Spanish educational production in the *Social Sciences Citation Index* (2010-2020). III

Producción educativa española en el Social Sciences Citation Index (2010-2020). III

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Abstract:

In 1999 and 2011, the revista española de pedagogía published two similar studies reviewing the Spanish production in the field of education indexed in the Social Sciences Education Index (SSCI) database. The first study covered the period 1988-1997 and the second 1998-2009. Once enough time had passed, a quasi-replica study of the previous ones was undertaken for the period 2010-2020.

Objectives: To carry out a scientometric review of Spanish production in educational research indexed in the SSCI database of the Web of Science (WoS) in the period from 2010 to 2020. The intention is to inform the Spanish educational community of its research achievements with visibility and international impact and to draw supported scientometric conclusions about Spanish educational research.

Method: A descriptive-quantitative (scientometric) design has been used on an operating sample of 7016 documents (articles and reviews) recovered after an advanced search in the SSCI database by deliberate or purposive sampling. This study may also be characterized as secondary, since documents are used which have already been published, and revisional as regards research production.

Results: Results related to productivity and citation are provided. The diachronic production shows an increasing trend fitted to a polynomial function. English (68.5%) and Spanish (30.3%) are the main languages of expression of such production. The most common subject

Revision accepted: 2022-03-14.
This is the English version of an article originally printed in Spanish in issue 282 of the **revista española de pedagogía**. For this reason, the abbreviation EV has been added to the page numbers. Please, cite this article as follows: Fernández-Cano, A., & Fernández-Guerrero, A. (2022). Producción educativa española en el *Social Sciences Citation Index* (2010-2020). III | *Spanish educational production in the Social Sciences Citation Index (2010-2020). III. Revista Española de Pedagogía, 80* (282), 347-370. https://doi.org/10.22550/REP80-2-2022-08

areas of the Web of Science with educational areas are linguistics, and also Rehabilitation and Developmental Psychology. The institutional production is mostly of university origin, with the top ten universities listed in the following order: Barcelona, Autónoma Barcelona, Valencia, Granada, País Vasco, Sevilla, Autónoma Madrid, Nacional a Distancia, Complutense and Oviedo. International collaboration is mainly established with the following countries: USA (5.01%), England (3.9%), Chile (2.32%), Portugal (2.02 %) and the Netherlands (1.56%).

The citation results give a Hirsch *h* index of 89, with an increasing diachronic trend fitted to both a polynomial and an exponential model. Documents were also recovered that are citation classics, with more than 200 citations; the journal *Computers & Education* being the body where the most quoted Spanish educational research is published. The most active research fronts are inferred from the citation classics and by means of a word cloud of terms included in the titles; specifically: General Education, Educational Computing and Educational Evaluation.

Discussion: The results obtained and their adaptation to general laws of Scientometrics bear witness to the fertility of Spanish educational research and its adjustment to patterns typical of science. Taking into consideration two studies prior to this one, and after successive comparisons, Spanish achievements are considered to be optimistic given their abundance, impact and international visibility.

Conclusion: The way in which Spanish educational research, from very limited initial stages, has followed a complex path of improvement to achieve scientometric patterns which are comparable to those of other scientific disciplines is confirmed.

Keywords: Spain, educational research, Social Sciences Citation Index database, 2010-2020, productivity and citation indicators, Scientometrics.

Resumen:

En los años 1999 y 2011, la revista española de pedagogía publicó dos estudios similares en los que se revisaba la producción española del campo de la educación indexada en la base *Social Sciences Education Index* (SSCI). El primer estudio comprendía el periodo 1988-1997 y el segundo 1998-2009. Pasado un tiempo suficiente se acomete un estudio cuasi de réplica de los anteriores para el periodo 2010-2020.

Objetivos: Realizar una revisión cienciométrica de la producción española en investigación educativa indexada en la base SSCI de la *Web of Science* (WoS) en el periodo 2010 a 2020. Se pretende informar a la comunidad educativa española de sus realizaciones investigadoras con visibilidad e impacto internacional y extraer conclusiones cienciométricas fundamentadas sobre la investigación educativa española.

Método: Se ha utilizado un diseño descriptivo-cuantitativo (cienciométrico) sobre una muestra operante de 7016 documentos (artículos y revisiones) recuperada tras una búsqueda avanzada en la base SSCI por muestreo intencional o a propósito. También puede caracterizarse este estudio como secundario, pues trabaja con documentos ya publicados, y revisional de la producción investigadora.

Resultados: Se aportan resultados relativos a productividad y citación. La producción diacrónica muestra una tendencia creciente ajustada a una función polinómica. Inglés (68.5 %) y español (30.3 %) son mayoritariamente los idiomas de expresión de tal producción. Las áreas temáticas de la *Web of Science* más comunes con las educativas son las lingüísticas, y también Rehabilitación y Psicología Evolutiva. La producción institucional es en su mayoría de origen universitario, siendo por este orden las diez primeras universidades: Barcelona, Autónoma Barcelona, Valencia, Granada, País Vasco, Sevilla, Autónoma Madrid, Nacional a Distancia, Complutense y Oviedo. La colaboración internacional se establece principalmente con estos países: USA (5.01 %), Inglaterra (3.9 %), Chile (2.32 %), Portugal (2.02 %) y Holanda (1.56 %).

Los resultados relativos a citación ofrecen un índice *h* de Hirsch de 89, con una tendencia diacrónica creciente ajustada tanto a un modelo polinómico como exponencial. También se recuperan documentos que son clásicos de citación, con más de 200 citas; siendo la revista *Computers & Education* el órgano donde se publica la investigación educativa española más citada. A partir de los clásicos de citación y mediante una nube de palabras de términos contenidos en los títulos, se infieren los frentes de investigación más activos; en concreto: Educación General, Informática Educativa y Evaluación Educativa.

Discusión: Los resultados obtenidos y su adecuación a leyes generales de la cienciometría testimonian la fertilidad de la investigación educativa española y su ajuste a patrones propios de la ciencia. Tomando en consideración dos estudios previos a éste, y tras sucesivas comparaciones, se infiere una visión optimista de las realizaciones españolas por abundante, de impacto y con visibilidad internacional.

Conclusión: Se confirma como la investigación educativa española, desde unos estadios iniciales muy limitados, ha recorrido una compleja senda de mejora hasta alcanzar patrones cienciométricos homologables a los de otras disciplinas científicas.

