

**revista de**  
**e** **EDUCACIÓN**  
Nº 370 OCTUBRE-DICIEMBRE 2015



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en Educación**

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**Calixto Gutierrez Braojos**  
**Ana Martín Romera**  
**Antoni Casasempere Satorres**  
**Antonio Fernández Cano**



# A Scientometric Analysis of the Grounded Theory in Education

## Análisis Cientimétrico de la Grounded Theory en Educación

DOI: 10.4438/1988-592X-RE-2015-370-300

Calixto Gutierrez Braojos

Ana Martín Romera

*Universidad de Granada*

Antoni Casasempere Satorres

*Universidad de Alicante*

Antonio Fernández Cano

*Universidad de Granada*

### Abstract

Grounded Theory (GT) is a qualitative inductive research methodology developed by Glaser and Strauss (1967). It is a methodology for the educational field that facilitates the construction of substantive theories about the study realities with a high level of ecological validity. The construction of these theoretical frameworks helps teachers and researchers to obtain a potentially profound and exact comprehension of the educational dynamics from an ecological perspective. Therefore, based on these theories, it is possible to design and apply contextualized action plans. Proof of this is the considerable increase in educational productions based on GT in recent years. Until now, there has been a lack of studies designed to analyze the progress and current state of the research on GT in the field of education. Thus, in order to offer synthesized information, this article presents a scientometric analysis of the productions indexed in the Web of Knowledge (WoS) impact databases of the Institute for Scientific Information, which includes the following thematic categories in the SSCI and SCI databases: Education & Educational Research; Psychology Educational; Education Scientific Disciplines; Education Special. The sample was

composed of all the products published in journals during the period from 1975 to 2013, representing a total of 688 indexed articles. The results indicate that the production is in an exponential growth phase, confirming the statements of the experts who consider GT to be a promising methodology in the educational field. Furthermore, based on the results obtained, and using indicators of production, consumption and collaboration, the leading authors, journals and institutions are discussed, and international collaboration networks are described.

*Keys Words:* Research Methodology, Grounded Theory, Bibliometrics, Educational Research, Bibliographic Databases.

### **Resumen**

La *Grounded Theory* (GT) es un tipo metodología de investigación inductiva de corte cualitativo desarrollada por Glaser y Strauss en el año 1967. La Grounded Theory es una metodología que facilita construir teorías sustantivas de las realidades de estudio con un alto grado de validez ecológica. La construcción de dichos marcos teóricos ofrece a los docentes e investigadores una comprensión ajustada y profunda de las dinámicas educativas. Por tanto, desde dichas teorías se pueden diseñar y aplicar planes de acción contextualizados. Prueba de ello es el incremento notable de producciones educativas basadas en la GT durante los últimos años. Hasta el momento, existía una carencia de estudios dirigidos al análisis del progreso y estado actual de la investigación sobre GT en el campo educativo. Así, con el propósito de ofrecer una información sintetizada, en este artículo se presenta un análisis cientimétrico de las producciones que fueron indexadas en las bases de impacto *Web of Knowledge* (WoS) del *Institute for Scientific Information*. Ello incluye las siguientes categorías temáticas contenidas en las bases *SSCI* y *SCI: Education & Educational Research; Psychology Educational; Education Scientific Disciplines; Education Special*. La muestra fue compuesta por todos los productos publicados en revistas durante el periodo comprendido entre 1975 y 2013, con un total de 688 artículos indexados. Los resultados indican que la producción se encuentra en fase de crecimiento exponencial, y por tanto, se confirman las afirmaciones de aquellos expertos que conciben la GT como una metodología prometedora en el campo educativo. Además, partir de los resultados obtenidos, y desde indicadores de producción, consumo, y colaboración, se discute sobre aquellas instituciones, revistas, y autores más con un mayor número de productos publicados, y de citaciones de dichos productos en el campo de la GT, y se muestran redes de colaboración manifiestas a nivel mundial.

*Palabras Claves:* Metodología de Investigación, Grounded Theory, Bibliometría, Investigación Educativa, Bases de datos bibliográficas.

## Introduction

*Grounded Theory (GT)* is a qualitative research methodology originally developed by Glaser and Strauss (1967). Unlike research oriented toward the verification of theories, *GT* has the explicit purpose of developing theories using inductive logic based on the data. The final objective in developing a data-based theory is to find a nuclear category. Therefore, in *GT*, theorize refers to the emerging process of conceptual abstraction that includes information gathering, codification, conceptual analysis, and writing memos and results (Glaser, 2004). This abstraction process is based on the brute data, which is transformed into concepts and, in turn, into categories, establishing relationships among them through hypotheses or propositions.

The codification proposed by Strauss and Corbin (1990) is useful to better understand the theorization process in *GT*. These authors differentiate three types of codification that, in turn, reflect three non-sequential phases of the analytic process. The first type is open codification, which consists of finding conceptual categories in the data through open coding. The second type is axial codification, directed toward the analysis and description of the relationships among the codified concepts/categories through propositions. The third type is selective codification, which has the purpose of conceptualizing and explaining the relationships at a higher level of abstraction.

To facilitate the theorization process, Glaser and Strauss (1967) developed two interdependent analytic strategies (Charmaz, 2000): i) the constant comparative method and; ii) theoretical sampling. On the one hand, the constant comparative method (CCM) refers to the systematic comparison of incidents extracted from the data (information obtained) with the purpose of discovering categories and their properties (causality, conditions, consequences, dimensions), as well as hypotheses about relationships based on these properties. On the other hand, theoretical sampling refers to the collection of new data during the analytic process, with the goal of refining ideas and, in this way, producing more accurate and central categories. The data collection must be carried out until reaching the saturation of the data, i.e., until the moment when the inferred evidence is not altered by introducing more data about the study problem. In other words, the data collection is directly related to the level of theoretical saturation.

