



El constructo Naturaleza de la Ciencia: un análisis bibliométrico

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ABSTRACT

The literature on the Nature of Science (NdC) is abundant and diverse, this generates the need for a bibliometric review to facilitate readers who begin in the subject to identify the main publications, authors, countries and variations in the research on NdC of the last years. Thus, this article deals with a bibliometric review of the main publications of nature of science (NOS) construct, in the journal with the most publications about it. Of 856 documents retrieved from the Scopus database for the last 7 years, 76 documents have been published in the journal Science and education (Sci and Edu) and on this set of documents, the United States is the country with the most publications (28%), followed by Brazil (9%), Germany, Spain, Turkey (6% each), China and Finland (4% each). Among the main authors on NOS are: García-Carmona, A. (15.8%), Lederman, N.G. (14.5%), Vázquez-Alonso, A. (13.2%), Clough, MP, and Manassero-Mas, MA (11.8% each author), as well as Abd-El-Khalick, F., Herman, BC, Khishfe, R., Taber, KS Allchin, D., and Wong, S.L. (10.5% each author).

The h-index reveals that the articles with the greatest impact are in decreasing order: Two Views About Explicitly Teaching Nature of Science; Teaching With and About Nature of Science, and Science Teacher Knowledge Domains y Developing Content Knowledge in Students Through Explicit Teaching of the Nature of Science: Influences of Goal Setting and Self-Monitoring.

Also, are established as categories of document analysis: beliefs and epistemological interventions, text analysis, History of science (HC), Philosophy of science (FC) or Sociology of science (SC) and possible aspects to consider in future analysis of NdC.

Resumen

La literatura sobre Naturaleza de la Ciencia (NdC) es abundante y diversa, lo anterior genera la necesidad de una revisión bibliométrica para facilitar a los lectores que incursionan en este constructo la identificación de las principales publicaciones, autores, países y variaciones en las investigaciones sobre NdC de los últimos años. Así, el presente artículo aborda una revisión bibliométrica de las principales publicaciones del constructo naturaleza de la ciencia en la revista con mayor número de publicaciones al respecto. De 856 documentos recuperados en la base Scopus para los últimos 7 años, se han publicado 76 documentos en la revista Science and education (*Sci and Edu*) y sobre este conjunto de documentos, se establece a Estados Unidos como país con mayor cantidad (28%), seguido de Brasil (9%), Alemania, España, Turquía (6% cada uno), China y Finlandia (4% cada uno). Entre los principales autores en NdC se encuentran: García-Carmona, A. (15,8%), Lederman, N.G. (14.5%), Vázquez-Alonso, A. (13,2%), Clough, M.P., y Manassero-Mas, M.A (11,8% cada uno), así como Abd-El-Khalick, F., Herman, B.C., Khishfe, R., Taber, K.S. Allchin, D., y Wong, S.L. (10,5% cada autor).

El índice h revela que los artículos con mayor impacto son en orden decreciente: Two Views About Explicitly Teaching Nature of Science; Teaching With and About Nature of Science, and Science Teacher Knowledge Domains y Developing Content Knowledge in

Students Through Explicit Teaching of the Nature of Science: Influences of Goal Setting and Self-Monitoring.

Asimismo, se establecen como categorías de análisis de los documentos: Creencias epistemológicas e intervenciones, análisis de textos, Historia de la ciencia (HC), Filosofía de la Ciencia (FC) o Sociología de la ciencia (SC) y posibles aspectos a considerar en futuros análisis NdC.

I. INTRODUCCIÓN

La NdC es un constructo que incluye la epistemología de la ciencia, qué se considera ciencia, el significado de la ciencia, cómo se produce el conocimiento científico (ciencia como proceso), de la actividad científica, su funcionamiento interno y externo, de la profundidad del conocimiento científico (ciencia como producto), los valores, creencias sobre la ciencia, cómo trabajan los científicos, la naturaleza de la comunidad científica y la cultura (Lederman 1992, 2007; Clough, 2007; Ryan y Aikenhead, 1992; Schwartz, Lederman, & Crawford, 2004, Izquierdo, García, Quintanilla Adúriz-Bravo, 2016; Acevedo, Vazquez, Martín, Oliva, Acevedo, Paixão, Manassero, 2005), y en palabras de Adúriz-Bravo & Ariza, 2012 se “reconoce la ciencia como un esfuerzo humano, dirigido por la teoría y la cultura, dependiente de la observación empírica y sujeto a cambios”.