Descriptores: España, investigación educativa, base de datos *Social Sciences Citation Index*, 2010-2020, indicadores de productividad y citación, cienciometría.

1. Introduction

22 years ago, an article entitled *Spanish educational production in the Social Sciences Citation Index* (1988-97) signed by this author (Fernández-Cano, 1999) appeared in the revista española de pedagogía (*REP*). In this study an excursion was carried out though this database of the former *Institute for Scientific Information* [hereinafter ISI] of Philadelphia, USA, with the intention of finding articles by authors residing in Spain. In 2010 a replica of this article appeared, *Spanish educational production in the Social Sciences Citation Index (1998-2009). II*, in which progress was compared to the previous stage (Fernández-Cano, 2011).

Over 30 years have passed since the WoS databases could only be accessed using yearly CDs. Significant changes have tak-

en place to improve access, availability and additional features of the *Web of Science* [hereinafter WoS] as a powerful platform of the ISI of Philadelphia based on the Web.

In parallel with these revisional-quantitative articles in the revista española de pedagogía, the community of Spanish educational researchers became highly concerned about the quality and impact of their research productions which could be read in seminal works on methodologies of educational research and their implementation in the Spanish sphere (Fernández-Cano, 1995, 1997).

Terms such as "impact journal", "impact factor", "quartile in the *Journal Citation Reports* [hereinafter, JCR for short]", "*Social Sciences Citation Index* [hereinafter SSCI] database", "productive ranking", "citation classic" and others, which will be seen in this study, now form part of the colloquial language of Spanish educational researchers. Spanish educational research, which has traditionally been self-contained, set out on a path to overcome this deeply-rooted isolation.

1.1. Literature records

Revisional-quantitative studies started to be carried out in the early 1990s; these were coined with the more successful term of scientometric studies1. All studies referred to, quoted and indexed below are a type of notarial X-ray which describe what has been carried out, who has conducted the studies, both individuals and institutions, how these have been carried out and the outcome according to citation impact. These studies bear witness to a great concern for both the analysis of production and the evaluation of Spanish educational research; thus, these have intended to establish the adjustment to standards typical of Big Science, as defined by Price (1986), in order to indicate the quality of the studies conducted and dispel the insidious belief of an unfounded low quality of Spanish educational research.

There is now a rather long list of scientometric studies which have been conducted since then and which are specifically focused on a dimension or aspect of Spanish educational research. Thus, Expósito and Fernández-Cano (2002) investigated the productivity of research on the evaluation of Spanish educational programmes (1975-2000). Bueno and Fernández-Cano (2003) carried out a scientometric analysis on productivity in the *Revista de Investigación Educativa*. Torralbo et al. (2004) analysed the methodology of the Spanish production of doctoral theses on Mathematics Education (1976-1998). The detection of citation patterns in Spanish research in mathematics education was published by Vallejo et al. (2006). A scientometric review and a prospective analysis on the Spanish production in doctoral theses on Pedagogy (1976-2006) may be found in Fernández-Cano et al. (2008). Fernández-Bautista et al. (2014) made a longitudinal analysis of Spanish doctoral theses on education (1841-2012). Curiel and Fernández-Cano (2015) carried out scientometric analysis on Spanish doctoral theses on Didactics of Social Sciences (1976-2012). A scientometric analysis of Spanish doctoral theses on high capacities and giftedness may be found in Padial and Fernández-Cano (2019).

Other than the aforementioned, scientometric studies on Spanish educational research have continued to be abun-

dant; to quote the most recent studies in the last four years; on works on music education (Morales et al., 2017); doctoral theses on education (Ramos-Pardo & Sánchez-Antolín, 2017); sociocultural/socioeducational disadvantage (Sánchez-Castro & Pascual, 2019); didactics of social sciences (Gómez-Carrasco et al., 2019); studies on community environmental education (Prosser & Caro, 2021); the use of Spanish PISA results in scientific publications (González-Mayorga et al., 2022) or deaf education in Spain according to the related doctoral theses (Schiavon & Hayashi, 2020); the last piece of work mentioned was conducted by female Brazilian authors and was published in a journal in Brazil.

The abundant and notable work carried out by the vast group of educational researchers, who do not always agree2, since 1989 has been obliged after seeing their research production subjected to examination every six years by the Spanish National Commission for the Assessment of Research Activity (CNEAI) by means of an assessment initially regulated by a Royal Decree (Ministry of Parliamentary Affairs and Government Registry, 1989) and by consecutive yearly ministerial orders, all with similar content. Some of these regulatory documents that acted as referential milestones include: Ministry of Science and Innovation (2008) and Ministry of Universities (2022). Government entities such as the Spanish National Agency for Quality Assessment and Accreditation (ANECA, 2021), which is responsible for promoting lecturers through its ACADEMIA programme, have stressed the importance of assessing the quality of the research of applicants in their accreditation work in order to evaluate with one key criterion: articles indexed in the WoS databases and published by quality journals which have been accredited by means of rigorous peer review processes and are included in the JCR database. Although in studies prior to this one (Fernández-Cano, 1999, 2011), the remoteness of evaluative criteria typical of the international scientific community and inferable criteria of data from the WoS, and also subsequently from the European database Scopus, were indicated and questioned, it was from 1989 onwards that these criteria started to be used to evaluate the research of lecturers and of the Scientific Research Council (CSIC), for both the evaluation of their six-year research period by the Spanish National Commission for the Assessment of Research Activity (CNEAI) and years later for the evaluation of curriculums of the lecturers by the above-mentioned ANECA.

We therefore consider that a new review of the Spanish educational research indexed in the SSCI database, a third submission for the 2010-2020 period, is advisable and necessary in order to inform the Spanish educational community of its research achievements with visibility and international impact and to draw supported scientometric conclusions about Spanish educational research.

Thus, the general objective of this study is to carry out a scientometric review of Spanish production in educational research indexed in the SSCI database of the Web of Science (WoS) in the period from 2010 to 2020. Consequently, the specific objectives to be achieved are as follows:

- Find out the similarity between subjects of Spanish educational research and other subject categories of the WoS.

- Diachronically analyse the time series of production in this period (years 2010-2020) and verify its fit to scientometric models; and by extension, to the 1990-2020 time series too.
- Show the institutional production, particularly the most productive universities in educational research for the considered period (2010-2020).
- Identify the publishing journals which publish Spanish educational research indexed in the SSCI database in this time frame (2010-2020).
- Infer the international collaboration pattern of Spanish production of educational research in the period under consideration.
- Explore general citation data of both cross-sectional (until 31 December 2020) and longitudinal Spanish educational research for the eleven years of the series.
- Determine which Spanish educational research documents may be considered citation classics in order to infer research fronts of Spanish educational research from the aforementioned.

