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Disciplinary Identity in the Origins of the Science of Science

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Abstract

This paper explores the disciplinary identity of the Science of Science (SoS) in Poland from its inception in 1918 to 2020. The study analyzes over 9,000 articles from three key Polish SoS journals to assess whether the thematic areas proposed by Maria and Stanisław Ossowski in the 1930s remain relevant for categorizing the field. Our findings indicate that while practical-organizational issues dominated early publications due to the challenges of rebuilding the Polish state, the field has evolved over time, with a growing share of articles addressing more diverse and complex themes. Using large language models for text classification, we demonstrate that 80-90% of the articles fit into the Ossowskis' five thematic categories, though a notable increase in unclassified articles in the 21st century suggests a broadening of SoS beyond its original conceptual framework.

Introduction

The Science of Science (SoS) as an academic discipline has a long and rich history, although for many researchers it remains an invisible part of science. Its origins date back more than 100 years, with the field primarily developing in Eastern Europe. The golden era of SoS occurred in the 1960s and 1970s, both in the East and the West. Contrary to the claims of Wang and Barabási in their book *The Science of Science* (Wang & Barabási, 2021), SoS is not an "emerging interdisciplinary field" driven by big data. Rather, it is part of a long-standing endeavor to study science through the tools of various disciplines, with philosophy, history, and sociology playing key roles. This is evident both in the early Western contributions to SoS, often associated with scholars like Jesmond D. Bernal, and in contemporary approaches to "research on research" or simply "metascience." (Krauss, 2024). The SoS programmatic foundations were rooted not in quantitative studies of science but in cultural, philosophical, and sociological understandings of science and its outcomes.

The aim of this paper is to demonstrate the disciplinary identity of a newly emerging academic discipline in Poland from 1918 to 2020. The year 1918 marks Poland's regaining of independence after 123 years and the founding of the world's first strictly science-of-science journal, *Nauka Polska. Jej Potrzeby, Organizacja i Rozwój* (in short: *Nauka Polska*, English: *Science and Letters in Poland: Their Needs, Organization, and Progress*). This journal continues to be published today, despite a 40-year interruption caused by the Sovietization of Poland's science and

higher education system. During this period, several Polish science-of-science journals were established, with two key ones being *Nauka (Polska)* [(Polish) Science] and *Zagadnienia Naukoznawstwa* [Problems of the Science of Science], both published by the Polish Academy of Sciences. These three journals served as platforms for discussion and publication by key SoS representatives from around the world, including Derek de Solla Price, Jesmond D. Bernal, Vasily Nalimov, and Gennady Dobrov.

To analyze the SoS disciplinary foundations, we use the classification of five areas of SoS presented by Maria and Stanisław Ossowski in the first programmatic article on the science of science. Utilizing large language models (LLMs), we will examine articles from the three aforementioned science-of-science journals from the years 1918 to 2020 to determine whether the classification proposed by the Ossowskis, based on experiences from the first two decades of the discipline's existence (up to 1935), remains useful for categorizing the SoS. For this purpose, we will use 9,272 full-text articles from three SoS journals from the *Corpus of Polish Science of Science Journals* (CPSSJ), which contains over 50,000 articles from 12 Polish science-of-science journals published between 1918 and 2020 (Kulczycki et al., 2023).

Polish origins of science of science

Why did the science of science emerge specifically in Poland in 1910-20s (Cain & Kleeberg, 2024; Kokowski, 2015)? The shortest possible answer is this: a group of Polish scholars, due to objective circumstances, was primarily educated outside the borders of what was then a non-existent Poland on the map of Europe. They participated in international research and discussions on the status and role of science. In terms of understanding what science is, how it should be practiced, and its role, there was nothing particularly unique to explain the emergence and development of the science of science in Poland. What was unique, however, at the turn of the 19th and 20th centuries, was the end of Poland's partition into three parts in 1918 after 123 years of non-independence.

In 1918, the Polish state was being built practically from scratch. There were no structures at the national level. The situation was also similar in science. Universities had already functioned in Poland for many centuries, but they were part of the science systems of the three states: Austro-Hungary, Germany and Russia. As part of the construction of the new structures of the state, work began on the consolidation of science. This challenge of unifying the three partitions and understanding the potential role of science in this task created the historical conditions for proposing the science of science in Poland. Scientists in no other country, who also discussed science and its role, faced the same political, cultural, and societal task as Polish scientists in similar historical circumstances.

In the Polish historiography of the science of science, it is accepted that three science of science programs emerged in Poland: Florian Znaniecki's in 1925, the Ossowskis' in 1935, and Kotarbiński's in 1965. However, it should be clarified that, although Znaniecki is considered a precursor of science of science programs, his foundational text, "Przedmiot i zadania nauki o wiedzy" [The Subject Matter and Tasks of the

Science of Knowledge] from (1925), is more of an encouragement to create a mature program (which the Ossowskis accomplished) than a mature program itself. In this work, Znaniecki first proposed the term "naukoznawstwo" (literally meaning *science connoisseurship* or *science studies*), whose equivalent in Polish is also the term "nauka o nauce" (science of science), proposed a decade later by the Ossowskis in 1935. In contrast, Kotarbiński's approach is best described as an analysis of the philosophical conditions for practicing the science of science.