A su vez, la NdC y su inclusión en los currículos del mundo ha sido ampliamente defendido (Lederman y Abd-El-Khalick, 1998, Matthews, 1994, Millar & Osborne, 1998, Ryan & Aikenhead, 1992, Smith & Scharmann, 1999) siendo indispensable para una buena calidad de la educación científica de la ciudadanía (Adúriz-Bravo & Ariza, 2012; Matthews 1994; McComas, 1998). Por lo anterior, promover en el estudiantado y profesorado vistas informadas de NdC sigue siendo una meta central en la educación científica y desarrollo de pensamiento crítico. Sin embargo, la literatura sobre NdC es abundante y diversa, siendo necesaria una revisión bibliométrica para los lectores que incursionan en este constructo, que les permita identificar las principales publicaciones, autores, países y variaciones en las investigaciones sobre NdC de los últimos años.

II. METODOLOGÍA

El análisis bibliométrico del presente documento parte de la construcción de una base de datos en Excel estructurada desde la información de la base de datos de referencia bibliográfica y citas Scopus de Elsevier, se establecen las principales revistas que publican sobre el constructo NdC y se analiza a profundidad la que mayor número de documentos relacione. Para este análisis se ha tomado como referencia un periodo de siete años (2012 a 2018). Una vez obtenido el conjunto de documentos de la revista con mayor número de publicaciones, se procede a analizarlos desde los autores, país de origen e índice h. Después de su lectura, se establecen categorías de análisis de las publicaciones.

III. RESULTADOS

La Tabla I revela como principal revista *Science and education (Sci and Edu)* con 76 documentos, seguida de las revistas *International Journal Of Science Education*, *Research In Science Education*, *American Biology Teacher* y *Journal Of Science Teacher Education* con 53, 40, 31 y 20 publicaciones respectivamente.

Tabla I. Principales revistas que publican sobre NdC.

Revista	Número de documentos
Science And Education	76

International Journal Of Science Education	53
Research In Science Education	40
American Biology Teacher	31
Journal Of Science Teacher Education	20
Journal Of Research In Science Teaching	16
Science Education	16
Eurasia Journal Of Mathematics Science And Technology Education	15
Aip Conference Proceedings	13
Cultural Studies Of Science Education	13

Así, en los últimos siete años se han publicado 856 documentos sobre NdC, la figura 1 evidencia la mayor frecuencia absoluta de publicaciones en el año 2014 con 169, y las menores en los años 2015 y 2018 con 117 y 30 documentos respectivamente. De igual forma, se observa mayor frecuencia de publicación en *Sci and Edu* en el año 2013 con 20 publicaciones, y las menores frecuencias en los años 2012 y 2018 con 9 y 2 documentos respectivamente. Desde luego, los datos reportados para el año 2018 son parciales y corresponden a la frecuencia acumulada hasta el cuarto mes del año.