2. Method

2.1. Design

The design of this study may be described in various ways:

- Descriptive as it describes the characteristics of a series of documents (articles and reviews) on Spanish educational research.
- Quantitative and more specifically scientometric as it quantifies documents taken from a database (SSCI), it categorizes them according to their constituent parts and verifies their fit to widely accepted regulatory patterns of science; furthermore, it makes plausible evaluative inferences without intending to make incisive considerations (Gingras, 2016).
- By deliberate or purposive sampling: choosing a sample which is conceptually well defined from an available population on which no sampling selection whatsoever is carried out afterwards.
- Secondary revisional as it revises documents which have already been published and it investigates them in order to extract inferences on their content based on productivity and citation indicators.

The variables considered in this study are those relating to production and citation; specifically, the production variables are: publication language of the documents, diachronic production (documents published yearly), institutional production (documents according to the centres of the authors), production according to publishing journals (documents published by each journal) and collaborating countries (documents common to authors from Spain and other countries).

The variables relating to citation are diverse: diachronic citation (quotations received yearly for all documents), quotations from citation classics and terms from recovered citation classic titles.

The data analysis techniques are those typical of descriptive statistics; counting of

frequencies, percentages, correlations (R^2, coefficient of determination), regression models and functions for deterministic adjustment (polynomial and exponential) and word cloud.

2.2. Search string and operating sample

At the end of December 2021 and start of January 2022, an advanced search was made on the Web of Science-Core collection, only operating in the SSCI database with the following string:

WC [categories of the WoS] = (education & educational research or special education or educational psychology) and AD [address] = Spain; refined for articles and reviews; covering (customized) the time frame: 2010-01-01 to 2020-12-31; it would not be appropriate to include the year 2021 because the publication was still not finalised in enough journals and the SSCI database would not therefore be fully up-to-date until 2021.

This link to the WoS makes it possible to recover the entire operating sample and work automatically on it, meaning it can be used to generate results:

https://www.webofscience.com/wos/woscc/summary/8e41f76e-e531-4aa9-b64f-d8a0f0faeac7-1c0a99f7/relevance/1

Documents have been selected, although only those in the format of an article or review, from the three educational subject categories of the WoS: education & educational research; special education and educational psychology for the time frame between the first day of 2010 and the last day of 2020. The operating sample appears as follows according to the type of document and category of the WoS:

TABLE 1. Operating sample according to the type of document and educational categories of the SSCI database of Spanish educational research in the period 2010-2020.

Type of document	Categories of the Web of Science			
	Education and Educational Research	Special Education	Educational Psychology	Total*
Article	5912	386	1021	6831
Review	154	22	19	185
Total-fully-fledged	6066	408	1040	7016

*: documents (articles or reviews).
Source: Own elaboration.

Considering only fully-fledged literature by solely selecting articles and reviews forces a quality standard to be maintained for scientific documents; something typical of scientometric studies, which is commonly accepted by the scientific community (van der Panne, 2007; Makkonen & van der Have, 2013) and by assessment agencies (ANECA, 2021; Ministry of Universities, 2022). Summaries of congressional communications, book reviews, editorials, notes, letters, corrections and others are disregarded.

Some documents may belong to two or more subject categories of the WoS as continent journals are assigned to several of these subject categories. Therefore, and these are advance findings, in its three WoS categories, Spanish educational research shows the following commonalities (according to the number of documents and percentage[3] of the total) with other subject categories; namely: Linguistics (673 documents; 9.59% of the total), Language & Linguistics (507 docs.; 7.22%), Rehabilitation (397 docs.; 5.65%); Psychology, Developmental (329 docs.; 4.68%); Communication (308 docs.; 4.39%); Computer Science, Interdisciplinary Applications (254 docs.; 3.62%); Education, Scientific Disciplines (157 docs.; 2.23%); Social Sciences, Interdisciplinary (139 docs., 1.98%), Music (78 docs.; 1.11%) and 39 more categories with values below 1%. Such a high degree of commonality gives the impression of the field of education being extremely fertile and how various disciplines end up in this field; an observation which was already made in two previous studies (Fernández-Cano, 1999, 2011).

The operating sample may be distinguished as follows. It operates with 7016 documents; of these, only 2154 (30.7%) are available for open access, a type of publishing which is being introduced gradually. The languages used are: English in 4,808 documents (68.5%); Spanish in 2,132 documents (30.3%) and Portuguese in 58 documents (0.82%). Other languages represent marginal percentages of around 0.1%. It is clear that English continues to be the main language for communication of Spanish educational research even though many Spanish journals and journals written in Spanish are included.

A series of indicators/variables relating to productivity and citation have been recovered from this sample, in their various fields and meanings, developed by Fernández-Cano and Bueno (1999) for Spanish educational research and the most relevant data are set out below as results.

3. Results

Typical patterns of science shall be deduced from the data resulting from productivity and citation (Price, 1986; Gingras, 2016).

3.1. Diachronic production and fitted models

Table 2 below shows the yearly production of fully-fledged documents for the 2010-2020 time frame.

TABLE 2. Diachronic production of Spanish educational research indexed in the SSCI database for the 2010-2020 period.