In recent years, *GT* has become one of the main contributors to the legitimacy of qualitative methods in applied social research, such as the field of educational research (Thomas & James 2006). Thus, *GT* is a promising methodology for the educational field, allowing researchers to construct substantive theories with a high degree of ecological validity in order to design and apply contextualized action plans (Charmaz, 2003; Olson & Raffanti, 2004). These theories present a high level of ecological validity; in other words, they usually show a high degree of correspondence with the study object in a specific context. Thus, the construction of these theoretical frameworks helps teachers and researchers to obtain an accurate and profound understanding of educational dynamics (Olson & Raffanti, 2004; Schön, 1983). As Strauss and Corbin (1990) point out, *GT* allows an in-depth comprehension of the phenomenon studied, as well as the possibility to design relevant responses. Likewise, Kinach (1995) states that *GT* offers a theoretical framework to efficaciously guide both the teaching and research action to emerging levels of knowledge building and educational improvement. Various studies have shown the application of this methodology to the study of educational topics, such as teaching and learning (e.g. Sunami, 2013), social justice (e.g. Ellis & Chen, 2013), and the ongoing professional development of teachers, principals and organizations (e.g. Song, Zhu & Liu, 2013).

Thus, during the last decade, there has been an exponential growth in educational studies supported by *Grounded Theory* (Babchuk, 1996; Hutchinson, 1988; Mills, Bonner, & Francis, 2006). Moreover, according to Lichtman (2006), the potential of this methodological approach in the field of education has been demonstrated by the variety of topics studied (e.g. Brown, Stevens, Troiano, & Schneider, 2002; Campbell, 1987; McCarthy, 2001; Starbuck, 2003; Zimmerman, 2002). This growth means that there is a need for a study that analyzes and organizes the research *GT* production in the field of education. However, no study has been found that has analyzed the progress and current state of the research on *GT* in education. This article presents and discusses a scientometric study of educational investigations on *GT* indexed in the *Web of Knowledge* (WoS) impact databases of the *Institute for Scientific Information*.

## Objectives

The main objective of the present study is to scientometrically analyze the GT production in educational thematic categories. The specific objectives are the following:

- Analyze the productivity on *GT* from a diachronic approach in the set of educational thematic categories.
- Analyze the production and consumption of *GT* according to the following indicators: author, institution, journal and publisher in the set of educational thematic categories (*Education & Educational Research; Psychology Educational; Education Scientific Disciplines; Special Education*).
- Specifically analyze the production and consumption of *GT* according to the following indicators: author, institution, journal and publisher in the thematic category of *Education & Educational Research*.
- Analyze the collaboration between authors and institutions in elaborating products about *GT* in the set of educational thematic categories.
- Analyze the fit of the *GT* production to the most relevant scientific productivity laws (e.g. Price, 1986; Lotka, 1926; Bradford, 1948) in the set of educational thematic categories.

## Method

This study used a descriptive method corresponding to scientometric studies in order to offer synthesized information about the production on *Grounded Theory* in the field of education. The scientometric method has a long tradition, to the point of forming a scientific discipline i.e., scientometrics, as the quantitative study of science, its agents, institutions and activities. The scientometric analysis offers a series of indicators whose application helps researchers to analyze the scientific progress and current state of a scientific topic (Fernández-Cano & Bueno, 1999), in this case, *GT*.

## Population and sample

The target population of the study consisted of the articles on *GT* published in journals indexed in the areas of education according to the *SSCI* (*Social Sciences Citation Index*) and *SCI* (*Science Citation Index*) databases. The following categories are included: *Education & Educational Research*; *Psychology Educational*; *Education Scientific Disciplines*; *Education Special*. The sample was composed of all the products published in journals within the 1975-2013 time period in this database; in fact, both the population and sample coincide, as this is a census study, with a total of 688 articles on *GT* indexed.

The *SSCI* and *SCI* databases were used because they are the scientific information databases most widely accepted by the international scientific community; see, for example, the *CNEAI* criteria for evaluating the research activity.

## Variables

The variables in this study are classified using the following categories (Bueno & Fernández-Cano, 2003): productivity, citation and collaboration (Table I).

TABLE I. Scientometric indicators

Variables	Productivity	Consumption	Collaboration
Diachronic	Yes	No	No
Personal	Yes	Yes	Yes
Source	Yes	Yes	No
Publisher	Yes	Yes	No
Institutional	Yes	Yes	Yes
Thematic categories	Yes	Yes	No

Based on the variables and bibliometric indicators, the following analyses were proposed:

- Diachronic productivity, understood as the set of documents on *GT* published from 1975 to 2013, in order to verify the law of exponential growth by Price (1986).
- Publisher, source, institutional, and personal productivity, understood as the number of documents published by each publisher, journal, institution and author, classifying the production based on the productive levels established by Price (1986). In personal productivity, an attempt will be made to verify Lotka's law (1926). In the same way, the distribution of the sources' productivity is analyzed (Bradford Law, 1948). The productivity analysis will be carried out focusing on the thematic categories, in coherence with the proposed study objectives.
- Publisher, source, institutional, and personal consumption, understood as the number of citations received and the impact index in the period analyzed.
- Personal and institutional collaboration, by analyzing the level of collaboration and multi-authorship obtained through the number of signatures per study, and the level of centrality and collaboration between authors and institutions.

## Procedure

The search for information began with a preliminary search to explore the number of documents on *GT* included in the *SSCI* database in the different thematic categories related to the field of education. Later, based on this exploration, specific objectives and categories were selected for the information search. After a new search, products (documents) contained in the *SSCI* and *SCI* databases up until January 2014 were collected and organized using the *SPSS software*. To do so, attention was paid to the basic *WoS* bibliographical fields (title of the document, year, authors, institution, title of the journal, publisher, language, bibliographical references, key words, citations received, scientific area, sample, and country). During the first months of 2014, matrixes were created of data derived from the original matrix in order to analyze the data and respond to the different objectives pointed out (e.g. the symmetrical collaboration matrix). In addition, the collaboration analysis was conducted using the *UCINET software* (Borgatti, Everett & Freeman,



2002), and the graphics were created with the *Net-Draw* tool that pertains to this *software*.

## Results

Next, the results obtained from the analysis of the GT production are presented, focusing on the study variables and indicators: the diachronic productivity about *GT*, the production and consumption of the publishers, sources, institutions and authors that have contributed to studies on *GT*, and the collaboration indexes and networks among the authors and institutions.