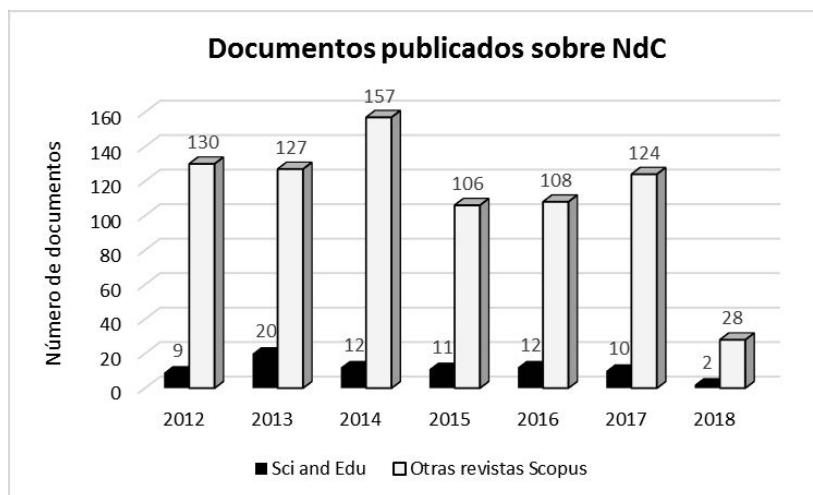


Figura 1. Se muestra la frecuencia absoluta de los documentos publicados en los últimos siete años en la revista *Sci and Edu* comparados con los demás registrados en Scopus. Así, la revista *Sci and Edu* presenta mayor número de publicaciones en el año 2013 y entre las otras revistas el año con mayor número de publicaciones es el 2014.

De los 856 documentos, se identifica a Estados Unidos como país que más ha publicado en el periodo establecido, con un 48% de los documentos, seguido por Turquía con 13% y Reino Unido con el 7% como se observa en la figura 2. Sobre el tipo de documentos, el 72% corresponden a artículos, 11,8% a capítulos de libro; 6,5% a conferencias en papel; 4% a revisiones y 5,7% entre artículos en prensa, libros, editoriales, fe de erratas, revisión de conferencia y notas.

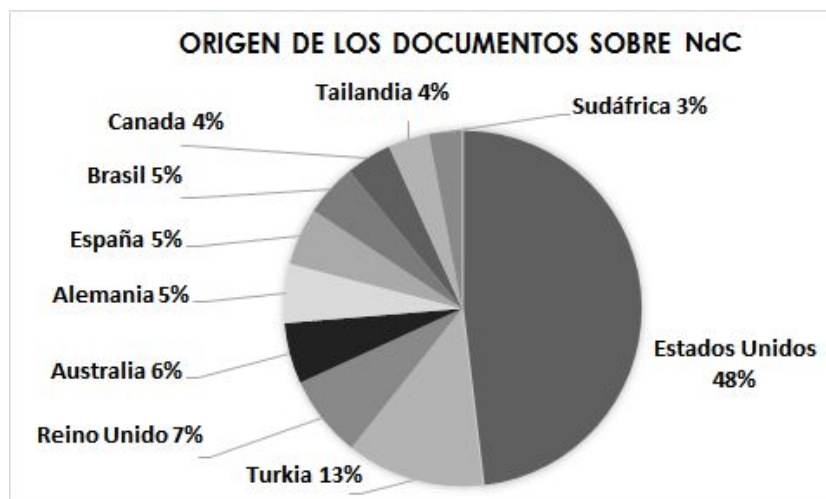


Figura 2. Se muestra la frecuencia relativa de las publicaciones en todas las revistas por país de origen.

Entre los principales autores en NdC se encuentran: García-Carmona, A., Lederman, N.G., Vázquez-Alonso, A., con 12, 11 y 10 publicaciones respectivamente, así como Clough, M.P., y Manassero-Mas, M.A. con 9 documentos cada uno y Abd-El-Khalick, F., Herman, B.C., Khishfe, R., Taber, K.S. Allchin, D., y Wong, S.L. con 8 documentos cada autor. Por lo anterior, a continuación se analizan los 76 documentos publicados en la revista *Sci and Edu* y que se relacionan en Tabla II.

TABLA II. Documentos publicados en *Sci and Edu* entre 2012 y 2018 sobre NdC.