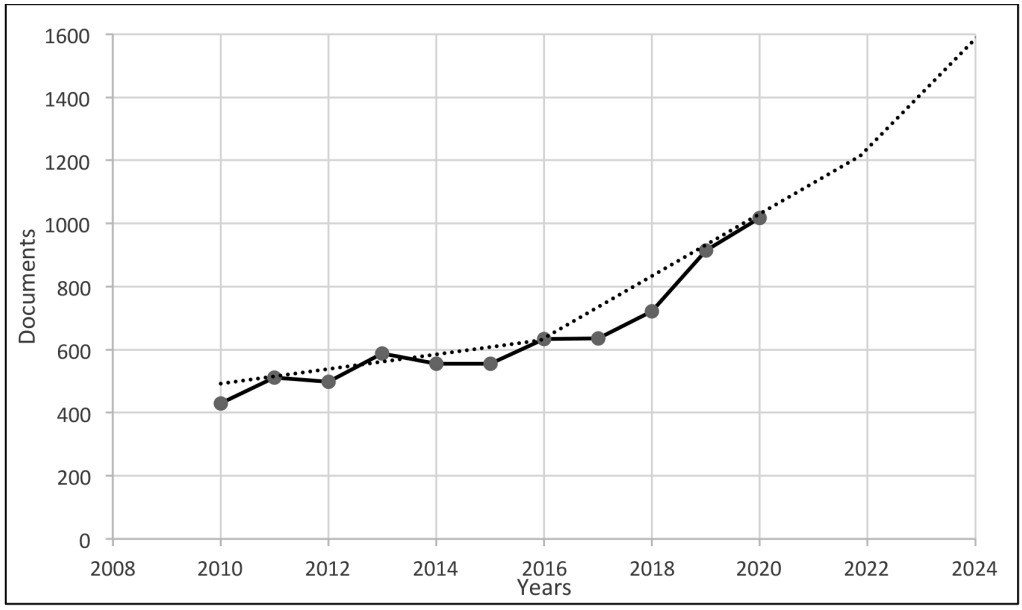
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Fully-fledged SSCI	430	512	498	587	556	555	634	636	721	915	1007	7016
(Δ) % yearly		19	-2.8	17.8	-5.5	0	14.2	0.03	13.3	26.9	10	9.2

Source: Own elaboration.

Given the yearly fluctuations, an average increase of 9.2% is calculated; this is higher than the average increases observed in previous studies: 4.7%, in the 1998-2009 period and 3% for 1988-1997. This percentage is a clear and unmistakable sign of improvement in the production of fully-fledged documents regarding Spanish educational research.

The graphical solution (Graph 1) provides us with more conclusive evidence as it includes the trend line of best fit and the four-year forecast.

GRAPH 1. Fitted graph pattern with forecasts of Spanish production in educational research indexed in the SSCI database between 2010-2020.

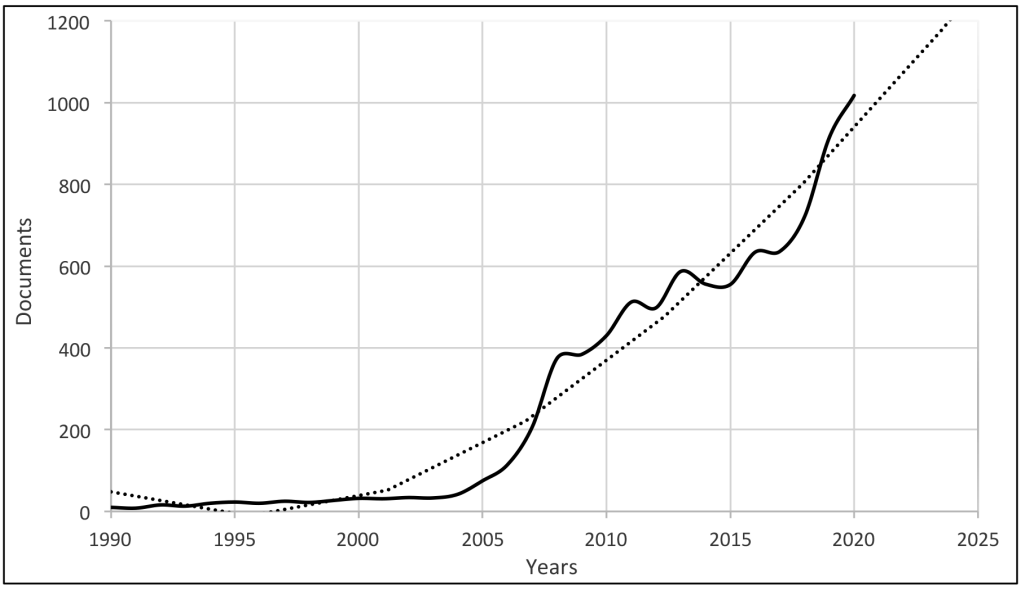


Source: Own elaboration.

The best fit is a 2nd order polynomial function ($Y = 6.3X^2 - 25549X + 1007$) given by a coefficient of determination between Production (documents) and Time (years), $R^2 = 0.93$, $p < 0.001$, which may be interpreted as a correlation coefficient. Predictive extrapolation until 2024 shows a growing productive trend; this signifies an optimistic outlook for Spanish educational research. It may be emphasized that in 2020 in the middle of the COVID19 pandemic, production increased by 10% compared to the previous year.

It could be of interest to include this study period (2010-2020) in a production time series determined by a more extensive time frame: 1990-2020, in order to obtain a more comprehensive view of the diachronic development of Spanish educational research in the last 30 years. We should therefore consider Graph 2:

GRAPH 2. Linear (____) and fitted (.....) graph pattern with forecasts of Spanish production in educational research indexed in the SSCI database between 1990-2020.



Source: Own elaboration.

The 1990-2020 time series is fitted to various trend lines, the most justified is a 3rd order polynomial function, $Y = -0.017X^3 + 106.78X^2 - 217034X + 1.8$, with a fitted value $R^2 = 0.96$, $p < 0.001$. The linear diagram of this series also fits an exponential trend, but not as well, $R^2 = 0.88$ $p < 0.001$. This shows that the Spanish educational production indexed in the SSCI database fits a pattern typical of the scientific information proposed by Price (1986) and which was reviewed for various scientific disciplines by Fernández-Cano et al. (2004). The alarm raised in the previous study for the 1998-2009 period, on the possible forecast of production tending towards a logistic model with a stabilized production, as predicted by Price[4] (1986), is still not justified with the data available. Production has continued to grow and at a faster rate; this gives the impression of a young and fertile field of Spanish educational research as it has not yet entered into the logistic stabilization speculated by Price.

3.2. Institutional production

The sample includes 2491 entries from various institutions in and with which authors based in Spain have published during this time frame between 2010-2020. The analysis based on the affiliation descriptor used by the WoS offers the main pattern of the university as a production body. A list of the most productive universities, at least 100 articles, to be used as proof by the academic authorities, is given in Table 3 below, which includes indicators relating to: number of documents, percentage of the total sample and one indicator which is not considered in the previous studies, which is the Hirsch index[5].

TABLE 3. List of most productive universities in Spanish educational research indexed in the SSCI database.

