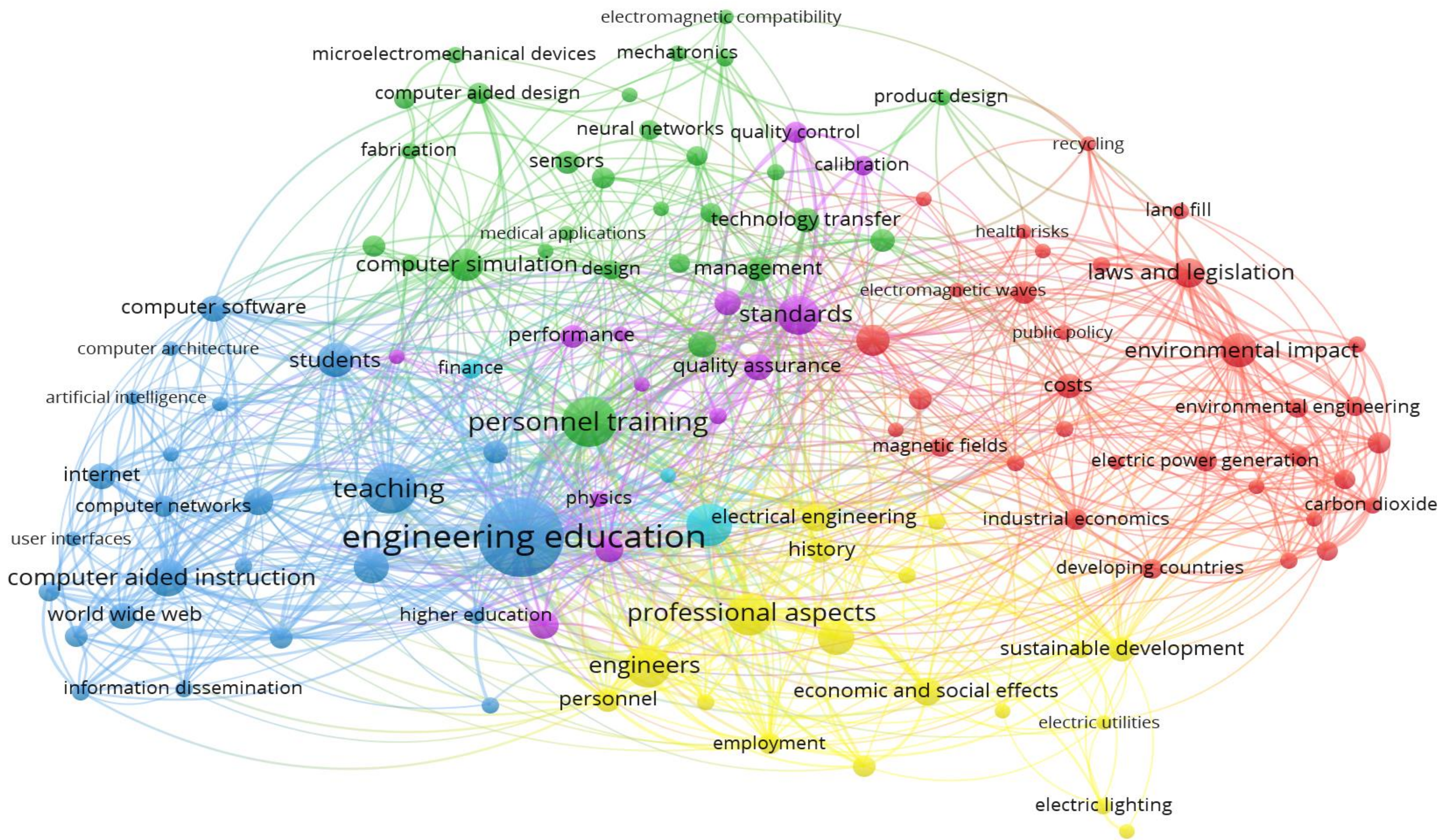

Figure 6.9. Keyword co-occurrence network

We found 6401 different index descriptors. The most frequent keyword is Student followed by Education (Table 6.11).

Table 6.0.11. Most frequently used keywords

Keyword	nº	%
Students	1103	4,5
Education	990	4,0
Societies and institutions	735	3,0
Professional aspects	476	1,9
Engineering education	470	1,9
Laws and legislation	441	1,8
Social aspects	430	1,7
Teaching	428	1,7
Civil engineering	302	1,2
Curricula	250	1,0
Public policy	248	1,0
Project management	229	,9
College buildings	215	,9
Construction industry	177	,7
Finance	162	,7
Research	142	,6
Biomedical and Behavioral Research	132	,5
Economic and social effects	122	,5
Engineers	122	,5
United States	121	,5
Decision making	116	,5
Contracts	115	,5
Personnel	115	,5
Surveys	115	,5

Costs	114	,5
Philosophical aspects	111	,5

6.1.7 Citations

The analysis of the citations in the analyzed journals indicates that 39.7% of the production has not received any citation (Table 6.12). Of all the documents cited, 12.6% have only been cited once, and 8.3% twice. The most cited article has 855 citations.

Table 6.0.12. Citations

Citation	Nº	%
1	4122	12,6
2	2704	8,3
3	1984	6,1
4	1472	4,5
5	1108	3,4
6	934	2,9
7	874	2,7
8	666	2,0
9	556	1,7
10	493	1,5
11	446	1,4
12	373	1,1
13	313	1,0
14	306	,9
15	264	,8
16	229	,7
17	179	,5
18	196	,6
19	161	,5
20	166	,5

21-25	559	1,7
26-30	423	1,2
31-35	273	0,8
36-40	205	0,5
41-45	148	0,5
46-50	100	0,5
51-60	152	0,3
61-70	93	0
71-80	50	0
81-90	47	0
91-100	31	0
101-200	78	0
201-300	12	0
301-400	6	0
417-855	3	0
Total	19721	60,3
	32715	100,0

Additionally, regarding the years these citations had been done, the highest percentage can be identified in 2003 with 944 citations, followed by 2007 with 905 citations