Artículo No.	Año	Volumen	Número	Título
1	2018	--	--	Teaching and Learning About the Nature of Science
2	2018	--	--	Taking the Scientist's Perspective: The Nonfiction Narrative Engages Episodic Memory to Enhance Students' Understanding of Scientists and Their Practices
3	2017	26	7-9	Learner Characteristics and Understanding Nature of Science: Is There an Association?
4	2017	26	7-9	Changes in Students' Views about Nature of Scientific Inquiry at a Science Camp
5	2017	26	6	The Impact of a Course on Nature of Science Pedagogical Views and Rationales: Comparing Preservice Teachers in Their First Versus Second Experience
6	2017	26	6	Changes in Pre-service Science Teachers' Understandings After Being Involved in Explicit Nature of Science and Socioscientific Argumentation Processes
7	2017	26	5	Controversy as a Blind Spot in Teaching Nature of Science: Why the Range of Different Positions Concerning Nature of Science Should Be an Issue in the Science Classroom

8	2017	26	5	The Cultural Argument for Understanding Nature of Science: A Chance to Reflect on Similarities and Differences Between Science and Humanities
9	2017	26	5	From black and white to shades of grey: A longitudinal study of teachers' perspectives on teaching sociocultural and subjective aspects of science
10	2017	26	5	Analysis of the Image of Scientists Portrayed in the Lebanese National Science Textbooks
11	2017	26	3-4	Working Alongside Scientists: Impacts on Primary Teacher Beliefs and Knowledge About Science and Science Education
12	2017	26	1-2	Understanding the Nature of Science Through a Critical and Reflective Analysis of the Controversy Between Pasteur and Liebig on Fermentation
13	2016	25	9-10	Nature of Science and Science Content Learning: The Relation Between Students' Nature of Science Understanding and Their Learning About the Concept of Energy
14	2016	25	9-10	Views from the Chalkface: Values of Teaching Nature of Science in Hong Kong
15	2016	25	9-10	From FRA to RFN, or How the Family Resemblance Approach Can Be Transformed for Science Curriculum Analysis on Nature of Science
16	2016	25	9-10	Dramatizing the Authentic Research of a Local Scientist to Urban Elementary Students Through Professional Theater
17	2016	25	7-8	Discussion of the Controversy Concerning a Historical Event Among Pre-service Teachers: Contributions to Their Knowledge About Science, Their Argumentative Skills, and Reflections About Their Future Teaching Practices
18	2016	25	5-6	Learning About the Nature of Science Using Newspaper Articles with Scientific Content: A Study in Initial Primary Teacher Education
19	2016	25	5-6	The Portrayal of Industrial Melanism in American College General Biology Textbooks
20	2016	25	3-4	Emphasizing the History of Genetics in an Explicit and Reflective Approach to Teaching the Nature of Science: A Pilot Study
21	2016	25	3-4	Using a Professional Development Program for Enhancing Chilean Biology Teachers' Understanding of Nature of Science (NOS) and Their Perceptions About Using History of Science to Teach NOS
22	2016	25	3-4	Why the Difference Between Explanation and Argument Matters to Science Education
23	2016	25	1-2	Reconceptualizing the Nature of Science for Science Education: Why Does it Matter?

24	2016	25	1-2	From Comparison Between Scientists to Gaining Cultural Scientific Knowledge: Leonardo and Galileo
25	2015	24	9-10	Using History of Science to Teach Nature of Science to Elementary Students
26	2015	24	9-10	Teachers' Ways of Talking About Nature of Science and Its Teaching
27	2015	24	9-10	The Contextual Nature of Scientists' Views of Theories, Experimentation, and Their Coordination
28	2015	24	9-10	Enhancing Teachers' Awareness About Relations Between Science and Religion: The Debate Between Steady State and Big Bang Theories
29	2015	24	7-8	Outcomes of a Self-Regulated Learning Curriculum Model: Network Analysis of Middle School Students' Views of Nature of Science
30	2015	24	7-8	Understandings of Nature of Science and Multiple Perspective Evaluation of Science News by Non-science Majors
31	2015	24	7-8	Explanation and the Nature of Scientific Knowledge
32	2015	24	7-8	History of Science and Science Museums: An Enriching Partnership for Elementary School Science
33	2015	24	4	Electricity and Vital Force: Discussing the Nature of Science Through a Historical Narrative
34	2015	24	4	Nature of Science Contextualized: Studying Nature of Science with Scientists
35	2015	24	3	The Philosophical Works of Ludwik Fleck and Their Potential Meaning for Teaching and Learning Science
36	2014	23	3	The Name of the Rose: A Path to Discuss the Birth of Modern Science
37	2014	23	2	Nature of Science, Scientific Inquiry, and Socio-Scientific Issues Arising from Genetics: A Pathway to Developing a Scientifically Literate Citizenry
38	2014	23	5	Production of a Science Documentary and its Usefulness in Teaching the Nature of Science: Indirect Experience of How Science Works
39	2014	23	6	When Energy Conservation Seems to Fail: The Prediction of the Neutrino
40	2014	23	8	How to Use Historical Approach to Teach Nature of Science in Chemistry Education?
41	2014	23	4	Assessing South China (Guangzhou) High School Students' Views on Nature of Science: A Validation Study
42	2014	23	5	Students' Conceptions of the Nature of Science: Perspectives from Canadian and Korean Middle School Students
43	2014	23	9	From Science Studies to Scientific Literacy: A View from the Classroom