R.	University	# docs.	%	Hirsch h
1ª	UB. Barcelona	507	7.22	38
2ª	UAB. Autónoma Barcelona	472	6.72	31
3ª	UV. Valencia	437	6.22	33
4ª	UGR. Granada	434	6.18	38
5ª	UPV/EHU. País Vasco	376	5.35	29
6ª	US. Sevilla	364	5.18	33
7ª	UAM. Autónoma Madrid	332	4.73	31
8ª	UNED. Universidad Nacional a Distancia	314	4.47	32
9ª	UCM. Complutense Madrid	297	4.23	22
10ª	UNIOVI. Oviedo	251	3.57	29
11ª	USAL. Salamanca	245	3.49	26
12ª	UM. Murcia	225	3.20	25
13ª	UMA. Málaga	206	2.93	25
14ª	UVA. Valladolid	174	2.48	24
15ª	UOC. Oberta de Cataluña	163	2.32	27
16ª	UNIZAR. Zaragoza	158	2.25	20
17ª	UA. Alicante	155	2.20	21
18ª	UCLM. Castilla-La Mancha	150	2.13	22
18ª	USC. Santiago de Compostela	150	2.13	19
20ª	URL. Ramón Llull	143	2.03	18
21ª	ULL. La Laguna	128	1.82	18
22ª	UCO. Córdoba	125	1.78	22
23ª	UdG. Gerona	121	1.72	17
23ª	UJI. Jaime I	121	1.72	21
25ª	UVIGO. Vigo	116	1.65	17
26ª	UPF. Pompeu i Fabra	115	1.63	23
26ª	UEX. Extremadura	115	1.63	20
28ª	UHU. Huelva	114	1.62	23
29ª	UDC. Coruña	113	1.61	21
30ª	UJA. Jaén	112	1.59	19
31ª	UAL. Almería	103	1.46	18
32ª	UAH. Alcalá de Henares	101	1.44	18
32ª	UDL. Lérida	101	1.44	18

Source: Own elaboration.

The table above allows some significant considerations to be made. Production is primarily from universities. A considerable statistical correlation is determined between production (number of documents) and Hirsch index; with Pearson's r, r = 0.91 ($p<0.0001$); rather, quality results from quantity, as some documents will be quoted a great deal if there are many available to quote.

3.3. Publishing journals

311 different journals are registered which have published this Spanish educational production in the 2010-2020 time frame. Table 4 below lists journals which have 50 or more documents published.

TABLE 4. List of publishing journals on Spanish educational research indexed in the SSCI database in the 2010-2020 time frame with at least 50 documents.

R.	Journal	# docs.	%	FI2020	Quartile
1ª	*Revista de Educación*	534	7.61	1.057	Q3
2ª	*Educación XX1*	334	4.76	3.265	Q2
3ª	Comunicar	308	4.39	6.013	Q1
4ª	*Enseñanza de las Ciencias*	304	4.33	1.217	Q4
5ª	Cultura y Educación	275	3.92	n.d.	n.d.
6ª	*Revista Española de Pedagogía*	231	3.29	1.612	Q3
7ª	*Porta Linguarum*	231	3.29	1.200	Q4
8ª	*Revista de Psicodidáctica*	198	2.82	3.225	Q2
9ª	*Infancia y Aprendizaje*	196	2.79	0.854	Q4
10ª	*Computers & Education*	194	2.76	8.538	Q1
11ª	Movimento	131	1.86	0.523	Q4
12ª	Research in Developmental Disabilities	120	1.71	3.230	Q1
13ª	International Journal of Bilingual Education and Bilingualism	82	1.16	4.159	Q1
14ª	British Journal of Educational Technology	74	1.05	4.929	Q1

15ª	Interactive Learning Environment	67	0.95	3.928	Q1
16ª	IEEE Transactions on Learning Technologies	60	0.85	3.720	Q2
17ª	Studies in Higher Education	60	0.85	4.379	Q1
18ª	Learning and Individual Differences	59	0.84	3.139	Q2
19ª	System	58	0.82	3.167	Q2
20ª	Psicología Educativa	56	0.79	1.250	Q4
21ª	Revista Latinoamericana de Investigación en Matemática Educativa-RELIME	55	0.78	0.792	Q4
22ª	*Higher Education*	55	0.77	4.634	Q1
23ª	*Journal of Intellectual Disability Research*	50	0.71	2.424	Q2

Code: R.: ranking according to production; Journal: Title; # docs.: Number of documents published; %: percentage of documents in relation to the total; IF2020: Impact factor of the journal in 2020; Q: Quartile in which the journal is found according to its impact factor; n.a.: not available; in *italics*, journals which have been repeated in the last two series considered. Source: Own elaboration.

It may be observed that the nine highest-producing journals are Spanish journals and journals written in Spanish; this shows a significant change in the information on Spanish educational research, which is very different from the situation in the 1980s when there were no Spanish educational journals indexed in the SSCI database until the entry of the **revista española de pedagogía**.

The journals which appear in italics are repeated in relation to the previous publication (II). However, none of the ten journals from the first publication (I) are reiterated, but they are repeated in relation to the 1998-2009 period; this gives the impression that the publishing pattern has changed over time.

The subjects inferred based on the titles and lines of the highest-producing journals are: computing education, special education, higher education, language and linguistics in education, learning problems, didactics of science and mathematics and physical education. Another noticeable pattern is that Spanish educational journals continue to be general; more specialization would perhaps be desirable.

3.4. International collaboration

Spanish researchers have collaborated on 2617 documents with other researchers from 104 countries. This represents 37% of the total production, a graph which has significantly increased in relation to the two previous publications of this study;

in particular, this collaboration between countries had rather marginal values in the first period investigated (1988-1997). A comparison is made here between 1998-2009 and 2010-2020 (the current period), where an increase is observed in international collaboration as regards frequency and percentage; the figures for the top ten collaborator countries may be seen in Table 5 below.

TABLE 5. International collaboration (only the top 10 countries) between two periods (1998-2009 and 2010-2020) in the Spanish research production indexed in the SSCI database.

	1998-2009 period			2010-2020 period		
Ranking	Country	No. docs.	%	Country	No. docs.	%
1º	USA	54	5.06	USA	352	5.01
2º	Inglaterra	30	2.61	Inglaterra	274	3.90
3º	Portugal	18	1.68	Chile	163	2.32
4º	Holanda	14	1.31	Portugal	142	2.02
5º	Francia	13	1.21	Holanda	110	1.56
6º	Canadá	12	1.12	Australia	105	1.49
7º	Chile	11	1.03	Alemania	95	1.35
8º	Alemania	11	1.03	Italia	86	1.22
9º	México	9	0.84	México	86	1.22
10º	Argentina	8	0.75	Brasil	82	1.16
	∑	180	15.89	∑	1495	21.25

Source: Own elaboration.