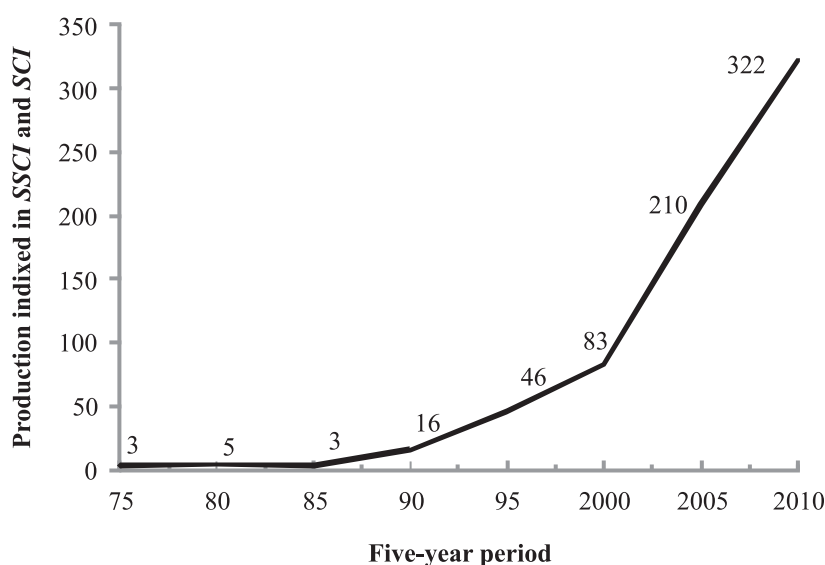
### Diachronic productivity on GT in the field of education

The number of documents indexed in the *SSCI* and *SCI* databases from the first publication in January 1975 until January 2014, that is, during a 39-year period, was 688. The mean is 17.6 per year, with a deviation of 26.1; the maximum number of documents per year was 97 (in 2013), and the minimum was 1 (1975). The language most utilized was English. Thus, of the total number of products, 96.2% were written in English, 2.5% in Japanese, 0.7% in Spanish, 0.3% in German, and 0.3% in Portuguese.

The volume of documents was organized in five-year periods. Figure I represents the accumulated frequency, by five-year periods, of the *GT* production in the field of education. It shows that from the second five-year period, the production doubled every ten years. It also shows two growth phases that correspond to the first two stages of Price's growth law (1963). The first phase includes the first three five-year periods (1975-1979; 1980-1984; 1985-1989) and corresponds to the Price stage with a production of less than five publications per five-year period. In the second phase, equivalent to Price's exponential stage, the production in each five-year period is greater than the sum of the production of previous years. This pattern is valid for the rest of the five-year periods (1990-1993, 1995-1999; 2000-2004, 2005-2010), except the one from 2010-2014. This could be due to the fact that for this period, data could not be obtained for the current year, i.e., 2014. To do so, 47 publications are required, when the mean per year in the four-year period is 80.5

(SD=13.23). Therefore, the law of exponential growth formulated by Price (1963) explains the *GT* production.

FIGURE I. Diachronic analysis of productivity about GT in education



### Productivity and consumption in the publishing variable

This study has analyzed a total of 79 publishers of journals that contain recovered documents and have contributed documents about *GT* in educational thematic categories. Adopting the Price classification (1986) applied to the authors' productive levels, we can group the producing publishers in three groups: low production ( $x = 10\log$ ); medium production ( $10\log > x < 10^{10}\log$ ); high production ( $x = 10^{10}\log$ ). At the low production level, we find 31 publishers (39.2% of all the publishers). At the medium production level, there are 35 publishers (44.3%) with a total of 114 documents (17.06% of the total *GT* production). Finally, 13 publishers (16.5% of the total) are high producers (Table II). In fact, the sum of the production of the publishers with a high production is 541 documents (78.9% of the total *GT* production).

The analysis of impact of the publishers by citation shows that the classification of the most prolific publishers does not correspond to the classification of their production. Thus, focusing on the impact index, the results show that the *American Psychological Association*, the publisher in sixth position in terms of production, shows a higher impact index (25.05). The most significant contrast occurs in the case of *Decker Periodicals Inc.*, which is in last position in production, but is the second publisher in terms of impact.

TABLE II. Production-consumption of the most prolific publishers on *GT* in the set of thematic categories

Editorial	Docs.	Percentage	Citations	Impact index
<i>John Wiley &amp; Sons Inc.</i>	118	17.2%	1515	12.83
<i>Taylor &amp; Francis Group</i>	109	15.8%	552	5.06
<i>Elsevier</i>	50	7.3%	682	13.64
<i>Sage Publications Inc</i>	49	7.1%	247	5.04
<i>Springer</i>	44	6.4%	150	3.40
<i>Lippincott Williams &amp; Wilkins</i>	40	5.8%	501	12.52
<i>American Psychological Association</i>	37	5.4%	927	25.05
<i>Informa Healthcare</i>	23	3.3%	192	8.34
<i>Japanese Assoc Educational Psychology</i>	17	2.5%	14	0.82
<i>Johns Hopkins University Press</i>	16	2.3%	222	13.87
<i>Teachers College Columbia University</i>	14	2.0%	21	1.5
<i>Oxford University Press</i>	13	1.9%	89	6.84
<i>Decker Periodicals Inc.</i>	13	1.9%	292	22.46

Note: impact index = Citations/Docs.

In another vein, a total of 55 publishers contain the 330 documents in the category *Education & Educational Research*. 40% are small producers (22 of all the publishers) and sign 6.6% of the total production. The publishers with an average productivity index represent 47.27% of the total (26 publishers) and sign 24.9% of the production (83 documents). Seven are high producers and have a total of 225 productions (68.2%) (Table III). With 90 productions, the *Taylor & Francis Group* is the most productive publisher in Educational Research.