44	2014	23	9	Analysis of Nature of Science Included in Recent Popular Writing Using Text Mining Techniques
45	2014	23	4	Using Ancient Chinese and Greek Astronomical Data: A Training Sequence in Elementary Astronomy for Pre-Service Primary School Teachers
46	2014	23	4	Epistemological Issues Concerning Computer Simulations in Science and Their Implications for Science Education
47	2014	23	9	Report on a Boston University Conference December 7–8, 2012 on How Can the History and Philosophy of Science Contribute to Contemporary US Science Teaching?
48	2013	22	10	Teaching Nature of Science to Preservice Science Teachers: A Phenomenographic Study of Chinese Teacher Educators' Conceptions
49	2013	22	10	Introduction: Commercialization of Academic Science and a New Agenda for Science Education
50	2013	22	10	Teaching About Theory-Laden Observation to Secondary Students Through Manipulated Lab Inquiry Experience
51	2013	22	9	Relevant Features of Science: Values in Conservation Biology
52	2013	22	9	Scientific Communication and the Nature of Science
53	2013	22	9	Two Views About Explicitly Teaching Nature of Science
54	2013	22	9	Teaching With and About Nature of Science, and Science Teacher Knowledge Domains
55	2013	22	9	Design of Chemistry Teacher Education Course on Nature of Science
56	2013	22	8	On the Power of Fine Arts Pictorial Imagery in Science Education
57	2013	22	7	Quantitative Analysis of Representations of Nature of Science in Nordic Upper Secondary School Textbooks Using Framework of Analysis Based on Philosophy of Chemistry
58	2013	22	7	A 'Semantic' View of Scientific Models for Science Education
59	2013	22	7	School Chemistry: The Need for Transgression
60	2013	22	6	Teaching the Nature of Science in Physics Courses: The Contribution of Classroom Historical Inquiries
61	2013	22	6	History, Philosophy, and Science in a Social Perspective: A Pedagogical Project
62	2013	22	5	When Nature of Science Meets Marxism: Aspects of Nature of Science Taught by Chinese Science Teacher Educators to Prospective Science Teachers
63	2013	22	5	Spanish Secondary-School Science Teachers' Beliefs About Science-Technology-Society (STS) Issues