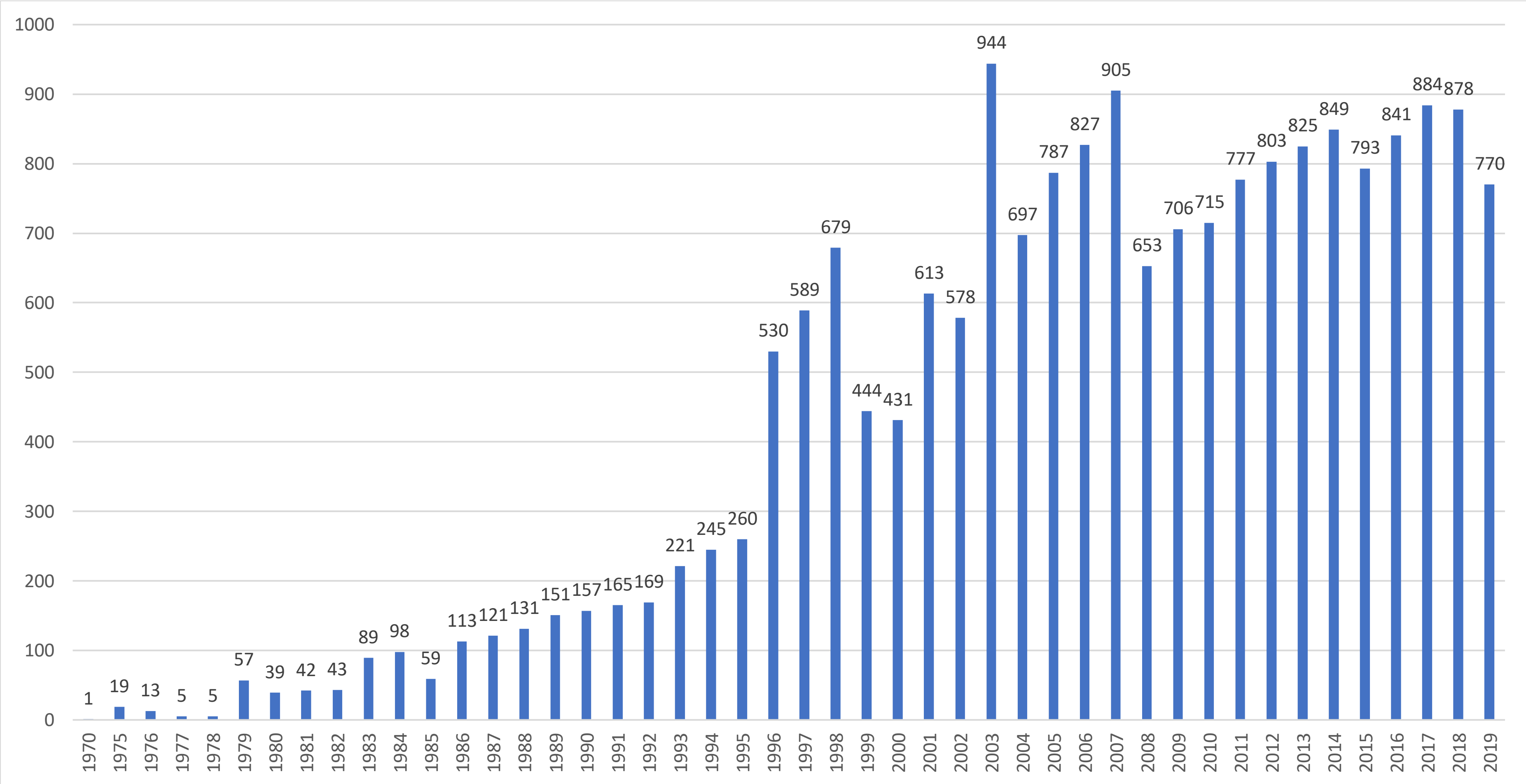

Figure 6.10. Citations per year

6.1.8 Journals

As for the journals that hosted the publications, 28.9% of the publications has been published in "Chronicle of Higher Education". The journals with the bold letters are the European ones. It can be seen that out of the 46 journals, exactly half of them are Europeans, which stands for 12948 out of 32715.

Table 6.0.13. Journals of publications

Journal	Nº	%
Chronicle of Higher Education	9443	28,9
Journal of Management Education	2082	6,4
Journal of Professional Issues in Engineering Education and Practice	1830	5,6
Childhood EducationW	1743	5,3
International Journal of Educational Management	1502	4,6
Management in Education	1339	4,1
Journal of Education for Business	1221	3,7
Industry and Higher Education	1086	3,3
Journal of Marketing Education	1073	3,3
Accounting Education	890	2,7
Journal of Accounting Education	890	2,7
Educational Management Administration and Leadership	796	2,4
Education and Training	791	2,4
Tertiary Education and Management	706	2,2
International Journal of Leadership in Education	698	2,1
Journal of Hospitality and Tourism Education	637	1,9
Journal of Teaching in International Business	612	1,9
Journal of Education and Work	485	1,5
Journal of Marketing for Higher Education	479	1,5
Journal of Entrepreneurship Education	451	1,4
Journal of Teaching in Travel and Tourism	424	1,3
Issues in Accounting Education	396	1,2

Engineering Science and Education Journal	323	1,0
International Journal of Management in Education	323	1,0
International Journal of Management Education	320	1,0
Journal of Hospitality, Leisure, Sport and Tourism Education	311	1,0
Journal of Mental Health Training, Education and Practice	244	,7
Educational Assessment, Evaluation and Accountability	240	,7
Decision Sciences Journal of Innovative Education	218	,7
Education, Business and Society: Contemporary Middle Eastern Issues	170	,5
The Journal of Mental Health Training, Education and Practice	168	,5
Advances in Accounting Education: Teaching and Curriculum Innovations	159	,5
British Journal of Education & Work	135	,4
Journal of International Education in Business	119	,4
International Journal of Educational Organization and Leadership	71	,2
Journal for Advancement of Marketing Education	58	,2
Sport Management Education Journal	49	,1
Management Education	43	,1
Journal of Advertising Education	34	,1
INFORMS Transactions on Education	32	,1
Journal of Teaching and Learning for Graduate Employability	27	,1
Journal of the Australasian Tax Teachers Association	26	,1
Tuning Journal for Higher Education	26	,1
The Chronicle of higher education	22	,1
Journal of Industrial Organization Education	18	,1
The Chronicle of higher education.	5	,0
Total	32715	100,0

6.1.9 Scientific production in Greece

In the analysed period, the scientific production in Greece in the field of Business, Management and Accounting is scarce. Only 143 papers have been found. The maximum production occurred in the years 2014 and 2015. All documents were published in English.

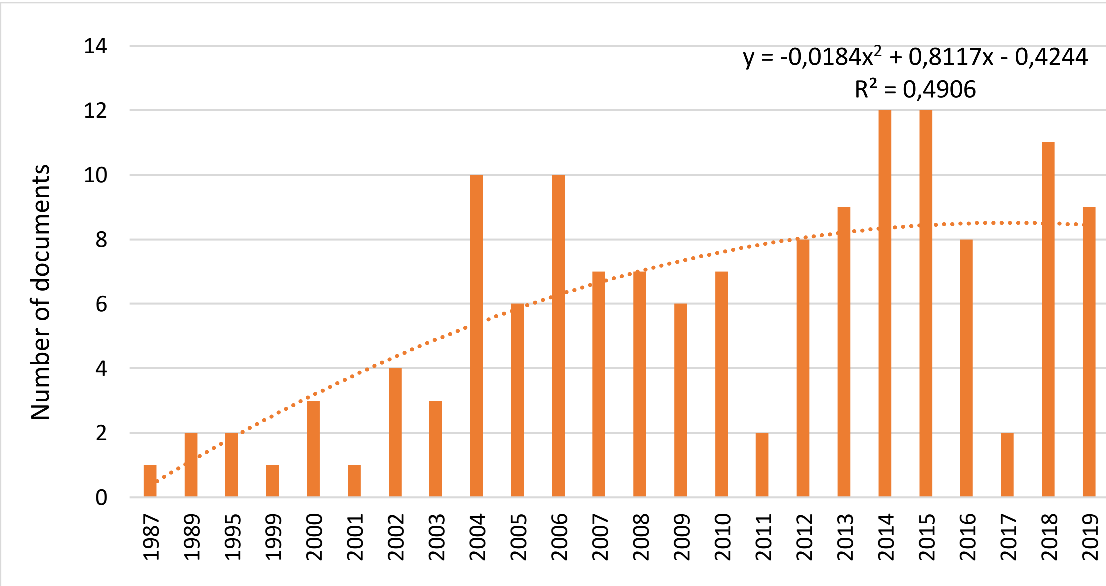

Figure 6.11. Diachronic scientific production in Greece.

It is evident that there is no continuous growth pattern; there are several fluctuations. At the beginning of the period, no production was found prior to 1987. The best fit to the data is a polynomial trend line of degree 2 (R2= 0.5442) (Figure 6.11).

These papers were produced by 122 different authors. No major producer was found in Bradford terms. (n≥10). The author who has published the most papers on the subject is Papadourakis (Table 6.14).

Table 6.0.14. Most productive authors (n ≥1).

Author	Nº docs	%
Papadourakis G.M.	9	6,3
Saiti A.	4	2,8

Laios A.	3	2,1
Sigala M.	3	2,1
Anastasiadou S.D.	2	1,4
Anastasiou S.	2	1,4
Papakonstantinou G.	2	1,4
Brinia V.	2	1,4
Kirpich P.Z.	2	1,4
Taousanidis N.I.,	2	1,4
Antoniadou M.A.	2	1,4
Thanopoulos J.	2	1,4

Greek authors have published their research in 24 journals. Almost half of the production (44.8%) has been disseminated in two journals, Industry and Higher Education and the International Journal of Educational Management (Table 6.15).

The Greek authors are grouped into three interrelated sub-networks, where Kiriakides and Cremers are the main protagonists due to their intermediary role between the other two sub-networks (Figure 6.12).