The main collaboration pattern with Anglo-Saxon colleagues (with the USA and England) is still observed. With over a third of research carried out as part of international collaboration, the assertion of an isolated Spanish educational research, which was influenced by previous studies, does not seem justified. The increase in collaboration with Chile is noteworthy, which may well be due to the guidelines of the Chilean National Agency for Research and Development (ANID), formerly the Chilean National Commission for Scientific and Technological Research (CONICYT), which promote the awarding of postgraduate education grants abroad (2020).

3.5. General citation of Spanish educational research

This is probably the most novel part of this study in relation to the two previous ones. Citation has been established as an evaluative indicator par excellence for research in hard and social sciences, and of course in education sciences too (Fernández-Cano and Expósito, 2001; Moed, 2005). However citation also allows us to infer hot topics and emerging fronts

in relation to research (Úbeda et al., 2020), which gives the impression of a research agenda in advance and which we missed for many years without defining one that was extensive or accepted.

The general citation data generated by 7016 Spanish educational research documents indexed in the SSCI database in the 2010-2020 period are as follows:

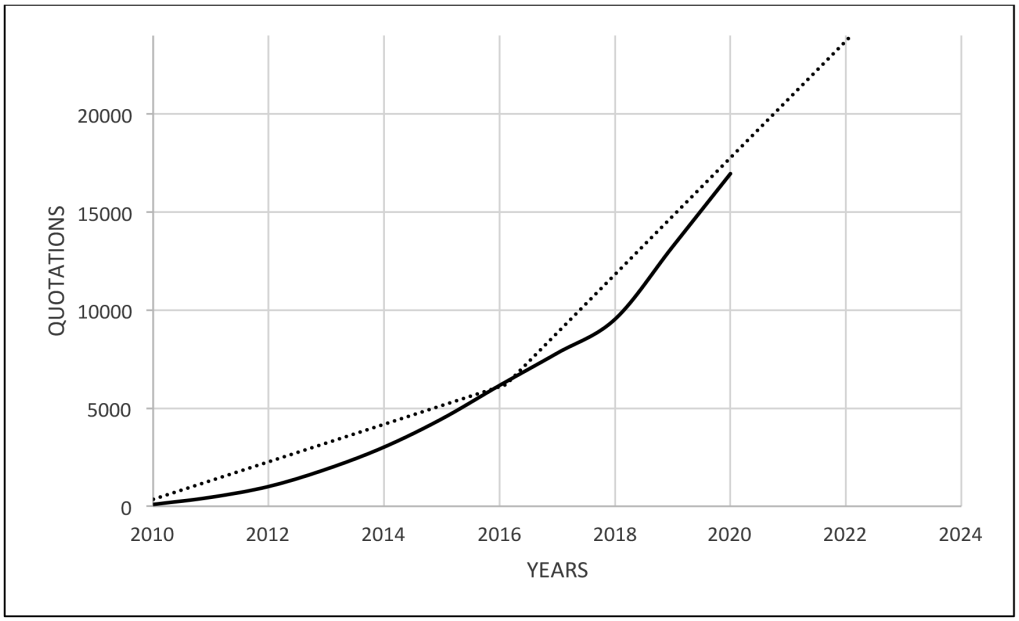
- Total quotations received: 81915.
- Deducted self-citation quotations: 74800.
- Average quotations per document: 11.68.
- Hirsch h index: 89.

The citation pattern obtained offers data which are very high in both total and average quotations, and particularly the h index of 89; this indicates that at least 89 documents have received 89 quotations or more; and, although there is no regulatory Archimedean point for this indicator, it is desirable that the higher this is, the more positive the assessment of the human group is, as in the case of this study, institution, journal or author (Rodríguez-Navarro and Imperial, 2007).

3.6. Diachronic citation pattern

Graph 3 shows the diachronic pattern, also referred to as the retrospective longitudinal pattern, of citation for this period. It is impressive that after 95 quotations were received in 2010, 16920 were received in 2020. This gives us a sound idea of the way in which and how much the acceptance and impact have progressed, in short, of Spanish educational research.

Graph 3. Fitted graph pattern with forecasts of the citation of Spanish educational research indexed in the SSCI database between 2010-2020.



Source: Own elaboration.

The graph pattern of the trend line is fitted to a 2nd order polynomial function ($Y = 165.63X^2 - 665886X + 7E+08$) with an almost perfect fit given by $R^2 = 0.99$, $p < 0.001$. An exponential fit is also acceptable with $R^2 = 0.94$, with equal statistical meaning. The four-year predictions are highly optimistic, with this growth pattern still rapid, almost exponential.

3.7. Citation classics

Eugene Garfield (1977, 1989), one of the founders of scientometrics as a scientific discipline and creator of the Institute for Scientific Information (ISI) of Philadelphia, conceptualized the idea of the citation classic as a scientific document which obtained at least 100 quotations. Since then, citation has become as mass, if not abusive practice (Gingras, 2016), the use of which is growing exponentially. Nonetheless, getting an article to reach 100 quotations is undoubtedly an achievement which bears witness to the quality of the aforementioned; even more so for 200 quotations, which is the Archimedean point used in this study to describe a scientific document as a citation classic; please see Table 6.

TABLE 6. List of citation classic articles (more than 200 quotations received) on Spanish educational research in the 2010-2020 period.