64	2013	22	3	Introducing History (and Philosophy) of Science in the Classroom: A Field Research Experience in Italy
65	2013	23	9	Changes Observed in Views of Nature of Science During a Historically Based Unit
66	2013	24	1-2	Mendelian Genetics as a Platform for Teaching About Nature of Science and Scientific Inquiry: The Value of Textbooks
67	2013	24	1-2	How Many Times Can You Be Wrong and Still Be Right? T. H. Morgan, Evolution, Chromosomes and the Origins of Modern Genetics
68	2012	21	6	Developing Content Knowledge in Students Through Explicit Teaching of the Nature of Science: Influences of Goal Setting and Self-Monitoring
69	2012	21	6	Integrating Scientific Methods and Knowledge into the Teaching of Newton's Theory of Gravitation: An Instructional Sequence for Teachers' and Students' Nature of Science Education
70	2012	21	6	D. Carlos de Bragança, a Pioneer of Experimental Marine Oceanography: Filling the Gap Between Formal and Informal Science Education
71	2012	21	6	Implementing Eratosthenes' Discovery in the Classroom: Educational Difficulties Needing Attention
72	2012	21	6	The History and Philosophy of Science in Physics Teaching: A Research Synthesis of Didactic Interventions
73	2012	21	5	History and Nature of Science in High School: Building Up Parameters to Guide Educational Materials and Strategies
74	2012	21	5	Teachers' Ideas About the Nature of Science: A Critical Analysis of Research Approaches and Their Contribution to Pedagogical Practice
75	2012	21	9	The Minnesota Case Study Collection: New Historical Inquiry Case Studies for Nature of Science Education
76	2012	21	9	Science and Society: The Case of Acceptance of Newtonian Optics in the Eighteenth Century

Sobre el origen de los documentos publicados, la figura 3 muestra a Estados Unidos con 25 documentos como país con mayor cantidad (28%), seguido de Brasil con 8 documentos(9%), Alemania, España, Turquía con 5 documentos por país (6% cada uno), China y Finlandia con 4 documentos por país (4% cada uno), Canadá, Francia, Israel y Suecia con 3 documentos por país (3% cada uno), Argentina, Hong Kong, Italia, Portugal y Taiwán con 2 documentos por país (2% cada uno) y Australia, Chile, Dinamarca, Grecia, Irlanda, Líbano, México, Nueva Zelanda, Singapur, Corea del Sur, Suiza y Reino Unido cada uno con 1 documento (1% por país).

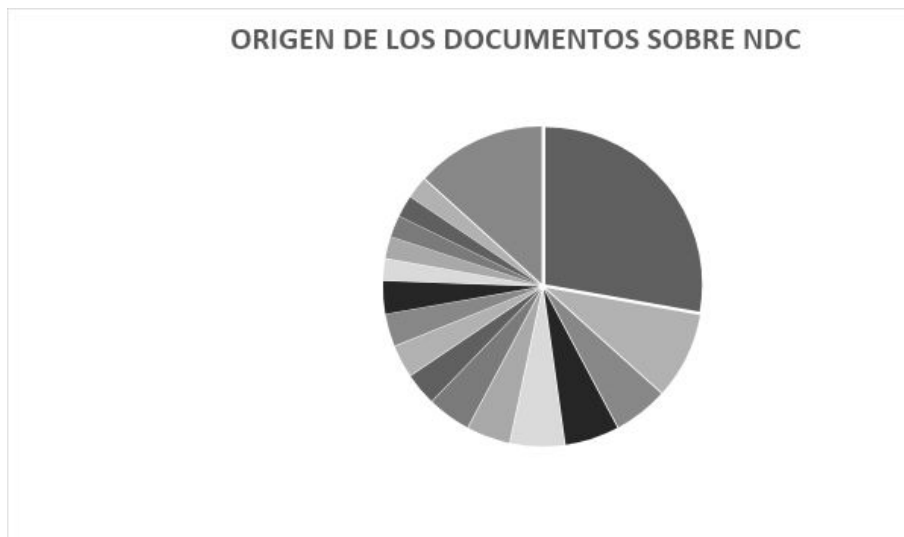


Figura 3. Se muestra la frecuencia relativa de las publicaciones en *Sci and Edu* por país de origen.

De lo anterior, los artículos son el tipo de documento más publicado (93%), seguido de los artículos en prensa, revisiones y editorial (2,6%; 2,6% y 1,3% respectivamente). Entre los autores con mayor número de publicaciones están: Vesterinen, V.M. (4 documentos), Aksela, M., García-Carmona, A., Guerra, A., Rudge, D.W., Wan, Z.H., y Wong, S.L. (cada uno con 3 documentos), Allchin, D., Braga, M., Décamp, N., Erduran, S., Faria, C., Fulford, J.M., Galili, I., Greca, I.M., Hansson, L., Leden, L., Lederman, N.G., Redfors, A., Silva, C.C., Zhan, Y., de Hosson, C., y Acevedo Díaz, J.A. (cada uno con 2 publicaciones).

