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## Study on the Nature of Science (NOS) in Science Education Since 1895-2022: Bibliometric Analysis

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Nature of Science, Vos Viewer,  
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### ABSTRACT

*The purpose of this overview is to map the studies focused on the nature of science in the scientific Scopus journal. The nature of science (NOS) and its impact on pedagogical learning and science education have become central themes of education and research. The Study methodology used in this study is bibliometrics utilising VOS viewer. Specifically, research results analysis and caward analysis were carried out. The term NOS has ever been analyzed in the Scopus database. A total of 2756 papers were analyzed consisting of 2048 articles, 202 conference articles, 56 books, 263 book chapters, and 187 other papers were analyzed. The results report that studies in the field of education of NOS more increased and have continued uninterruptedly up to the present day, even though interest generated in the scientific community has been irregular. It can be concluded that NOS studies have not had an established and robust line of research over time, this study can be observed that the trends in this aspect are focused on science education.*

## INTRODUCTION

The nature of science is one of the essential elements of scientific literacy. It is believed that an accurate understanding of NOS will provide students with more information in the future when making decisions that require scientific ideas and data e.g. (Garcia-Carmona, 2021; Safkolam, et al., 2021; Lederman, 1999). Various methods and media have been developed to teach NOS to students (Safkolam, et al., 2021; Prachagool and Nuangchalerm, 2019). Studies on NOS have been designed at different levels of education. Incorporate NOS into all levels of education for this purpose.

Lederman describes four ways to carry out NOS studies in his study. The four pathways are to assess students' understanding of NOS, develop and evaluate educational programs to assess students' understanding of NOS, assess teachers and students' understanding of NOS and develop this understanding of NOS, and study An explanation of the relationship between teachers' educational practices decisions and teachers' educational practices regarding NOS Student performance by NOS (Lederman, 1992). Since NOS is one of the most popular research topics in the literature, researchers have explored various aspects since NOS was first investigated. Most studies focus on the understanding of NOS students and teachers and the impact of various teaching methods on the understanding of NOS.

Until there is currently no consensus among science philosophers, science historians, scientists, and science educators on a particular definition of NOS. However, some experts determine the definition of NOS. Scripture explains that science consists of "weighing evidence and giving each statement an indicator of its credibility" (Scripture, 1895). The phrase "the nature of science" usually refers to the epistemology of science, science as a path to knowledge, or the values and beliefs inherent in the development of scientific knowledge. One of the broadest definitions is that NOS combines specific aspects of different disciplines such as philosophy, sociology, history of science, and psychology, what science is, how it works, and how it works it's a fertile hybrid field that seeks answers to the question of what to do (Lederman, 1992). Scientists work as sociology groups and show how society itself manages and reacts to scientific research (Garcia-Carmona, 2021; Nouri and McComas, 2021; Abd-El-khalick and Lederman, 2000).

The purpose of this study was to map studies on the subject of science in the scientific journal Scopus, and systematic quantitative literature was used in this study. Data based on analysis collected from 1985 to 2022. The articles used in this study were investigated through document analysis. The data consisted of articles published in NOS of the Scopus database during the period 1895-2022.

## METHOD

### Data Collection

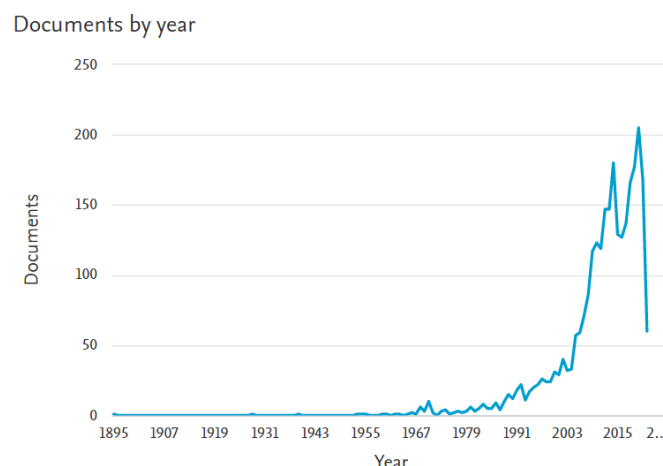
Use the Scopus document search engine to search for literature in the field of NOS. This survey was conducted by searching for the online keyword {Nature of Science}. The analysis consists of keyword analysis for research using Scopus sources. A total of 2756 articles were analyzed for all articles found in the NOS database, of which 2048 articles, 202 conference proceedings, 56 books, 263 book chapters, and 187 other papers were analyzed. Sample articles data downloaded in \*CSV format are processed by VOS Viewer software to facilitate visualization and identify trends in this study (Ninglasari, 2021; Hamidah et al, 2020). Analyze Search result Scopus data index has too utilized in this study. This method is mainly inspired by Kasi et al. (2021), Kurtulus and Bilen (2021), Winarno et al. (2020).