The impact index of the most prolific publishers in this category ranges between 1.5 for *Teachers College Columbia University* and 13.87

for *Johns Hopkins University Press*, with these two publishers maintaining the same production and citation values as in the general analysis (Table II). However, the classification of publishers with a high impact index does not coincide with those that are more productive. Thus, the publisher with the highest impact is in sixth position according to the productivity classification (*Johns Hopkins University Press*), and the publisher with the second highest impact index (*John Wiley & Sons Inc.* respectively) is in third position in the productivity classification.

TABLE III. Production and Consumption on GT of the publishers in the category *Education & Educational Research*

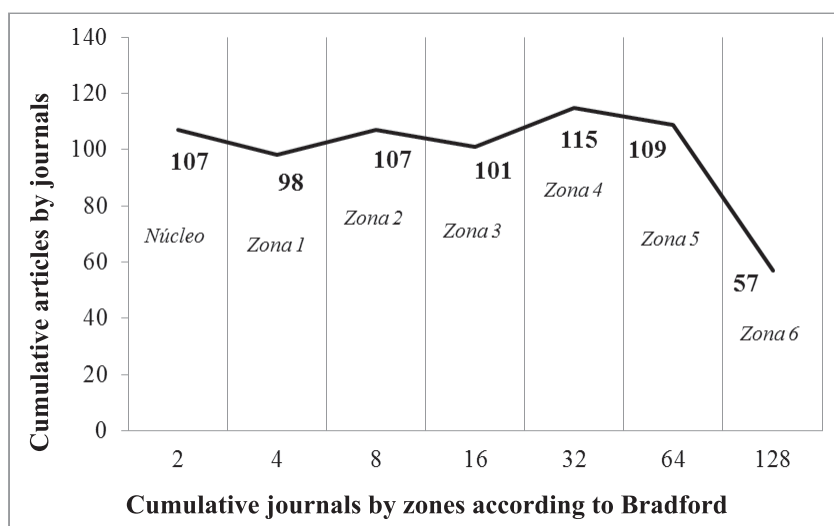
Publishers	Docs.	Percentages	Citations	Impact index
<i>Taylor &amp; Francis Group</i>	90	27.3%	396	4.4
<i>Elsevier</i>	30	9.1%	215	7.16
<i>John Wiley &amp; Sons Inc.</i>	26	7.9%	264	10.15
<i>Sage Publications Inc</i>	26	7.9%	166	6.38
<i>Springer</i>	23	7.0%	29	1.26
<i>Johns Hopkins University Press</i>	16	4.8%	222	13.87
<i>Teachers College Columbia University</i>	14	4.2%	21	1.5

Note: Impact index = Citations/Docs.

### Products and consumption of the most prolific journals on GT

A total of 183 journals have produced publications on GT. As Table IV shows, the GT production has mainly been carried out by journals written in English (95.62%). Through the geometric progression ( $2^n$ ) proposed by Bradford (1948), the nucleus and distribution zones were identified (Figure II). The nucleus is composed of two journals with 107 documents; the next layer of four journals presents 98 documents; next, a layer of eight journals shows 107 articles; the following layer of 16 journals has 101 articles, and the next one with 32 journals shows 115 documents; 64 journals contain 109 articles, and the last layer, theoretically of 128 journals, in reality presents 57 journals with one article each.

FIGURE II. Distribution zones of journals and documents according to the Bradford model



On the other hand, the Price classification (1986), referring to the authors and applied to the journals' productivity, shows similar results regarding Bradford's more nuclear zones. Thus, 43.2% of the journals are occasional producers of *GT* and have a low productivity index ( $x = 10\log$ ). The production of these journals adds up to 11.5% of the total. Next, 49.7% of the journals show a medium productivity index ( $10\log > x < 10^{10}\log$ ), with 42% of the total production. And finally, 7.1% of the journals are highly productive ( $x = 10^{10}\log$ ), with a total of 320 articles, i.e., 46.5% of the total *GT* production (Table IV). In the majority of the highly productive journals, the texts are written in English, with the exception of the *Japanese Journal of Educational Psychology*, which is written in Japanese. It should be pointed out that the majority of highly productive journals belong to *SSCI* and *SCI* categories related to the area of Health Sciences, and to a greater degree to *Health Care Sciences & Services*.

The results of the consumption analysis show that the three most productive journals are the ones consumed most, i.e., *Medical Education*, *Academic Medicine*, *Journal of Counseling Psychology* and *Health*

*Education Research*, respectively. However, the results indicate that the journal with the highest impact (32.04) is the *Journal of Counseling Psychology*, edited by the *American Psychological Association* and belonging to the categories of Educational Psychology and Applied Psychology. The publication *Journal of College Student Development* (belonging to the thematic categories of *Education & Educational Research; Psychology Applied*) is in second place, with an impact index of 23.27. This journal is edited by *Johns Hopkins University Press*.

TABLE IV. Most productive journals on GT in the set of thematic categories

Journal	Docs.	%	Citations	Impact index	Language	Categories*	Editorial
<i>Medical Education</i>	59	8.6	1053	17.84	English	2 ; 5	John Wiley & Sons
<i>Academic Medicine</i>	48	7.0	915	19.06	English	2; 5	Lippincott Williams & Wilkins
<i>Journal of Counseling Psychology</i>	25	3.6	801	32.04	English	3; 4	American Psychological Association
<i>Medical Teacher</i>	23	3.3	192	8.34	English	2; 5	Informa Healthcare
<i>Journal of Nutrition Education and Behavior</i>	22	3.2	257	11.68	English	2; 7	Elsevier
<i>Advances in Health Sciences Education</i>	18	2.6	126	7	English	1; 2 ; 5	Springer
<i>Japanese Journal of Educational Psychology</i>	17	2.5	14	0.82	Japanes	3	Japanese Assoc Educational Psychology
<i>Teachers College Record</i>	17	2.5	40	2.35	English	1	Teachers College Columbia University
<i>Journal of College Student Development</i>	15	2.2	256	23.27	English	1; 4	Johns Hopkins University Press
<i>Teaching and Teacher Education</i>	15	2.2	126	8.4	English	1	Elsevier
<i>Health Education Research</i>	12	1.7	72	6	English	1; 6	Oxford University Press
<i>Journal of Research in Science Teaching</i>	12	1.7	175	14.58	English	1	John Wiley & Sons
<i>Educational Gerontology</i>	10	1.5	97	9.7	English	1; 8	Taylor & Francis Group

Note: impact index = Citations/Docs.