Title of article/ review	No, authors	Year	Journal	University/ Country**	Total quotations	Quotations#
Gamifying learning experiences: Practical implications and outcome	6/6	2013	Computers & Education	Alcalá de Henares	662	66.2
Augmented reality trends in education: a systematic review of research and applications	5/3	2014	Educational Technology & Society	Gerona Athabasca, CAN	408	45.3
Impact of an augmented reality system on students' motivation for a visual art course	3/2	2013	Computers & Education	Simón Bolívar, USB, VEN Carlos III	404	40.4
The impact of entrepreneurship education in higher education: a systematic review and research agenda	5/2	2017	Academy of Management Learning & Education	Manchester, MMU, GBR, Sevilla Anglia Ruskin, ARU, GBR Lyon, EML, FRA	330	55
Blended learning in higher education: Students' perceptions and their relation to outcomes	3/3	2011	Computers & Education	Granada	312	26

Predicting students' final performance from participation in on-line discussion forums	4/4	2013	Computers & Education	Córdoba	269	26.9
Using game theory and competition-based learning to stimulate student motivation and performance	1/1	2010	Computers & Education	Vigo	268	20.6
An empirical study comparing gamification and social networking on e-learning	4/4	2014	Computers & Education	Alcalá de Henares	263	29.2
The use of scoring rubrics for formative assessment purposes revisited: A review	2/1	2013	Educational Research Review	Autónoma Barcelona Kristianstad, HKR, SWE	260	26
Context-aware recommender systems for learning: a survey and future challenges	7/1	2012	IEEE Transactions on Learning Technologies	Católica Lovaina, KU, BEL Alcalá de Henares Atenas, AUA, GRC Guayaquil, ESPOL, ECU Fraunhofer, FIT, DEU	259	23.5
Parental involvement on student academic achievement: A meta-analysis	6/6	2015	Educational Research Review	Complutense/ UNED/País Vasco/La Rioja	252	31.5
Emotion-regulation ability, burnout, and job satisfaction among British secondary-school teachers	5/1	2010	Psychology in the Schools	Yale, USA Cantabria Jaguelónica, UJ, POL	235	18
Using clickers in class, The role of interactivity, active collaborative learning and engagement in learning performance	4/4	2012	Computers & Education	Zaragoza	229	25.4
Evaluating virtual reality and augmented reality training for industrial maintenance and assembly tasks	7/2	2015	Interactive Learning Environments	ORT Braude, ISR Tecnalia, Madrid Fraunhofer, IGD, DEU Navarra, UNAV Parma Sidel SpA, ITA	227	28.3
La competencia mediática: propuesta articulada de dimensiones e indicadores	2/1	2012	Comunicar	Pompeu i Fabra Buenos Aires, UBA, ARG	221	20

Experimenting with electromagnetism using augmented reality: Impact on flow student experience and educational effectiveness	4/2	2014	Computers & Education	Carlos III de Madrid Simón Bolívar, USB, VEN	209	23.2
New technology trends in education: Seven years of forecasts and convergence	5/5	2011	Computers & Education	UNED	207	17.2
Developing responsible global leaders through international service-learning programs: the Ulysses experience	3/2	2011	Academy of Management Learning & Education	Ramón Llull Viena, UNIVIE, AUT	206	17.1
CLIL research in Europe: past, present, and future	1/1	2012	International Journal of Bilingual Education and Bilingualism	Jaén	204	18.5
Virtual and remote labs in education: A bibliometric analysis	6/6	2016	Computers & Education	UNED/Granada	203	29

Code: No. authors: a/b; a total authors/b authors from Spanish centres; *: Abbreviations of the country according to the ISO 3166-1 standard; #: Average yearly quotations.
Source: Own elaboration.

The inferable pattern in this list of citation classic articles is that the majority have been published in foreign journals and in English, and are rich in collaborations, both at a national and international level. The only citation classic published in Spanish is that published by the journal *Comunicar*, assigned to two subject categories of the WoS: Education & educational research and Communication.

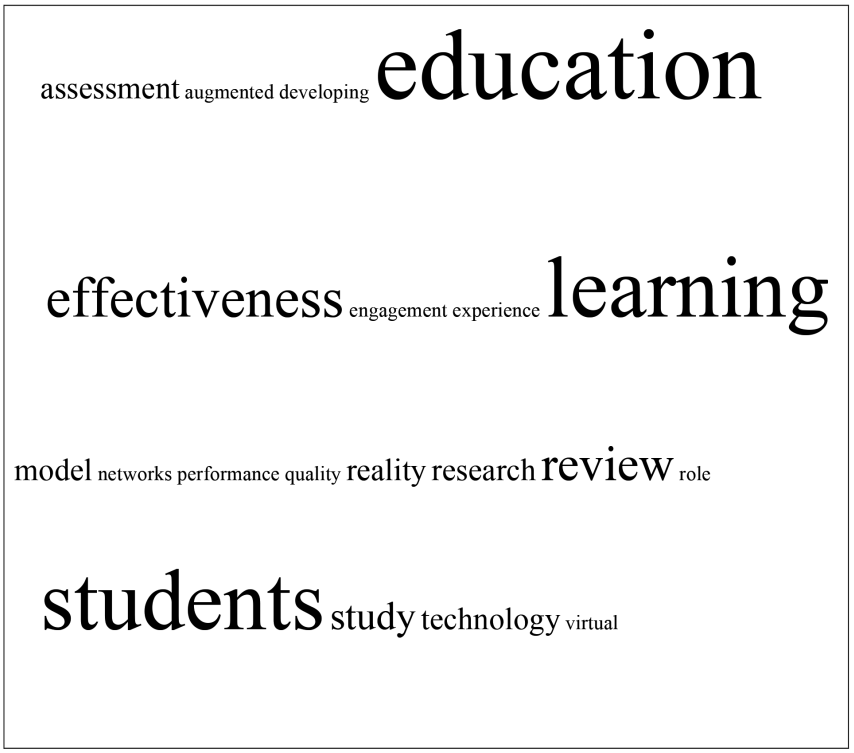
Computers & Education is noteworthy, with ten articles published, for being the journal in which the most quoted Spanish educational research is published; and for the peculiar fact the authors do not tend to work at faculties of education. *Computers & Education* therefore has an extensive and clear influence on educational research as a journal which receives a large number of quotations to studies with some authors based in Spain. This journal is, of course, found in the first quartile (Q1) in two subject categories: Education & Educational Research and Computer Science, Interdisciplinary Applications, and this position is a sign of the consolidation of an emerging research front: Education and Computing (Úbeda and Fernández-Cano, 2019).

The university of Alcalá de Henares (UAH) is also noteworthy as, despite its low productivity in the general ranking (32nd position), it stands out with three highly quoted articles. The first article on gamification has over 600 quotations with a yearly average of 66.2 quotations/year.

3.8. Inferring research fronts based on citation data

A cloud has been created with the twenty most used words in the titles of the most quoted articles (with at least 100 quotations); this cloud has been generated by the program *TagCrowd* which shows an interesting pattern that can be seen in Graph 4.

GRAPH 4. Word cloud of the most quoted (>100 quotations) terms included in the titles of the Spanish articles on educational research indexed in the SSCI database.