Table 6.0.15. Journals that have published the papers of Greek authors

Journal	Nº Docs	%	% Accumulated
Industry and Higher Education	33	23,1	23,1
International Journal of Educational Management	31	21,7	44,8
Education and Training	8	5,6	50,3
International Journal of Management in Education	8	5,6	55,9
Journal of Professional Issues in Engineering Education and Practice	7	4,9	60,8
Educational Management Administration and Leadership	6	4,2	65
International Journal of Leadership in Education	6	4,2	69,2
Journal of Hospitality, Leisure, Sport and Tourism Education	6	4,2	73,4

Childhood Education	5	3,5	76,9
International Journal of Management Education	5	3,5	80,4
Journal of Hospitality and Tourism Education	4	2,8	83,2
Journal of Education and Work	3	2,1	85,3
Management Education	3	2,1	87,4
Tertiary Education and Management	3	2,1	89,5
Educational Assessment, Evaluation and Accountability	2	1,4	90,9
International Journal of Educational Organization and Leadership	2	1,4	92,3
Journal of Management Education	2	1,4	93,7
Journal of Teaching in International Business	2	1,4	95,1
Management in Education	2	1,4	96,5
Accounting Education	1	0,7	97,2
Advances in Accounting Education: Teaching and Curriculum Innovations	1	0,7	97,9
Engineering Science and Education Journal	1	0,7	98,6
Journal of Entrepreneurship Education	1	0,7	99,3
Journal of Marketing for Higher Education	1	0,7	100

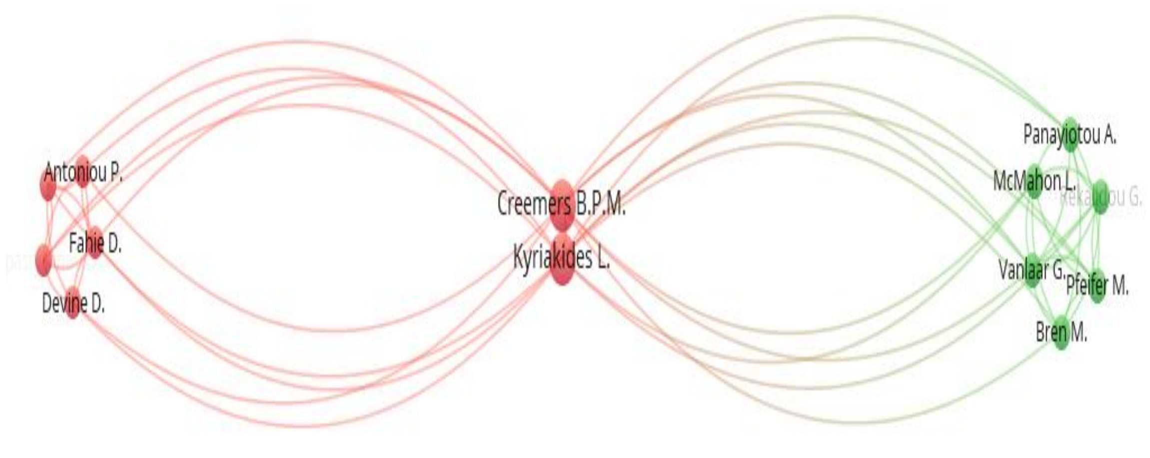

Figure 6.12. Greek authors' collaboration network

6.2 Scientometric laws

6.2.1 Bradford's law for journals

It is interesting to know the dispersion of the production on legislation and education in the category of Business, Management and Accounting in the SCOPUS database to know which are the journals that make up the main research area's main dissemination focuses.

To achieve this purpose, we proceed to apply the law of dispersion of scientific literature or Bradford's Law (1948) to determine the different zones. The data on the productivity of documents published in journals were analyzed. Table 19 shows the distribution of the journals according to the production of documents.

Table 6.0.16. Distribution of journals according to the publication of documents

Journals = a	Docs = b	$a \cdot b$	Accumulated journals = c	ln c	Accumulated documents
1	9443	9443	1	0,0000	9443
1	2082	2082	2	0,6931	11525
1	1830	1830	3	1,0986	13355
1	1743	1743	4	1,3863	15098
1	1502	1502	5	1,6094	16600
1	1339	1339	6	1,7918	17939
1	1221	1221	7	1,9459	19160
1	1086	1086	8	2,0794	20246
1	1073	1073	9	2,1972	21319
2	890	1780	11	2,3979	23099
1	796	796	12	2,4849	23895
1	791	791	13	2,5649	24686
1	706	706	14	2,6391	25392

1	698	698	15	2,7081	26090
1	637	637	16	2,7726	26727
1	612	612	17	2,8332	27339
1	485	485	18	2,8904	27824
1	479	479	19	2,9444	28303
1	451	451	20	2,9957	28754
1	424	424	21	3,0445	29178
1	396	396	22	3,0910	29574
2	323	646	24	3,1781	30220
1	320	320	25	3,2189	30540
1	311	311	26	3,2581	30851
1	244	244	27	3,2958	31095
1	240	240	28	3,3322	31335
1	218	218	29	3,3673	31553
1	170	170	30	3,4012	31723
1	168	168	31	3,4340	31891
1	159	159	32	3,4657	32050
1	135	135	33	3,4965	32185
1	119	119	34	3,5264	32304
1	71	71	35	3,5553	32375
1	58	58	36	3,5835	32433
1	49	49	37	3,6109	32482
1	43	43	38	3,6376	32525
1	34	34	39	3,6636	32559
1	32	32	40	3,6889	32591
1	27	27	41	3,7136	32618
2	26	52	43	3,7612	32670
1	22	22	44	3,7842	32692
1	18	18	45	3,8067	32710
1	5	5	46	3,8286	32715

To illustrate Bradford's Law, we initially present the graphical representation in Figure 15. The horizontal axis is logarithmic and represents the cumulative number of journals in descending order of productivity and the vertical axis represents the cumulative number of papers. The resulting curve of the cumulative number of papers by R(r) journals is monotonic and increasing.

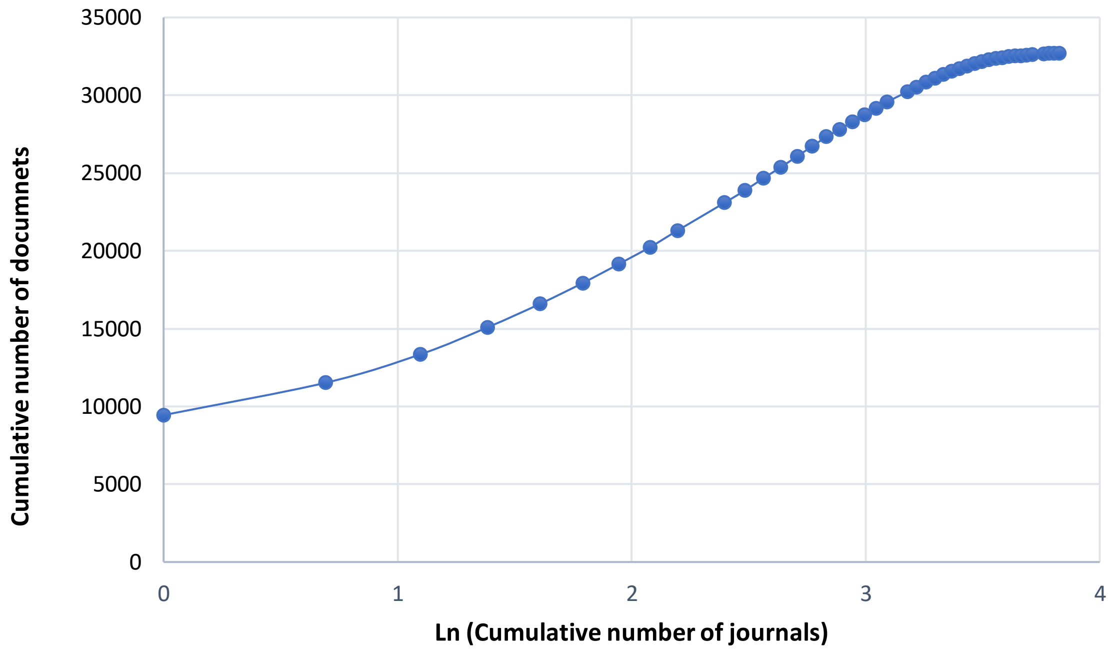

Figure 6.13. Dispersion of the scientific literature according to the Bradford model.