\*Note. Categories SSCI : 1= Education & Educational Research; 2= Education Scientific Disciplines; 3= Psychology Educational; 4= Psychology Applied; 5= Health Care Science & Services; 6= Public, Environmental & Occupational Health; 7= Nutrition & Dietetics; 8= Gerontology.

Focusing on the category *Education and Educational Research*, 123 journals contribute productions about *GT*. Fifty-five are journals with low productivity, with 16.5% of the total production, 64 are medium producers, with a total of 216 productions (64.8% of the total), and only four journals (3.2% of all the journals) are highly productive (Table V).

TABLE V. Most productive journals on GT in the category Education & Educational Research

Journal	Docs.	%	% accumulated	Citations	Impact index
<i>Teachers College Record</i>	17	5.2	5.2	40	2.35
<i>Journal of College Student Development</i>	15	4.5	9.7	256	23.27
<i>Teaching and Teacher Education</i>	15	4.5	14.2	126	8.4
<i>Journal of Research in Science Teaching</i>	12	3.6	17.8	175	14.58

Note: impact index = Citations/Docs.

## Institutional productivity and consumption about GT

According to the data collected, 515 institutions have contributed documents about *GT*. Using the Price classification (1986) as the reference, applied to the productivity levels of the authors, we find that 338 institutions are low producers (65.6% of all the institutions), 31.8% (164 institutions) are medium producers, and 13 are high producers (2.6%) (Table VI). The most productive institution is the University of Toronto, which signs a total of 41 documents (5.95% of the total production).

The analysis of the consumption of the most productive institutions on *GT* shows that the total number of citations received ranges between 86 (*University of Pennsylvania*) and 827 (*University of Toronto*).

The three institutions with the highest impact index are the *U. of Maryland College Park* (36.66), *McMaster U.* (20.4) and *U. of Toronto* (20.17).

TABLEVI. Production and consumption on GT of the productive institutions in the set of thematic categories

Institution	Documents	Percentage of the total	Citations	Impact index
<i>U. of Toronto (Canada)</i>	41	5.95%	827	20.17
<i>Maastricht U. (Netherlands)</i>	23	3.34%	438	19.04
<i>U. Health Network (Canada)</i>	17	2.47%	320	18.82
<i>U. of Western Ontario (Canada)</i>	15	2.18%	104	0.66
<i>U. of Illinois Chicago (USA)</i>	14	2.03%	143	10.21
<i>Michigan State U. (USA)</i>	13	1.88%	130	0
<i>U. of Wisconsin Madison (USA)</i>	13	1.88%	89	6.84
<i>U. of Maryland College Park (USA)</i>	12	1.74%	440	36.66
<i>U. of Manchester (England)</i>	12	1.74%	228	19
<i>U. of British Columbia (Canada)</i>	12	1.74%	108	9
<i>U. of Washington Seattle (USA)</i>	11	1.59%	104	9.45
<i>McMaster U. (Canada)</i>	10	1.45%	204	20.4
<i>U. of Pennsylvania (USA)</i>	10	1.45%	86	8.6

Note: impact index = Citations/Documents

Regarding the category *Education & Educational Research*, out of a total of 283 institutions, 195 (68.9%) have a small production. The rest are medium producers (31.1% of the institutions) (Table VII). The most prolific institutions present a production that ranges between five and nine products (Table VII), with the universities in the USA standing out.

In addition, the total number of citations of the most prolific institutions in this category ranges between six and 138, with the most cited universities being *Ohio State U.* and the *U. of Maryland College*, and the *U. of Minnesota Twin Cities*, respectively; furthermore, universities with the highest impact index are *Ohio State (23)*, *Minnesota Twin Cities (21.8)* and *Arizona State (11.8)*.



**TABLE VII.** Production and consumption on GT of the productive institutions in the category Education & Educational Research

Institution	Docs.	Citations	Impact index
Michigan State U. (USA)	9	88	9.77
U. of Birmingham (England)	8	47	5.87
U. of Maryland College Park (USA)	7	119	17
U. of Illinois Chicago (USA)	7	17	2.42
U. of Washington Seattle (USA)	6	9	1.5
Linköping U. (Sweden)	6	11	1.83
Ohio State U. (USA)	6	138	23
U. of Minnesota Twin Cities (USA)	5	109	21.8
Arizona State U. (USA)	5	59	11.8
National U. of Ireland	5	6	1.2

Note: impact index = Citations/Docs.

### Productivity and consumption in personal productivity

A total of 1502 authors sign materialized knowledge about *GT* indexed in the *SSCI* and *SCI* bases (Table VIII). Of them, according to the author typology classification by Price (1986), 88.4% are occasional authors or low producers ( $x \leq 10\log$ ), 11.3% are medium producers ( $10\log > x < 10^{10}\log$ ), and 0.5 % can be considered high producers ( $x \geq 10^{10}\log$ ). Therefore, these data indicate that a large percentage of authors publish very few studies, while a small percentage of authors can be considered high producers.

In order to analyze the fit of the distribution to Lotka's Law (1926), Table VIII was elaborated to show the observed data and the expected data according to Lotka's model ( $Y' = C/X^n$ ). As the table reveals, there is no correspondence between the two types of data.

TABLE VIII. Observed frequency of contributions by producing author on GT

X	Y	XY	ΣXY	%Y	Σ%Y	%XY	Σ%XY	Y <sup>o</sup>
1	1328	1328	1328	88.42	88.42	71.17	71.17	1328
2	114	228	1556	7.59	96.01	12.22	83.39	332
3	30	90	1646	1.99	98	4.82	88.21	147.5
4	8	32	1678	0.53	98.53	1.71	89.92	83
5	7	35	1713	0.47	99	1.88	91.8	53.12
6	6	36	1749	0.40	99.4	1.93	93.73	36.8
7	2	14	1763	0.13	99.53	.75	94.48	27.10
8	2	16	1779	0.13	99.66	.96	95.34	20.75
11	1	11	1790	0.07	99.73	.59	95.93	10.98
14	2	28	1818	0.13	99.86	1.5	97.43	6.77
18	1	18	1836	0.07	99.93	.96	98.39	4.1
30	1	30	1866	0.07	100	1.61	100	1.48
Total	1502	1866						1743

Note X= N° Contributions by author; "Y" = N° of authors; XY= Total articles; Y<sup>o</sup>= Authors expected according to Lotka.