### Data Analysis

VosViewer was used to analyze the obtained data. This program is available on the official website <https://www.vosviewer.com/>. This packaged program, used in the bibliometric analysis, is very useful for quantitative research (Kurtulus and Bilen, 2021). We chose to use the Vos Viewer for bibliometric analysis because it allows for more findings and more detailed presentations. We created a data file for analysis from articles retrieved from the Scopus database according to the research criteria.

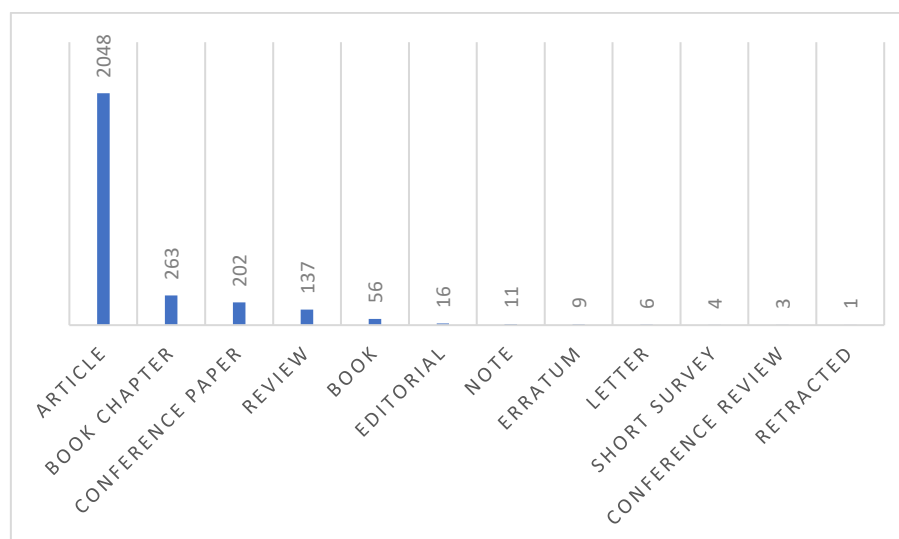
## RESULTS AND DISCUSSIONS

The results of this study show that the first NOS-related study was done in 1895. The study of NOS was first published by the Scripture. In this article, Scripture defines what science is. Science consisted of "weighing evidence and giving each statement an indicator of its reliability" (Scripture, 1895). The highest number of NOS-related articles published in the last decade was in 2020, with a total of 205 (7.4%) articles. Figure 1 shows the details of the year the article was published on NOS.



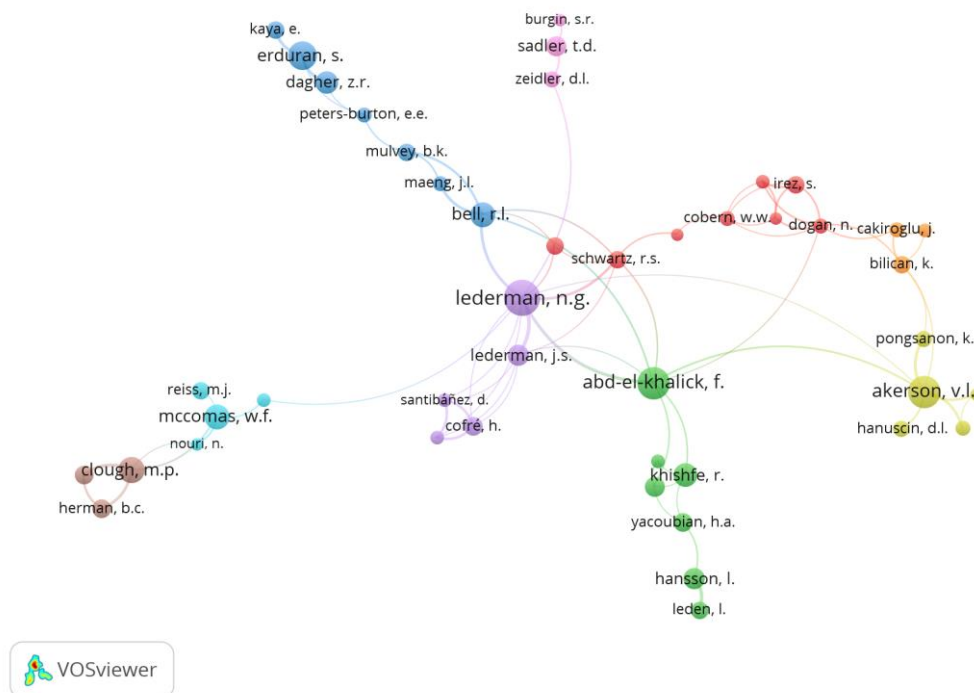
**Fig. 1.** Distribution of the research according to a year of publication

Figure 2 shows the types of publications obtained from the Web Scopus Index. Then we can see the types of publications most released in NOS. Twelve types of documents are available: articles, book chapters, meeting papers, reviews, books, editorials, memos, errata, letters, summaries, meeting minutes, and retracted documents. Figure 2. Plot the number of publications based on the type of document published.