Bradford did not enunciate his law by means of mathematical expressions, for this reason, we will proceed to find the so-called Bradford zones using the Law of Leimkuhler (1967) who expresses it in mathematical terms: R(r)=a·ln(1+b·r). For such purpose we will follow the procedure proposed by Egghe (1986) and which has been tested in other studies (Maz-Machado et al., 2020; Pinto et al., 2015).

If we consider that:

r_0 is the number of journals in the first Bradford zone.

y_0 is the number of articles in each Bradford zone (each zone must be of equal size).

K is the Bradford multiplier.

$R(r)$ is the cumulative number of articles published by journals.

a and b are the constants of the Leimkuhler formula: $R(r) = a \cdot \ln(1 + b \cdot r)$.

Egghe (1986) indicates that the following formulas are used to find the values of the constants a and b: $a = \frac{y_0}{Lnk}$ and $b = \frac{k-1}{r_0}$. First, we determine the number of Bradford zones we want to find p (number of Bradford zones), so p=3. Now we can find the value of k, following Egghe (1986):

$$k = (e^\gamma \cdot y_m)^{1/p}$$

where γ is Euler's constant, $\gamma = 0{,}5772$, so that $e^\gamma = 1{,}781$.

$k = (1{,}781 \cdot y_m)^{1/p} = (1{,}781 \cdot 9443)^{1/3} == 25{,}6207$

$r_0 = \frac{T}{1+k+k^2+\cdots+k^p-1} = \frac{T\cdot(k-1)}{k^p-1}$, T is the total number of journals.

$r_0 = \frac{T\cdot(k-1)}{k^p-1} = \frac{46\cdot(25{,}6207-1)}{25{,}6207^3-1} = \frac{1132{,}5522}{16816{,}94677} = 0{,}0673.$

Once the values of k and r_0 are obtained, we proceed to find *a* and *b*.

$$a = \frac{(31476/3)}{\ln(25{,}6207)} = \frac{10492}{3{,}2434} = 3234{,}876 \text{ y } b = \frac{25{,}6207 - 1}{0{,}0673} = 350{,}976$$

To calculate the number of journals in each of the Bradford zones $(r_0, k \cdot r_0, k^2 \cdot r_0, \ldots)$ Egghe (1990) himself recommends using the exact values of r_0 and k and thus also the values of *a* and *b* in the Leimkuhler's law formula.

$$R(r) = a \cdot \ln(1 + b \cdot r) = 3234{,}876 \cdot \ln(1 + 350{,}976 \cdot 0{,}0673)$$

$$= 10263{,}206$$

The distribution of all journals in the three Bradford zones is presented in Table 20. The core is made up of two journals that accumulate 11526 documents and are shown in Table 21.

Table 6.0.17. Distribution of all journals in three Bradford zones.

Zones	Journals	Documents	K
Core	2	11525	--
Zone 1	9	11574	4,5
Zone 2	35	9616	3,88
Total	46	32715	

Table 6.0.18. Journals that make up the Bradford core.

	Revista	Nº Docs	%
Bradford core	Chronicle of Higher Education	9443	28,9
	Journal of Management Education	2082	6,4

6.2.2 Lotka's law for journals

As explained in section 2.2.2, Lotka's law allows us to observe whether there is a regularity in the distribution of authors according to the number of documents produced. To verify Lotka's law, we followed the work of Maz-Machado et al. (2017) as a model to achieve it and following the proposals Pao (1985; 1986). For the study sample, Table 22 presents the distribution of authors on legislation and education in the category of Business, Management and Accounting in the SCOPUS database, according to the number of publications. A complete count has been made so that each author present in a document is considered equally and in total for all.

Table 6.0.19. Number of authors according to the number of articles published

Number of contributions by author	Number of authors	Total article		% of authors		% of articles	% of accumulated articles
x	y	xy	$\sum xy$	$\%y$	$\sum\%y$	$\%xy$	$\sum\%xy$
1	24056	24056	24056	76,604	76,60	45,69	45,69
2	4147	8294	32350	13,206	89,810	15,75	61,45

3	1468	4404	36754	4,675	94,485	8,37	69,81
4	645	2580	39334	2,054	96,539	4,90	74,72
5	330	1650	40984	1,051	97,589	3,13	77,85
6	193	1158	42142	0,615	98,204	2,20	80,05
7	125	875	43017	0,398	98,602	1,66	81,71
8	70	560	43577	0,223	98,825	1,06	82,78
9	50	450	44027	0,159	98,984	0,85	83,63
10	47	470	44497	0,150	99,134	0,89	84,52
11	23	253	44750	0,073	99,207	0,48	85,00
12	29	348	45098	0,092	99,299	0,66	85,66
13	15	195	45293	0,048	99,347	0,37	86,03
14	13	182	45475	0,041	99,389	0,35	86,38
15	19	285	45760	0,061	99,449	0,54	86,92
16	14	224	45984	0,045	99,494	0,43	87,35
17	18	306	46290	0,057	99,551	0,58	87,93
18	12	216	46506	0,038	99,589	0,41	88,34
19	7	133	46639	0,022	99,612	0,25	88,59
20	6	120	46759	0,019	99,631	0,23	88,82
21	5	105	46864	0,016	99,647	0,20	89,02
22	4	88	46952	0,013	99,659	0,17	89,19
23	6	138	47090	0,019	99,678	0,26	89,45
24	4	96	47186	0,013	99,691	0,18	89,63
25	6	150	47336	0,019	99,710	0,28	89,92
26	6	156	47492	0,019	99,729	0,30	90,21
27	3	81	47573	0,010	99,739	0,15	90,37
28	3	84	47657	0,010	99,748	0,16	90,53
29	5	145	47802	0,016	99,764	0,28	90,80
30	5	150	47952	0,016	99,780	0,28	91,09
31	2	62	48014	0,006	99,787	0,12	91,20
32	5	160	48174	0,016	99,803	0,30	91,51
33	5	165	48339	0,016	99,818	0,31	91,82
34	2	68	48407	0,006	99,825	0,13	91,95

35	4	140	48547	0,013	99,838	0,27	92,22
36	2	72	48619	0,006	99,844	0,14	92,35
37	2	74	48693	0,006	99,850	0,14	92,49
38	2	76	48769	0,006	99,857	0,14	92,64
39	1	39	48808	0,003	99,860	0,07	92,71
40	1	40	48848	0,003	99,863	0,08	92,79
44	1	44	48892	0,003	99,866	0,08	92,87
47	1	47	48939	0,003	99,869	0,09	92,96
48	2	96	49035	0,006	99,876	0,18	93,14
51	2	102	49137	0,006	99,882	0,19	93,34
52	1	52	49189	0,003	99,885	0,10	93,44
53	1	53	49242	0,003	99,889	0,10	93,54
54	2	108	49350	0,006	99,895	0,21	93,74
56	1	56	49406	0,003	99,898	0,11	93,85
57	1	57	49463	0,003	99,901	0,11	93,96
62	1	62	49525	0,003	99,904	0,12	94,07
65	1	65	49590	0,003	99,908	0,12	94,20
66	1	66	49656	0,003	99,911	0,13	94,32
68	1	68	49724	0,003	99,914	0,13	94,45
73	1	73	49797	0,003	99,917	0,14	94,59
74	1	74	49871	0,003	99,920	0,14	94,73
75	2	150	50021	0,006	99,927	0,28	95,02
76	1	76	50097	0,003	99,930	0,14	95,16
80	1	80	50177	0,003	99,933	0,15	95,31
83	1	83	50260	0,003	99,936	0,16	95,47
88	1	88	50348	0,003	99,939	0,17	95,64
91	1	91	50439	0,003	99,943	0,17	95,81
94	1	94	50533	0,003	99,946	0,18	95,99
95	1	95	50628	0,003	99,949	0,18	96,17
101	1	101	50729	0,003	99,952	0,19	96,36
102	2	204	50933	0,006	99,959	0,39	96,75
105	1	105	51038	0,003	99,962	0,20	96,95