The list of top ten greatest producers shows that only half of them are high producers, with the work of Canadian authors standing out, especially the work by Lingard, L.A (Table IX).

TABLE IX. Most prolific authors on GT in the set of thematic categories

Name	Products	Category*	**N. Price	University	Country
Lingard, L.A.	30	2	3	U. Western	Canadá
van der Vleuten, C.	18	1;2	3	Maastricht U.	Netherlands
Ginsburg, S.	14	1;2	3	U. Toronto.	Canadá
Regehr, G.	14	2	3	U. Bri. Columbia	Canadá
Holmboe, E.S.	11	1;2	3	A. B. Int. Med.	USA
Driessen, E.	8	2	2	Maastricht U.	Netherlands
Watling, C.J.	8	2	2	U. Western	Canadá
Mann, K.	8	1;2	2	Dalhousie U.	Canadá
Devine, C.M.	7	2	2	Cornell U.	USA
Dornan, T.	6	2	2	U. Manchester.	England

\*Note : SSCI categories : 1= Education & Educational Research; 2= Education Scientific Disciplines

\*\* Levels according to Price: "2": medium producers; "3": high producers

Table X presents the consumption of the most prolific authors (see Table X). The authors' classification based on the impact index does not correspond to the classification of prolific authors. Thus, Lingard is the most prolific author, but the impact index of her production is in fourth position. Dornan, although in last place on the list of most prolific authors, is the author with the highest impact factor (33.83), followed by Carol M. Devine (31.28) and Glenn Regehr (27.85). The results show that, from the set of the most prolific authors, the author with the lowest impact factor is Watling, with eight citations and an impact factor of 6.75.

TABLE X. Consumption by GT author in the set of thematic categories

Author	Production	Citations	Impact index	Category *	Institution
Lingard, L.A.	30	674	22.46	2	Univ.Western
Regehr, G.	14	390	27.85	2	Univ. British Columbia
van der Vleuten	18	327	18.16	1;2	Maastricht Univ.
Devine, C.M.	7	219	31.28	2	Cornell Univ.
Ginsburg, S.	14	213	15.21	1;2	Univ.Toronto.
Dornan, T.	6	203	33.83	2	Univ Manchester.
Holmboe, E.S.	11	142	12.9	1;2	AmerBoardInternalMed,
Driessen, E	8	132	16.5	2	Maastricht Univ.
Mann, K.	8	130	16.25	1;2	Dalhousie Univ.
Watling, C.J.	8	54	6.75	2	Univ Western

Note: impact index = Citations/Docs.

\*Note: SSCI categories : 1=Education & Educational Research; 2= Education Scientific Disciplines

Furthermore, focusing on the analysis of GT production exclusively in the *Education and Educational Research* category, there is a lack of high producers ( $x \geq 10^{10} \log$ ). Nine of the most prolific authors are in this category. Their productions range between three and six documents (Table XI). It should be pointed out that four of these authors collaborate on their productions about GT. Armour from the University of Birmingham (England) is the most prolific author, with six documents. She is the co-author of three productions with Chambers from *College Cork* University (Ireland). In addition, Eilks and Markic, both from the University of Bremen (Germany), are co-authors on their three articles.

The citation analysis shows that the author with the largest number of citations and highest impact factor is Jones from the University of Maryland (USA), with a total of 118 citations in four products. Lubben is in second place, with 32 citations in three products. Therefore, the products by Jones are by far consumed the most.

**TABLE XI.** Consumption of the most productive authors in the category *Education & Educational Research*

Author	Production	Citations	Impact index	Institución
Armour, K.M.	6	13	2.16	Univ. of Birmingham (England)
Thornberg, R.	5	11	2.2	Linkoping Univ. (Sweden)
Jones, S.R.	4	118	29.5	Univ. System of Maryland (USA)
Spector, B.	4	27	6.75	Univ. of South Florida (USA)
Eilks, I.	3	14	4.66	Univ. of Bremen (Germany)
Chambers, F.C.	3	4	1.33	Univ. College Cork (Ireland)
Markic, S.	3	14	4.66	Univ. of Bremen (Germany)
Lubben, F.	3	32	10.66	Univ. of York (England)
Taskin, C.S.	3	2	0.66	Canakkale Onsekiz Mart Univ (Turkey)

Note: impact index = Citations/Docs

## Analysis of the level of scientific collaboration

### Analysis of personal collaboration

As Table XII shows, the mode corresponds to studies that were signed by only one author (29.8% of the total), and the rest were collaborative studies with a collaboration index of 2.71 authors per study (mean or number of authors signing divided by the number of studies). Of them, a high percentage of studies were conducted by two (24.4%), three (20.1%) and four authors (13.2%). Collaborations involving larger groups of authors are somewhat more unusual.

TABLE XII. Collaboration index

N° of Authors (a)	N° of Studies (b)	% de	N° authors appearing (a×b)
12	2	0.3	24
11	2	0.3	22
10	3	0.4	30
9	2	0.3	18
8	7	1	54
7	14	2	98
6	21	3.1	126
5	35	5.1	175
4	91	13.2	364
3	138	20.1	414
2	168	24.4	336
1	205	29.8	205
Total	688	100%	1866

In addition, a centrality analysis (Table XIII) using the network analysis software *UCINET* shows that the most nuclear authors in the entire network are van der Vleuten (94) and Lingard (91) in the set of categories analyzed, while in the category *Education & Educational Research*, the most nuclear authors are Armour (11) and Chambers (7).