Source: Own elaboration.

There is a ranking in the terms used in the titles. On the one hand, we find very generic terms which have already been indicated in previous studies and with more of an influence, more dimension according to Graph 4: Education, learning, students, study, research, review. These terms determine a general research front. On the other hand, another more specific level shows hot research topics, such as augmented, networks, virtual reality, technology. These last terms are typical of the emerging front of Educational Computing. Another specific second front is that of Educational Evaluation, which is not emerging but constant, and is made up of topics such as effectiveness, performance, assessment, quality, experience, engagement. These are therefore the two main specific research fronts of Spanish educational research with the highest international visibility and impact in the 2010-2020 period opposite the general front.

4. Discussion

The results obtained allow for a general pattern to be inferred which is the fitting of Spanish educational research to patterns typical of the most advanced sciences. An optimistic view of this field is not therefore unfounded. Consequently, it may be stated that Spanish educational research is abundant, with a high citation impact6, fitted in terms of scientometrics and internationalist.

4.1. Conclusions and recommendations

After this third version has been written and taking into account the two previous versions, well-supported conclusions may be reached which make it possible to recommend some guidelines.

The highest-producing journals are primarily Spanish. However, as a *lingua franca* for scientific communication, English continues to be the language which has gradually prevailed in the scientific communication of Spanish educational research. Although Spanish journals continue to be published in Spanish, it is now common for articles to be presented in a bilingual publication; in Spanish and English, of course.

In the most recent time frame, international collaboration has extended to 37.3% of the articles indexed in the SSCI and this is mainly carried out with Anglo-Saxon universities and with countries which are close in terms of geography (Portugal) and language (Chile and Mexico).

Retrospective longitudinal analyses of the 2010-2020 period for both the production and citation variables indicate a growing trend which may be fitted to polynomial and exponential functions; a clear sign of the force of Spanish educational research.

It is confirmed, as was already expressed in a study prior to this one (Fernández-Cano, 2011) when it was stated that "the field of Spanish education continues to be extremely fertile and welcoming for other members and disciplines"; this example is from the world of Computing which has eagerly and productively considered problems in education, publishing in the journal *Computers & Education*, with highly quoted articles which determine an emerging research front, Educational Computing. These incursions would be unthinkable and intolerable in other scientific communities which are rather zealous about their scopes of activity. However, from the perspective of the field of education, as education is a field of study in which various disciplines advance quickly, these are considered fruitful visits which contribute to the positive transformation of this field. Educational Evaluation continues to be a specific research front, which is not emerging but constant, as well as general education.

4.2. Openings

In view of the huge production of Spanish bibliometric studies on education, it is recommendable to begin a summary with the bibliometric works available according to the recommendations and indicators offered by Fernández-Cano and Bueno (1999); rather, a third study in line with the work carried out by Fernández-Guerrero et al. (2020) with Spanish doctoral theses on scientific and medical information.

It would be recommendable to perform a retrospective longitudinal study to ob-

serve the citation of Spanish journals from the inclusion of the aforementioned in the SSCI database and its subsequent leap to JCRs. Likewise, enquiries should be made into how journals have stopped being indexed in the SSCI and no longer appear in the latest JCRs (e.g. Cultura y Educación).

This is where quoting Spanish works starts to be encouraged, which should perhaps be an almost patriotic duty. In other countries, such as the USA, Moed (2005) observed that academicians primarily quote their fellow citizens and not so many people from other nations, although it is a well-known fact that the number of American journals and journals written in English which are included in JCRs is higher than those published in other countries and languages.

It would be feasible to carry out additional studies parallel to this one in order to investigate publishers and funding bodies as regards Spanish educational research; a matter which is rather neglected as Spanish educational research has had very scarce, dispersed and limited funding. Without elaborating on more data in this respect, for this study it has been stated that 4980 records/documents, in other words 71% of the operating population have not received any funding whatsoever from the 1920 funding bodies included. Two funding entities stand out: the Government of Spain funded 588 documents (8.38%) and the European Commission made it possible for 290 documents (4.13%) to be funded. In terms of publishers, this is not a trivial matter as for some time now the purchasing and management of Spanish journals by multinational scientific publishing companies has been verified.

The performance of our illustrious scientists who publish in journals of the *Education, Scientific Disciplines* category of the *Science Citation Index Expanded* database should be investigated once and for all.

It would be advisable to perform more specific studies, which are highly necessary, that compare Spanish educational research to that which is carried out in other countries and disciplines; as is observed in a study on Spanish emergency doctors (Fernández-Guerrero et al., 2017).

Furthermore, given the significant progress in scientometrics and altimetry and the availability of powerful bibliometric computer packages (e.g. Bibliometrix and VOSviewer) it would be advisable to carry out studies on underlying structures, such as the various analyses of networks relating to authors, journals, institutions and terms, semantic maps, subject evolution, verbal analysis and co-citation. These advanced activities would be suitable for specialist scientometrics, however they would exceed the scope of this study and possibly the interests of the potential readers of this journal.

One last recommendation: readers should dispel their insidious belief, where this is the case, of a low quality of Spanish educational research, as this is unsupported.

Notes

[1] It would be relevant to make a distinction between scientometrics and bibliometrics. Bibliometrics concerns the measurement (*metrics*) of published products (*biblios*) in any format. Scientometrics is the measurement of any science achievement and its agents and institutions, including, of course, bibliometrics.

[2] The tension between specialists and non-specialists.

[3] Amounts with decimals have been rounded.

[4] Price (1986) predicted that all scientific production indicators (number of articles, journals, centres, researchers, etc.) tended towards a logistic model (similar to an S slanting to the right) with three consecutive phases: linear, exponential and logistic; constant and indefinite growth is therefore unacceptable.

[5] The Hirsch index is an eponym given to a scientometric indicator which combines productivity and citation data. A value *h* of this index indicates that a production unit (author, group, institution or country) has published at least *h* articles with at least *h* citations; in other words, this is the number matched by documents and citations. Although the success of the indicator has been questioned, it has resulted in the seminal article in which the indicator was set out (Hirch, 2005) obtaining 5444 citations (!) in the WoS until the start of January 2022.

[6] There has been a great deal of discussion about the validity of the citation indicator as a sign of quality as regards research. There is plenty of literature in this respect and the general conclusion that may be drawn from it is that citation has been accepted by the scientific community (Fernández-Cano, 2021); it has been validated through use.

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