106	1	106	51144	0,003	99,965	0,20	97,15
113	2	226	51370	0,006	99,971	0,43	97,58
118	1	118	51488	0,003	99,975	0,22	97,80
123	1	123	51611	0,003	99,978	0,23	98,04
130	1	130	51741	0,003	99,981	0,25	98,28
131	1	131	51872	0,003	99,984	0,25	98,53
146	1	146	52018	0,003	99,987	0,28	98,81
149	1	149	52167	0,003	99,990	0,28	99,09
151	1	151	52318	0,003	99,994	0,29	99,38
158	1	158	52476	0,003	99,997	0,30	99,68
169	1	169	52645	0,003	100,000	0,32	100,00

We have then taken the data from the *x* and *y* columns of table 22 and proceeded to plot the distribution of contributions according to the number of distributions in the logarithmic figure 6.14.

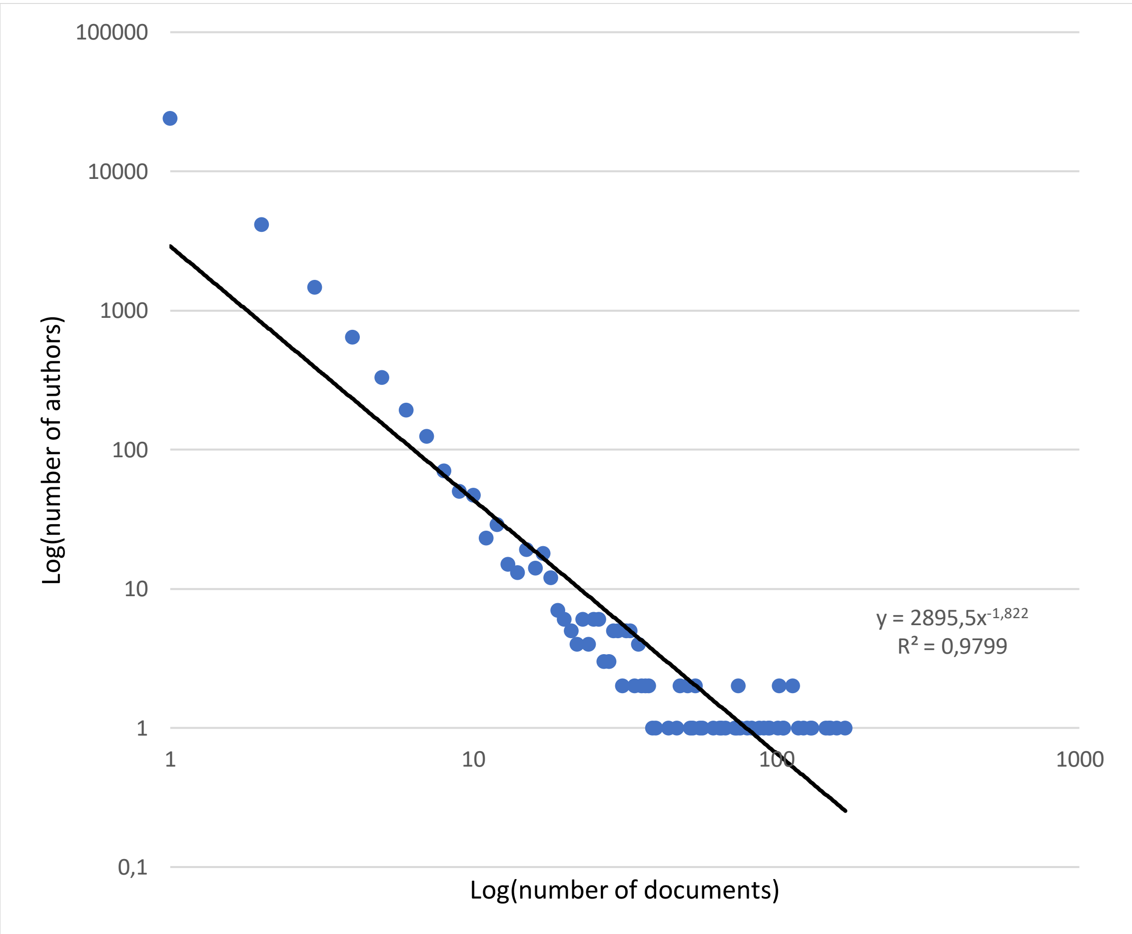

Figure 6.14. Logarithmic plot of the number of authors Vs number of contributions.

As can be seen in the graph in Figure 16, this potential distribution is transformed into a linear relationship to apply the least squares method to determine the parameters of the distribution.

Next, the least squares distribution for the study sample is found (Table 6.20).

Table 6.0.20. Least squares distribution of the observed data

X	Y	$\log X$	$\log Y$	$\log X \cdot \log Y$	$(\log X)^2$
1	24056	0.0000	4.3812	0.0000	0.0000
2	4147	0.3010	3.6177	1.0890	0.0906
3	1468	0.4771	3.1667	1.5109	0.2276
4	645	0.6021	2.8096	1.6915	0.3625
5	330	0,6990	2,5185	1,7604	0,4886
6	193	0,7782	2,2856	1,7785	0,6055
7	125	0,8451	2,0969	1,7721	0,7142
8	70	0,9031	1,8451	1,6663	0,8156
9	50	0,9542	1,6990	1,6212	0,9106
10	47	1,0000	1,6721	1,6721	1,0000
11	23	1,0414	1,3617	1,4181	1,0845
12	29	1,0792	1,4624	1,5782	1,1646
13	15	1,1139	1,1761	1,3101	1,2409
14	13	1,1461	1,1139	1,2767	1,3136
15	19	1,1761	1,2788	1,5039	1,3832
16	14	1,2041	1,1461	1,3801	1,4499
17	18	1,2304	1,2553	1,5445	1,5140
18	12	1,2553	1,0792	1,3547	1,5757
19	7	1,2788	0,8451	1,0807	1,6352
20	6	1,3010	0,7782	1,0124	1,6927

21	5	1,3222	0,6990	0,9242	1,7483
22	4	1,3424	0,6021	0,8082	1,8021
23	6	1,3617	0,7782	1,0596	1,8543
24	4	1,3802	0,6021	0,8310	1,9050
25	6	1,3979	0,7782	1,0878	1,9542
26	6	1,4150	0,7782	1,1011	2,0021
27	3	1,4314	0,4771	0,6829	2,0488
28	3	1,4472	0,4771	0,6905	2,0943
29	5	1,4624	0,6990	1,0222	2,1386
30	5	1,4771	0,6990	1,0325	2,1819
31	2	1,4914	0,3010	0,4489	2,2242
32	5	1,5051	0,6990	1,0521	2,2655
33	5	1,5185	0,6990	1,0614	2,3059
34	2	1,5315	0,3010	0,4610	2,3454
35	4	1,5441	0,6021	0,9296	2,3841
36	2	1,5563	0,3010	0,4685	2,4221
37	2	1,5682	0,3010	0,4721	2,4593
38	2	1,5798	0,3010	0,4756	2,4957
39	1	1,5911	0,0000	0,0000	2,5315
40	1	1,6021	0,0000	0,0000	2,5666
44	1	1,6435	0,0000	0,0000	2,7009
47	1	1,6721	0,0000	0,0000	2,7959
48	2	1,6812	0,3010	0,5061	2,8266
51	2	1,7076	0,3010	0,5140	2,9158
52	1	1,7160	0,0000	0,0000	2,9447
53	1	1,7243	0,0000	0,0000	2,9731
54	2	1,7324	0,3010	0,5215	3,0012
56	1	1,7482	0,0000	0,0000	3,0562
57	1	1,7559	0,0000	0,0000	3,0831
62	1	1,7924	0,0000	0,0000	3,2127
65	1	1,8129	0,0000	0,0000	3,2867
66	1	1,8195	0,0000	0,0000	3,3107