TABLE XIII. Centrality of the most prolific authors on GT

Set of thematic categories		Education & Educational Research Category	
Authors	Centrality	Authors	Centrality
van der Vleuten	94	Armour, K.M.	11
Lingard, L.A.	91	Chambers, F.C.	7
Holmboe, E.S.	63	Lubben, F.	6
Regehr, G.	53	Thornberg, R.	3
Mann, K.	46	Jones, S.R.	3
Dornan, T.	41	Eilks, I.	3
Ginsburg, S.	40	Markic, S.	3
Driessen, E.	36	Spector, B.	2
Watling, C.J.	35	Taskin, C.S.	1
Devine, C.M	18		

Likewise, as the following figure (Figure III) shows, the majority of the most prolific authors on *GT* in the set of thematic categories collaborate

with each other (nine of the ten authors), in spite of belonging, in most cases, to different institutions. Therefore, we can say that in the field of *GT*, there is a collaborative network made up of the most prolific authors in the category *Health Care Sciences & Services* and *Education Scientific Disciplines*. However, Devine does not collaborate with any of the authors because her production is in the category of *Nutrition & Dietetics* and *Education Scientific Disciplines*.

Furthermore, the analysis of the co-authorship of the most prolific authors on *GT* in the category *Education & Educational Research* (Figure IV) shows that only four authors collaborate with each other.

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FIGURE III. Collaboration among prolific authors on GT in the set of thematic categories

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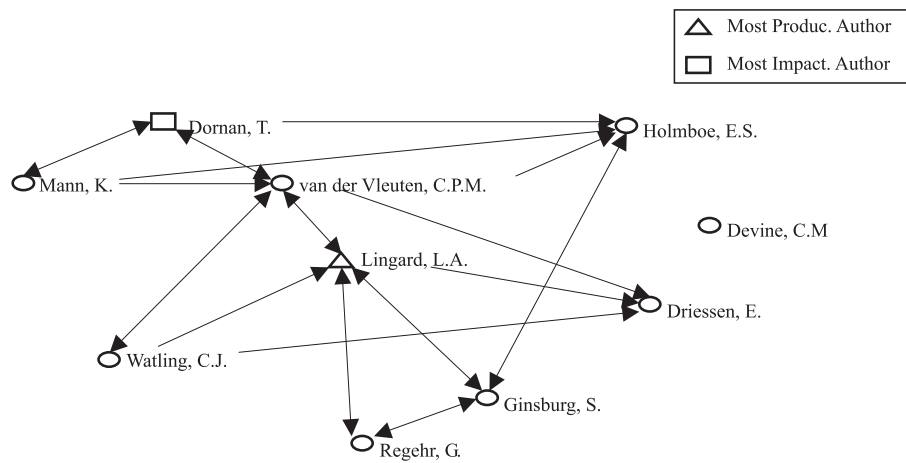
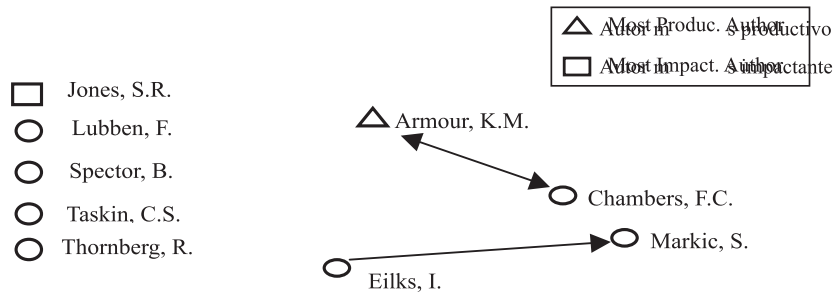


FIGURE IV. Collaboration among prolific authors on GT in the category Education & Educational Research



#### Analysis of the level of scientific collaboration among prolific institutions

As the table shows (Table XIV), the centrality index of the institutions is lower than the one obtained for the authors. This is due to the fact that the authors signed studies together in spite of being affiliated with different institutions. Of the most prolific institutions on *GT* in the set of thematic categories, those that stand out as nuclear in the entire network are: the University of Toronto (28), U. of Pennsylvania (24) Maastricht U. (23), while in the category *Education & Educational Research*, the nuclear institutions are the *U. of Minnesota Twin Cities* (19), *Michigan State U.* (13), and the *U. of Maryland College Park* (Table XIV).

TABLE XIV. Centrality of the most prolific institutions on GT

Set of thematic categories		Category of Education & Educational Research	
Institutions	Centrality	Institutions	Centrality
<i>U. of Toronto</i>	28	<i>U. of Minnesota TwinCities</i>	19
<i>U. of Pennsylvania</i>	24	<i>Michigan State U.</i>	13
<i>Maastricht U.</i>	23	<i>U. of Maryland College Park</i>	8
<i>U. of British Columbia</i>	15	<i>U. of Illinois Chicago</i>	7
<i>McMaster U.</i>	13	<i>U. of Washington Seattle</i>	7
<i>U. of Western Ontario</i>	13	<i>U. of Birmingham</i>	4
<i>Michigan State U.</i>	13	<i>Ohio State U.</i>	4
<i>U. of Manchester</i>	11	<i>Arizona State U.</i>	2
<i>U. Health Network</i>	9	<i>National U. of Ireland</i>	1
<i>U. of Maryland College Park</i>	8	<i>Linköping U.</i>	0
<i>U. of Illinois Chicago</i>	7		
<i>U. of Washington Seattle</i>	7		
<i>U. of Wisconsin Madison</i>	6		

Based on the analysis of collaboration among the most prolific institutions on *GT* in the set of thematic categories (Figure V), two institutional collaboration networks can be differentiated. One network is composed of eight of the most prolific universities, seven Canadian and one from the USA (*University of Washington Seattle*). The second network is composed of six institutions from the USA, three of the most prolific and three with medium productions (*Yale*, *Penn State* and *Minnesota Twin Cities*). Yale University can be considered the connection point between these two networks because it collaborates with four of the most prolific universities, including the University of Toronto.

However, two of the most prolific universities do not collaborate with others: *Illinois Chicago* and *Wisconsin Madison*. Regarding the collaboration among the most prolific universities in the category *Education & Educational Research* (Figure VI), the figure shows that there is only collaboration among institutions in the USA. On the one hand, there is a collaboration network among four universities and, on the other, between two.