**Fig. 2.** Distribution of the research according to the type of document

After analyzing the VOS Viewer, you can see the visualization and mapping of the interrelationships between authors (Figure 3). Figure 3 shows a collaborative network of researchers. The minimum number of terms used in the VOS viewer is 5. After analysis, there are 127 authors with 9 clusters. Each cluster shows the relationship between the authors.

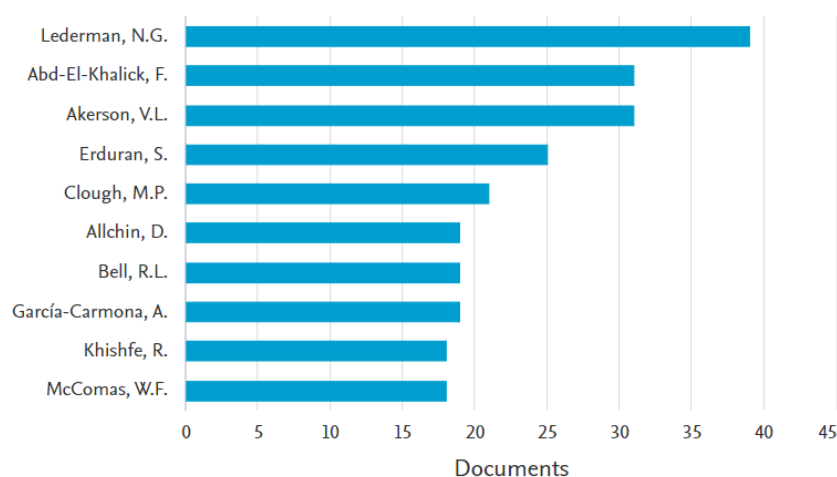


**Figure 3.** Visualization author using VOS Viewer using network visualization

The Scopus index data shows the list of authors with the most articles published on NOS (Figure 4). These data show that the highest numbered author is Lederman ( $n = 39$ ) and the second-highest numbered author is Abdel Khalick ( $n = 31$ ). This result means that Lederman is the author of interest.

#### Documents by author

Compare the document counts for up to 15 authors.

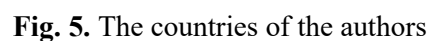


**Fig. 4.** Visualization author using Scopus index data

Figure 5 shows the results for the author's country. The first 10 countries are included. In terms of the number of articles, the United States ( $n = 1132$ ), the United Kingdom ( $n = 227$ ), and Turkey ( $n = 194$ ) are ranked first. In terms of the number of NOS publications ( $n = 63$ ), Indonesia is ranked 9<sup>th</sup>,

## Documents by country or territory

Compare the document counts for up to 15 countries/territories.



The aim of this examination became to behaviour a bibliometric evaluation of research targeted at NOS. For this aim, a complete 2756 research which has been posted on NOS in Scopus journals index

had been analyzed the use of bibliometric evaluation via the Vos Viewer dan Scopus Index records. For the evaluation of the record, the distribution of research in line with years, maximum posted authors, articles of the countries, and collaborations had been considered.

From the overall data obtained and the analysis performed, you can search for new research results on the topic of NOS. Researchers can contribute by linking under-researched topics, countries of publication, different methods, or types of documents for publication. From this study, we can provide data support for further studies that want to use NOS, which can be enriched by combining different parameters in one study. This study supports previous studies on bibliometric analysis using the Web of Science Core Collection database, which covers the scope of the analysis from 1986 to 2019, by performing follow-up (Kurtulus and Bilen, 2021).

## **CONCLUSION AND SUGGESTION**

Based on the above results and discussion, it can be concluded that the development of NOS research in science education continued from 1895 to 2022. Most publications on this topic will have 205 articles in 2020. For the document type, 2048 article documents have been published Starting with the types/types of documents that are frequently published, these are articles, followed by books, chapters, and conference papers. This study collected data on various research topics and their interrelationships by author, country, years of publication and type of document. In this article, we will visualize various references through bibliometric analysis and identify the main themes of each study or scope. According to the results of this study, VOS Viewer revealed nine clusters that characterize the current major research topics in this area.

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