68	1	1,8325	0,0000	0,0000	3,3581
73	1	1,8633	0,0000	0,0000	3,4720
74	1	1,8692	0,0000	0,0000	3,4940
75	2	1,8751	0,3010	0,5644	3,5159
76	1	1,8808	0,0000	0,0000	3,5375
80	1	1,9031	0,0000	0,0000	3,6218
83	1	1,9191	0,0000	0,0000	3,6829
88	1	1,9445	0,0000	0,0000	3,7810
91	1	1,9590	0,0000	0,0000	3,8378
94	1	1,9731	0,0000	0,0000	3,8932
95	1	1,9777	0,0000	0,0000	3,9114
101	1	2,0043	0,0000	0,0000	4,0173
102	2	2,0086	0,3010	0,6046	4,0345
105	1	2,0212	0,0000	0,0000	4,0852
106	1	2,0253	0,0000	0,0000	4,1019
113	2	2,0531	0,3010	0,6180	4,2151
118	1	2,0719	0,0000	0,0000	4,2927
123	1	2,0899	0,0000	0,0000	4,3677
130	1	2,1139	0,0000	0,0000	4,4688
131	1	2,1173	0,0000	0,0000	4,4828
146	1	2,1644	0,0000	0,0000	4,6844
149	1	2,1732	0,0000	0,0000	4,7227
151	1	2,1790	0,0000	0,0000	4,7479
158	1	2,1987	0,0000	0,0000	4,8341
169	1	2,2279	0,0000	0,0000	4,9635
4174	31403	119,1636	49,4901	45,95933	201,2309

Taking the data from Table 6.20, we proceeded to find the parameters *n* and C for use in Lotka's formula:

$$f(x) = \frac{C}{x^n} = Cx^{-n}$$

To determine the value of α we use the formula given by Pao (1985):

$$n = \frac{N \sum XY - \sum X \sum Y}{N \sum x^2 - (\sum X)^2}$$

Were,

N = number of observed data pairs.

X = base 10 logarithm of x.

Y= base 10 logarithm of y.

We use the data from Table XX2:

$n = \frac{77*(45{,}9593)-(4174)*(31403)}{77*(201{,}2309)-(41744)^2}$

$$n = 7{,}52997$$

Since C represents the theoretical percentage of authors collaborating with a single article or paper in the distribution of author productivity, the inverse Riemann Zeta function is used. To obtain this estimate of the value, Pao (1985; 1986) provides a formula to calculate it with an exact approximation which is expressed as:

$$C = \frac{1}{\sum_{x=1}^{P-1} \frac{1}{x^n} + \frac{1}{(n-1)P^{n-1}} + \frac{1}{2P^n} + \frac{n}{24(P-1)^{n+1}}}$$

Were,

x = is the number of 1, 2, 3, ... n contributions per author.

n = is the value of the parameter obtained above, *n* = 7,52997

P = is the number of observed data pairs.

$$C = \frac{1}{1{,}18630293 + 4{,}89207 * 10^{-10} + 7{,}98454 * 10^{-11} + 3{,}88016 * 10^{-12}}$$

$$C = \frac{1}{1{,}1863029} = 0{,}84295501$$

Now we replace the values of the parameters *n* and C in equation 1:

$$F_{(x)} = \frac{c}{x^n} = Cx^{-n} = 0{,}84295501. x^{-7{,}52997}$$

Table 6.0.21. Data obtained by application of Lotka's law of generalized inverse power.

Observed values		Expected values (Lotka)	
X	Y	$y = Cx^{-n}$	$y = y_x \sum y$
1	24056	0,84295500	26471,3159
2	4147	0,00456097	143,228253
3	1468	0,00021533	6,76186967
4	645	2,4678E-05	0,77496459
5	330	4,5981E-06	0,14439507
6	193	1,1651E-06	0,03658642
7	125	3,6496E-07	0,01146074
8	70	1,3353E-07	0,0041931
9	50	5,5003E-08	0,00172726
10	47	2,4879E-08	0,00078128
11	23	1,2138E-08	0,00038117
12	29	6,3038E-09	0,00019796
13	15	3,4502E-09	0,00010835
14	13	1,9747E-09	6,2011E-05
15	19	1,1746E-09	3,6884E-05
16	14	7,2247E-10	2,2688E-05
17	18	4,5768E-10	1,4372E-05
18	12	2,976E-10	9,3457E-06
19	7	1,9807E-10	6,2201E-06

20	6	1,3461E-10	4,2273E-06
21	5	9,3225E-11	2,9275E-06
22	4	6,5675E-11	2,0624E-06
23	6	4,6993E-11	1,4757E-06
24	4	3,4108E-11	1,0711E-06
25	6	2,5082E-11	7,8764E-07
26	6	1,8668E-11	5,8623E-07
27	3	1,405E-11	4,4121E-07
28	3	1,0684E-11	3,3552E-07
29	5	8,2034E-12	2,5761E-07
30	5	6,3551E-12	1,9957E-07
31	2	4,9647E-12	1,5591E-07
32	5	3,909E-12	1,2276E-07
33	5	3,1006E-12	9,7367E-08
34	2	2,4764E-12	7,7765E-08
35	4	1,9908E-12	6,2516E-08
36	2	1,6102E-12	5,0567E-08
37	2	1,3101E-12	4,114E-08
38	2	1,0717E-12	3,3655E-08
39	1	8,8132E-13	2,7676E-08
40	1	7,2835E-13	2,2872E-08
44	1	3,5535E-13	1,1159E-08
47	1	2,1625E-13	6,7909E-09
48	2	1,8455E-13	5,7953E-09

51	2	1,1691E-13	3,6713E-09
52	1	1,0101E-13	3,1719E-09
53	1	8,751E-14	2,7481E-09
54	2	7,6021E-14	2,3873E-09
56	1	5,781E-14	1,8154E-09
57	1	5,0596E-14	1,5889E-09
62	1	2,6863E-14	8,4357E-10
65	1	1,882E-14	5,9101E-10
66	1	1,6776E-14	5,2682E-10
68	1	1,3399E-14	4,2076E-10
73	1	7,8531E-15	2,4661E-10
74	1	7,0884E-15	2,226E-10
75	2	6,4069E-15	2,012E-10
76	1	5,7988E-15	1,821E-10
80	1	3,9409E-15	1,2376E-10
83	1	2,9868E-15	9,3794E-11
88	1	1,9227E-15	6,0378E-11
91	1	1,4938E-15	4,6909E-11
94	1	1,1701E-15	3,6744E-11
95	1	1,0805E-15	3,3929E-11
101	1	6,8128E-16	2,1394E-11
102	2	6,3257E-16	1,9864E-11
105	1	5,0852E-16	1,5969E-11
106	1	4,7349E-16	1,4869E-11

113	2	2,9254E-16	9,1866E-12
118	1	2,1115E-16	6,6308E-12
123	1	1,5448E-16	4,8512E-12
130	1	1,0183E-16	3,1978E-12
131	1	9,612E-17	3,0185E-12
146	1	4,2491E-17	1,3343E-12
149	1	3,6457E-17	1,1448E-12
151	1	3,2974E-17	1,0355E-12
158	1	2,3441E-17	7,3613E-13
169	1	1,4122E-17	4,4346E-13

In Figure 6.15 we compare the distribution of the observed values in the sample under study with the expected values calculated by fitting Lotka's generalized inverse power law.