FIGURE V. Collaboration among prolific institutions from the set of thematic categories

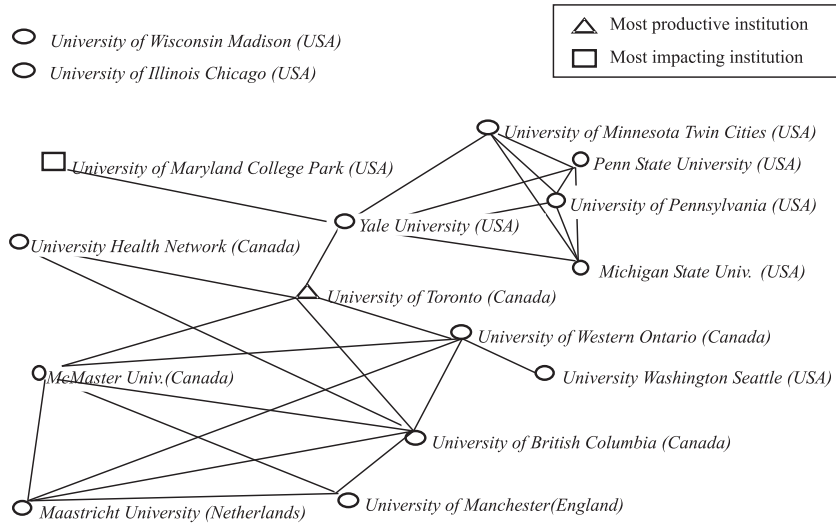
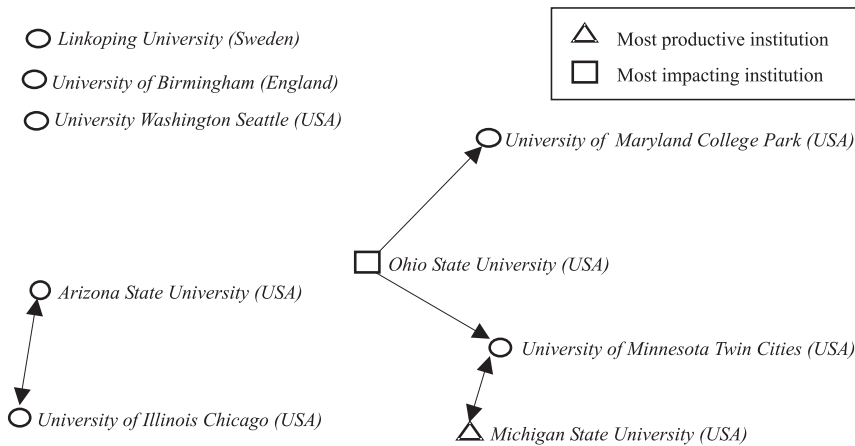


FIGURE VI. Collaboration among prolific institutions in the category of Education & Educational Research



## Discussion and conclusions

The main objective of this study was to carry out the first analysis of the production and consumption of the Grounded Theory in the educational field since the first production indexed in the *SSCI* and *SCI* in 1975. From that time on, and in congruence with Price's law (1963), our results indicate that the production has been in a phase of exponential growth, thus confirming statements by experts who consider *GT* to be a promising methodology in the educational field (e.g. Charmaz, 2003; Olson & Raffanti, 2004).

Moreover, in this study a descriptive analysis was performed of the production and consumption on *GT*, focusing on different variables (publishers, journals, institutions and authors) and specifying prolific producers and the impact index according to Lotka's law. In addition, the degree of centrality and collaboration in the case of prolific authors and institutions has been examined. Based on these results, we can make various statements about each of these variables that can be contrasted in future studies.

- The production is concentrated in a certain group of publishers, as, of 668 products, 541 correspond to 13 publishers. However, there is no one-to-one correspondence between production and consumption, as the most prolific publisher, *John Wiley & Sons*, is not the one with the highest impact index, which would pertain to the *American Psychological Association*.
- There is greater specialization in *GT* in the category of *Education Scientific Disciplines* (and specifically disciplines related to health sciences) on any of the variables analyzed (journals, institutions, and authors). For the set of thematic categories, there are 13 journals, 13 institutions, and five authors who are high producers, while in the category of *Education & Educational Research* only four journals are high producers, and not one institution or author is a high producer.
- The majority of studies on *GT* are carried out collaboratively (70.2%). The most common collaboration pattern involves co-authorship between two (24.4%), three (20.1%) or four authors (13.2%).
- There is a great deal of co-authorship among the most prolific authors in the set of thematic categories, which could make up a

type of invisible school as described by Crane (1972). Thus, almost 90% of the most prolific authors have collaborated at least once in elaborating products on *GT*. However, although there are no prolific authors, we analyzed co-authorship in the category of *Education & Educational Research* and observed a lack of collaboration.

- There are two large collaboration networks among prolific institutions in the set of thematic categories, one between Canadian and European institutions and the other among institutions in the USA, and there is little connection between these two networks. Among the most prolific institutions in the category of *Education & Educational Research*, collaboration can be observed among institutions in the USA.

In conclusion, this article presents the first scientometric study on *GT*, and additional studies would be necessary to confirm our findings. Furthermore, given that the relationship has been shown between *GT* production and the educational field, we suggest that future studies specify the study sample according to each thematic category, in order to offer more in-depth and qualitative knowledge about *GT* in each category. For example, future studies could report on the research topics that are more commonly approached using the *GT* methodology in the category of *Education & Educational Research*.

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**Contact address:** Calixto Gutiérrez Braojos. Universidad de Granada. Facultad de Educación, Economía y Tecnología de Ceuta. Departamento de Métodos de Investigación y Diagnóstico. C/ Cortadura del Valle, S/N Despacho nº 1. Ceuta. E-mail: calixtomb@ugr.es

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NIPO línea: 030-15-016-X

NIPO lbd: 030-15-017-5

ISSN línea: 1988-592X 0034-8082

ISSN papel: 0034-8082

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