También, al conjunto de 76 documentos se calcula el índice h, que mide el impacto de estos artículos y refleja el número de citas por documento, así, el índice h es 10, es decir, 10 documentos se han citado al menos 10 veces y estos documentos se muestran en la tabla III.

TABLA III. Publicaciones más citadas entre el periodo 2012 a 2018.

No	Título	Año	Número de citaciones							Tot al
			20 12	20 13	20 14	20 15	20 16	20 17	20 18	
1	Two Views About Explicitly Teaching Nature of Science	2013		1	9	11	17	15	1	54
2	Teaching With and About Nature of Science, and Science Teacher Knowledge Domains	2013		1	4	13	12	6	1	37
3	Developing Content Knowledge in Students Through Explicit Teaching of the Nature of Science: Influences of Goal Setting and Self-Monitoring	2012		2	3	4	7	5	2	23
4	Nature of Science, Scientific Inquiry, and Socio-Scientific Issues Arising from Genetics: A Pathway to Developing a Scientifically Literate Citizenry	2014			3	3	6	4	5	21

5	The Minnesota Case Study Collection: New Historical Inquiry Case Studies for Nature of Science Education	2012		1	5	7	2	2		17
6	A 'Semantic' View of Scientific Models for Science Education	2013		1	3	3	4	3	2	16
7	From Science Studies to Scientific Literacy: A View from the Classroom	2014				4	3	6	1	14
8	School Chemistry: The Need for Transgression	2013			4	6	3			13
9	Scientific Communication and the Nature of Science	2013		1	2	2	4	2		11
10	The History and Philosophy of Science in Physics Teaching: A Research Synthesis of Didactic Interventions	2012		1	4	4	2			11

Categorías de análisis en los documentos sobre NdC

Creencias epistemológicas e intervenciones 25

Nueve investigaciones exploran las creencias epistemológicas de diferentes poblaciones, entre ellos Çetinkaya-Aydın & Çakiroğlu (2017), Kruse, Easter, Edgerly, Seebach & Patel (2017), Kutluca & Aydın (2017), Park, Nielsen & Woodruff (2014), Vázquez-Alonso, García-Carmona, Manassero-Mas & Bennassar-Roig (2013) Wan, Wong & Zhan (2013 a y b), Sandoval & Redman (2015), Guerra (2012) y diferentes estudios contemplan intervenciones para modificar las creencias epistemológicas, entre estos Michel & Neumann (2016), Peters-Burton (2015), Kim, Yi & Cho (2014), Anderson & Moeed (2017), Tala & Vesterinen (2015), Leblebicioglu, G., Metin, D., Capkinoglu, E., Cetin, P. S., Eroglu Dogan, E., & Schwartz, R. (2017), Leden, Hansson & Redfors (2017), Greca, Seoane, & Arriasecq (2014), Lau & Chan (2013), Peters (2012). Algunas intervenciones usan obras de teatro como Burgin, Alonzo & Hill (2016). Otras investigaciones plantean sugerencias para intervenciones en aula como Leden, Hansson & Redfor (2017), Lederman, Antink & Bartos (2014), Abd-El-Khalick (2013), e investigaciones con docentes para evaluar su compromiso con la enseñanza de NdC como Wan & Wong (2016), Vesterinen & Aksela (2013).

Análisis de textos 9

Investigaciones sobre aspectos NdC en periódicos y revistas, entre estos estudios están Jiang & McComas (2014), García-Carmona & Acevedo (2016), Leung, Wong & Yung (2015), Jiang & McComas (2014), así como Yacoubian, Al-Khatib & Mardirossian (2017), Fulford & Rudge (2016), Galili (2016), Vesterinen, Aksela, & Lavonen (2013), Campanile, Lederman & Kampourakis (2013) en libros de ciencias.