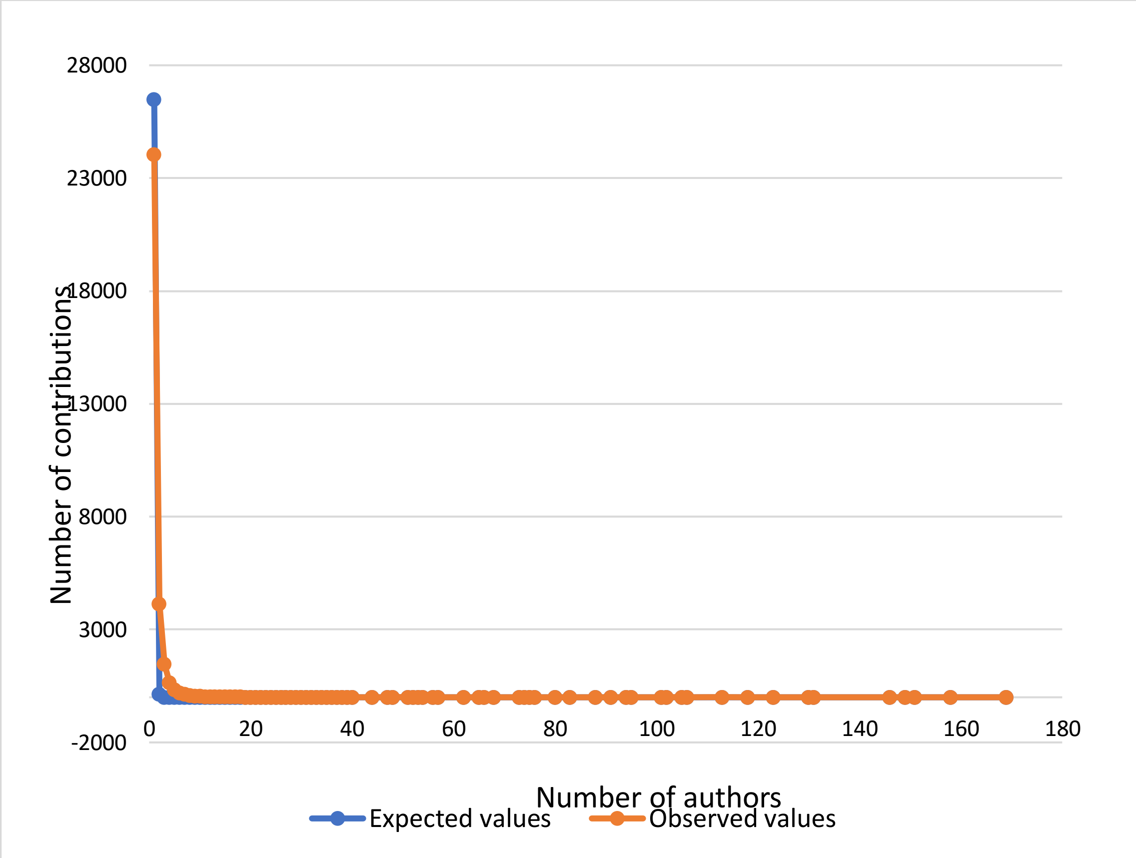

Figure 6.15. Distributions of observed and expected frequencies after applying Lotka's law.

To check if there are significant differences between the two distributions found, we proceed to apply the Kolmogorov-Smirnov (K-S) test, which allows us to determine the goodness of fit between the distributions. For this calculation we compare the accumulated normalized observed values with respect to the accumulated expected absolute values, and establish the difference between them in absolute terms (Table 6.22). It is observed that the maximum value of the Difference (Dmax) is 5.722282. The critical value of D (Dcrit) for a significance level of 0.01 is calculated using the formula:

$$Dcrit = \frac{1.63}{\sqrt{N}}$$

N being the cumulative value of the number of authors. For $N = 31403$ we have that $Dcrít = 0.00976249$ which is less than the maximum Deviation (Dmax)=

0,0769, therefore, we can conclude **that this distribution does not conform to Lotka's law** at 0.01 level of significance according to the K-S test (Table 6.22).

Table 6.22. Kolmogorov-Smirnov fit test of the distribution of authors' output in the analyzed papers.

x	y	$\frac{yx}{\sum yx}$	$\sum\left(\frac{yx}{\sum yx}\right)$	Cx^{-n}	$\sum(Cx^{-n})$	$Dmáx$
1	24056	0,P766041	0,766041	0,842950	0,842950	0,0769085
2	4147	0,132057	0,898099	0,004561	0,847511	-0,0505880
3	1468	0,046747	0,944846	0,000215	0,847726	-0,0971198
4	645	0,020539	0,965385	0,000025	0,847751	-0,1176345
5	330	0,010509	0,975894	0,000005	0,847756	-0,1281385
6	193	0,006146	0,982040	0,000001	0,847757	-0,1342832
7	125	0,003981	0,986020	0,000000	0,847757	-0,1382634
8	70	0,002229	0,988250	0,000000	0,847757	-0,1404923
9	50	0,001592	0,989842	0,000000	0,847757	-0,1420845
10	47	0,001497	0,991338	0,000000	0,847757	-0,1435811
11	23	0,000732	0,992071	0,000000	0,847757	-0,1443135
12	29	0,000923	0,992994	0,000000	0,847757	-0,1452370
13	15	0,000478	0,993472	0,000000	0,847757	-0,1457146
14	13	0,000414	0,993886	0,000000	0,847757	-0,1461286
15	19	0,000605	0,994491	0,000000	0,847757	-0,1467337
16	14	0,000446	0,994937	0,000000	0,847757	-0,1471795
17	18	0,000573	0,995510	0,000000	0,847757	-0,1477527
18	12	0,000382	0,995892	0,000000	0,847757	-0,1481348
19	7	0,000223	0,996115	0,000000	0,847757	-0,1483577
20	6	0,000191	0,996306	0,000000	0,847757	-0,1485488
21	5	0,000159	0,996465	0,000000	0,847757	-0,1487080
22	4	0,000127	0,996593	0,000000	0,847757	-0,1488354
23	6	0,000191	0,996784	0,000000	0,847757	-0,1490264
24	4	0,000127	0,996911	0,000000	0,847757	-0,1491538
25	6	0,000191	0,997102	0,000000	0,847757	-0,1493449
26	6	0,000191	0,997293	0,000000	0,847757	-0,1495359

27	3	0,000096	0,997389	0,000000	0,847757	-0,1496315
28	3	0,000096	0,997484	0,000000	0,847757	-0,1497270
29	5	0,000159	0,997644	0,000000	0,847757	-0,1498862
30	5	0,000159	0,997803	0,000000	0,847757	-0,1500454
31	2	0,000064	0,997866	0,000000	0,847757	-0,1501091
32	5	0,000159	0,998026	0,000000	0,847757	-0,1502683
33	5	0,000159	0,998185	0,000000	0,847757	-0,1504276
34	2	0,000064	0,998249	0,000000	0,847757	-0,1504913
35	4	0,000127	0,998376	0,000000	0,847757	-0,1506186
36	2	0,000064	0,998440	0,000000	0,847757	-0,1506823
37	2	0,000064	0,998503	0,000000	0,847757	-0,1507460
38	2	0,000064	0,998567	0,000000	0,847757	-0,1508097
39	1	0,000032	0,998599	0,000000	0,847757	-0,1508415
40	1	0,000032	0,998631	0,000000	0,847757	-0,1508734
44	1	0,000032	0,998663	0,000000	0,847757	-0,1509052
47	1	0,000032	0,998694	0,000000	0,847757	-0,1509371
48	2	0,000064	0,998758	0,000000	0,847757	-0,1510008
51	2	0,000064	0,998822	0,000000	0,847757	-0,1510645
52	1	0,000032	0,998854	0,000000	0,847757	-0,1510963
53	1	0,000032	0,998885	0,000000	0,847757	-0,1511281
54	2	0,000064	0,998949	0,000000	0,847757	-0,1511918
56	1	0,000032	0,998981	0,000000	0,847757	-0,1512237
57	1	0,000032	0,999013	0,000000	0,847757	-0,1512555
62	1	0,000032	0,999045	0,000000	0,847757	-0,1512874
65	1	0,000032	0,999077	0,000000	0,847757	-0,1513192
66	1	0,000032	0,999108	0,000000	0,847757	-0,1513510
68	1	0,000032	0,999140	0,000000	0,847757	-0,1513829
73	1	0,000032	0,999172	0,000000	0,847757	-0,1514147
74	1	0,000032	0,999204	0,000000	0,847757	-0,1514466
75	2	0,000064	0,999268	0,000000	0,847757	-0,1515103
76	1	0,000032	0,999299	0,000000	0,847757	-0,1515421
80	1	0,000032	0,999331	0,000000	0,847757	-0,1515740