Historia, Filosofía de la Ciencia o Sociología de la ciencia 32

Reflexiones sobre la conveniencia de la HC y FC se evidencian en los trabajos de Guerra & Braga (2014), Allechin (2014), de Hosson & Décamp (2014), Garik & Benétreau-Dupin (2014) Silva & Moura (2012), Stuckey, Hering, Mamlok-Naaman, Hofstein & Eilks (2015), Talanquer (2013).

Adúriz-Bravo (2013) explora una visión "semántica" de los modelos científicos, Irzik (2013) plantea como la comercialización de la ciencia académica es importante en la educación científica. Igualmente algunas investigaciones empleando HC en la enseñanza NdC como Kötter & Hammann (2017), García-Carmona, & Acevedo-Díaz (2017),

Justi & Mendonça (2016), Williams & Rudge (2016), Pavez, Vergara, Santibañez, & Cofré (2016), Fouad, Masters, & Akerson (2015), Bagdonas & Silva (2015), Faria, Guilherme, Gaspar & Boaventura (2015), Schiffer & Guerra (2015), Guerra, Leone & Robotti (2014), Tolvanen, Jansson, Vesterinen, & Aksela (2014), Galili (2013), Maurines & Beaufils (2013), Guerra, Braga, & Reis (2013), Dibattista & Morgese (2013), Rudge, Cassidy, Fulford & Howe (2013), Allen (2013), Develaki (2012), Faria, Pereira & Chagas (2012), Décamp & de Hosson (2012), Teixeira, Greca & Freire (2012), de Forato, de Andrade & Pietrocola (2012), Allchin (2012).

Posibles aspectos a considerar en futuros análisis NdC 9

Reiners, Bliersbach & Marniok (2017) argumentan el aspecto cultural para comprender la ciencia, no solo desde conceptos específicos, sino sobre las similitudes entre ciencia y las humanidades, y Deng, Chai, Tsai & Lin (2014) analizan la adaptación y validación de un instrumento desde la perspectiva sociocultural. Además, Nielsen (2013) considera que la comunicación es un componente fundamental en la NdC y Larison (2018) confirma el poder de la narrativa en la comprensión del conocimiento de los científicos para desarrollar la práctica científica. Dagher & Erduran (2016). Kaya & Erduran (2016) emplean el enfoque de semejanza familiar a NdC.

McCain (2015) analiza la relación entre la explicación y comprensión para generar conocimiento científico que permite encontrar características generales de NdC y Brigandt (2016) exalta la importancia de objetivos explicativos en el aula para enseñar NdC. Duschl & Grandy (2013) defiende la construcción y perfección de prácticas científicas basadas en modelos como alternativa en la enseñanza explícita de NdC.

IV. CONCLUSIONES

El presente análisis bibliométrico establece a la revista *Sci and Edu* como el medio con mayor número de publicaciones sobre el constructo NdC. En esta se reportan 76 documentos analizados en las categorías Creencias epistemológicas e intervenciones, análisis de textos, Historia, Filosofía de la Ciencia o Sociología de la ciencia y Posibles aspectos a considerar en futuros análisis de NdC. Entre los principales autores están Vesterinen, V.M., Aksela, M., García-Carmona, A., Guerra, A., Rudge, D.W., Wan, Z.H., y Wong, S.L. Los países con mayor número de publicaciones son Estados Unidos, Brasil, Alemania, España y Turquía.

El mayor número de publicaciones reflexionan sobre la conveniencia de Historia y Filosofía de la Ciencia en el constructo NdC, así como el uso de la HC en su enseñanza. Igualmente, un buen número de publicaciones buscan develar las creencias epistemológicas sobre la ciencia en diversas poblaciones y diferentes estrategias sin el uso de la HC para transformar mencionadas creencias.

Entre los posibles aspectos a considerar en análisis de NdC esta la perspectiva sociocultural, la importancia de la comunicación y la narrativa, la relación entre explicación y comprensión, así como la enseñanza explícita de NdC.

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