83	1	0,000032	0,999363	0,000000	0,847757	-0,1516058
88	1	0,000032	0,999395	0,000000	0,847757	-0,1516376
91	1	0,000032	0,999427	0,000000	0,847757	-0,1516695
94	1	0,000032	0,999459	0,000000	0,847757	-0,1517013
95	1	0,000032	0,999490	0,000000	0,847757	-0,1517332
101	1	0,000032	0,999522	0,000000	0,847757	-0,1517650
102	2	0,000064	0,999586	0,000000	0,847757	-0,1518287
105	1	0,000032	0,999618	0,000000	0,847757	-0,1518606
106	1	0,000032	0,999650	0,000000	0,847757	-0,1518924
113	2	0,000064	0,999713	0,000000	0,847757	-0,1519561
118	1	0,000032	0,999745	0,000000	0,847757	-0,1519879
123	1	0,000032	0,999777	0,000000	0,847757	-0,1520198
130	1	0,000032	0,999809	0,000000	0,847757	-0,1520516
131	1	0,000032	0,999841	0,000000	0,847757	-0,1520835
146	1	0,000032	0,999873	0,000000	0,847757	-0,1521153
149	1	0,000032	0,999904	0,000000	0,847757	-0,1521472
151	1	0,000032	0,999936	0,000000	0,847757	-0,1521790
158	1	0,000032	0,999968	0,000000	0,847757	-0,1522108
169	1	0,000032	1,000000	0,000000	0,847757	-0,1522427

7. Conclusions

7.1 Answering the objectives

The general objective of this research was to analyze the production on legislation and education in the *Business, Management and Accounting* category through a scientometric study of the publications indexed in the database of SCOPUS.

The hypotheses were that the research articles in legislation and education in the Business, Management and Accounting category in SCOPUS-indexed journals in the study period verify the main scientometric laws: Lotka and Bradford and that the collaboration between authors in this scientific production is of local or national character.

The first objective was to know the diachronic development of the scientific production in education related to legislation and indexed in SCOPUS (*Business, Management and Accounting*). This objective is answered in the section 6.1.1. All production was found in the period between 1970 and 2019, while there has been a gradual increase in the volume of production until 2002, reaching the maximum peak in 2002, but since then, there has been a decrease. Additionally, there was no continuous growth pattern, various fluctuations are evident. At the beginning of the period, no production was found for four years in a row and between 1999 and 2000 there has been a decrease in production, with a negative Interannual Variation Rate (TVI) equal to -47, and in 2008, with a negative Interannual Variation Rate (TVI) equal to -45, while the highest positive TVI (not taking into account the increase in 1975, since there were 4 years with no production) was reached in 2001 with a value of 207. In general, it has gone from producing 36 documents in 1975 to 1052 in 2020; that is, it is a percentage increase of 4072%. The average number of published documents is 711 per year.

Regarding the annual rate of change, the highest rate has been identified in 1975, followed by 1978. Comparing our result with the results of Lopera-Perez et al (2021), who conducted a bibliometric analysis of the international scientific production on Environmental Education on the Web of Science (WoS) within the categories Education and Educational Research and Education, Scientific Disciplines for the last two decades (2000-2019). The results showed the accelerated increase in the production of knowledge in this area, they present the main research contexts, as well as some educational and research perspectives. These results are in contrast with our results, since we found a decrease in production since 2002. In the same vein, Gantman & Fernández (2017) analyzed the production of academic literature in Spanish on organizational and management studies between 2000 and 2010 indexed in the Latindex Catalog.

The second objective was to describe and identify the different knowledge network relationships that are generated. This objective is answered in the section 6.1.6. It was found that there is a relatively low collaboration (1.7) in authoring in this area, but this situation has been changing over the years. The collaboration between authors and universities was identified by Lopera-Perez et al (2021), which agrees with our results, since we found that collaboration began to take off and its increase is noticeable from the year 2008.

The third objective was to visualize the national and international collaboration networks, both at the level of authorship and at the institutional level, and to identify collaboration patterns. This objective is answered in the section 6.1.6. It was found that the majority have been of sole authorship, and those signed by two or three authors represent 1/3 of the total. The pattern of authorship has undergone changes in the period, going from a start in 1975 with predominance in the publication of documents with single authorship compared to those with multiple authorship until reversing the relationship in 2019.

The fourth objective was to identify citation and collaboration patterns. This objective is answered in the section 6.1.6. and 6.1.7. The analysis of the citations in the analyzed journals indicated that 39.7% of the production had not received any citation. Of all the documents cited, 12.6% have only been cited once, and 8.3% twice. The most cited article has 855 citations. Additionally, regarding the years these citations had been done, the highest percentage was in 2003 with 944 citations, followed by 2007 with 905 citations. Regarding collaboration patterns, when analyzing in detail the number of authors, it was found that 58.21% have been of sole authorship, and those signed by two or three authors represent 34.37% of the total. The pattern of authorship has undergone changes in the period, going from a start in 1975 with predominance in the publication of documents with single authorship compared to those with multiple authorship until reaching reverse the relationship in 2019. The annual average of the documents without collaboration was found to be above average, which could induce that there is almost equality between the documents without collaboration and those that do have it. However, this value is largely due to the early years within the study range. Collaboration began to take off and its increase is noticeable from the year 2008. Finally, the values of the three most frequent indicators of collaboration in the literature were determined. Thus, the Degree of Collaboration in the period is DC =0.66. The minimum value occurred in 2002 and the maximum in 1970. This value wass almost similar to that obtained by education journals published in Brazil (0,636) (Madrid, et al, 2017) and close to that found for GD (0.75) in Colombian scientific publications in SciELO (Maz-Machado, Jiménez-Fanjul and Villarraga-Rico, 2016). However, it was higher than that found for the SSCI categories *Demography* (0.605) and *Urban Studies* (0.591) (Maz-Machado & Jiménez-Fanjul, 2018).

The fifth objective was to establish values for the indicators of the quantitative dimension of scientific production on the subject. This objective is answered in the section 6.2.1 and 6.2.2. Bradford's Law was verified with the Journals that make up the Bradford core being Chronicle of Higher Education and Journal of Management Education and these two accumulate 11526 documents. Additionally Lotka's law was verified.

The last objective was to identify the topics addressed. This objective is answered in the section 6.1.8. It was found that the topics were related to Management & Leadership in Education, Childhood Education, Higher Education, Marketing in Education, Accounting Education, Education and Work, Tourism Education, Mental Health Education and Industrial Organization Education.

7.2 Contributions of the thesis

This study allowed us to obtain a global vision of the research landscape in Business, Management and Accounting field of knowledge and thus complement the knowledge we have about the scientific production in this field. This research indicated the significance of Research evaluation as long as the Educational research and research evaluation and its purposes and it outlined the Legislation and education system. Furthermore, the research analyzed the role of Scientometrics in research evaluation, including the historical development of scientometrics, the Laws of Scientometrics, the Scientometric indices and the Scientific cooperation networks from a theoretical perspective.

7.3 Future research

Given the fact that there is an exponential increase in scientific publications related to the scientific subject under consideration, this may be repeated at regular intervals, e.g. every five years, in order to have up-to-date drawing of conclusions.

7.4 Difficulties and limitations

One of the limitations of this study is that, despite the fact that all the journals are classified in the BMA category, it was detected that some of the journals publish monographs on topics that are not directly related to the field of study in question, although Due to the volume of information, it was not possible to manually review the summaries of the publications, which may cause some noise in the results.

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