In 20th-century Polish social sciences, the Ossowskis' name was one of the most prominent and influential. After World War II, both served as professors at the University of Warsaw, fulfilling key academic roles and playing significant social roles in resisting the Stalinization and Sovietization of Polish social and scientific life. A few years before the war, they co-authored a key text crucial to the development of the science of science. Thirty years after the publication of the Ossowskis' work, Bernal referred to their proposal during a congress in Warsaw in 1965, stating that the first use of the term *science of science* in its current sense should be attributed to the Ossowskis (Bernal & Mackay, 1966, p. 9).

Their 1935 article "Science of Science" is regarded as the first comprehensive and most important programmatic work in the field of science of science and we believe that it remains relevant and offers more than just historical value. It is worth noting that the text was available in English in *Organon* a year after its publication, though in limited circulation, later reprinted a couple of times, among others, in English in the 1960s in *Minerva* (Ossowska & Ossowski, 1964), the 1980s in a volume dedicated to the Polish contribution to science of science (Walentynowicz, 1982), and again in 2024 in a collective work on science of science in interwar Poland (Cain & Kleeberg, 2024). Despite these publications, the article is not widely known, even among contemporary scholars of science of science.

Five Areas of Science of Science

Since the publication of the Ossowskis' work, much has been written about science studies and the science of science itself. When re-reading their "Science of Science," it is crucial to remember that their approach—treating science as a social and cultural phenomenon—was far from obvious at the time. In fact, it was quite revolutionary during the 1920s and 1930s. The Ossowskis propose identifying five overlapping areas (as they note) that the science of science should study. They write that three are fundamental groups of science of science problems that would form the backbone of a new branch of science and add two areas of practical issues. According to the Ossowskis, the science of science consists of three fundamental groups of problems concerning *episteme*, the people of science, and the entire sector of science and higher education, along with their institutions. These three areas are:

1. *Philosophy of Science*, which considers, among other things, the concept of science (what it is and what it is not). This represents the epistemological perspective of the science of science.
2. *Psychology of Science*, which studies the mental development of the scientific worker.

3. *Sociology of Science*, which examines science in the context of social life and the entire cultural life. Within the sociology of science, the dependence of scientific development on economic conditions, the structure of a given society, and the organization of education are studied.

Additionally, the science of science encompasses two areas of practical problems:

4. *Practical-Organizational Issues*. The Ossowskis emphasize that research and reflection on these issues have thus far been primarily conducted by institutions dedicated to promoting science, which have applied theoretical results from the previously defined three areas to practical purposes. This area also includes science policy ("social and state policy towards science"). The Ossowskis note that this area deserves to be distinguished due to its practical nature.
5. *Historical Issues*. The study of the history of individual disciplines, the history of the researcher's concepts, and so forth, also has a practical dimension, as earlier mentioned areas or groups can utilize these studies in their work.

Materials and Methods

We analyzed 9,232 texts from three journals published between 1918 and 2020 (the last year included in the CPSSJ). Table 1 presents the quantitative characteristics of the journals' contents. We analyzed only articles published in Polish (the document count also includes editorial pages, tables of contents, announcements, and a few articles published in languages other than Polish).

Table 1. Characteristics of three analyzed journals.

Journal	Years	Documents	Articles
Nauka Polska. Jej Potrzeby Organizacja i Rozwój	1918–1920, 1923, 1925, 1927–1939, 1947, 1992-2020	1,516	1,095
Nauka (Polska)	1954–2020	7,844	6,024
Zagadnienia Naukoznawstwa	1965–2019	2,484	2,113
Total number of documents / articles		11,844	9,232

Each article from the three journals was stored as a text file. The mean text length was 32,785 characters, the median was 25,523 characters, and the 75th percentile was 43,288 characters. The longest article contained more than one million characters (it was a monographic issue on the history of an institution). To limit costs, the length of articles was capped at 80,000 characters. This truncation affected 52 articles, i.e., 5.56% of the texts.

Using the OpenAI platform (https://platform.openai.com), we prompted a Large Language Model, the GPT-4o, for each file using code written in Python. The GPT-4o model is a multilingual generative transformer developed by OpenAI and was released in May 2024. In total, GPT-4o was queried 9,232 times. The prompts for each article were independent of the others, so GPT-4o performed a full-text analysis

each time to assign the best category. The prompt was in Polish, and we asked GPT-4o to classify the article into one of five areas of the science of science indicated by the Ossowskis (as presented in the previous section) or to assign a 'non-classified category', if none of the five categories were appropriate. GPT-4o returned an answer for each article, including the assigned category and a justification. The category was extracted from the GPT-4o response using regular expressions. Both author of the study crosschecked the GPT-4o responses and agreed on the quality of the provided classification.

Results

We have analyzed the complete set of articles from the three journals included in our dataset, as well as the results for each journal separately. Figures 1 and 2 show the classification of articles across years and thematic areas. The highest number of articles was published during the so-called golden age of the Science of Science (SoS), in the 1970s. This peak can be attributed to both global and local factors. Globally, researchers across the world increasingly engaged with SoS themes, driven by Cold War-era research competition. Locally, Poland experienced a period of relative prosperity in the 1970s, which translated into greater availability of paper and the capacity to publish more extensive journal issues.

Figure 2 demonstrates that in the early years (1918–1939), practical-organizational issues dominated SoS publications. This focus was understandable, given the need to rebuild the Polish state and its science and higher education system after regaining independence. Over time, the prominence of this category declined, but it remained a dominant theme throughout the years. The analysis shows that 80-90% of the articles were successfully classified into one of the five categories proposed Ossowskis. However, starting from the 2000s, the percentage of unclassified articles approaches 20%, which may suggest that the conceptual scope of SoS has expanded beyond the original five areas. Confirming this hypothesis will require further, planned analyses.

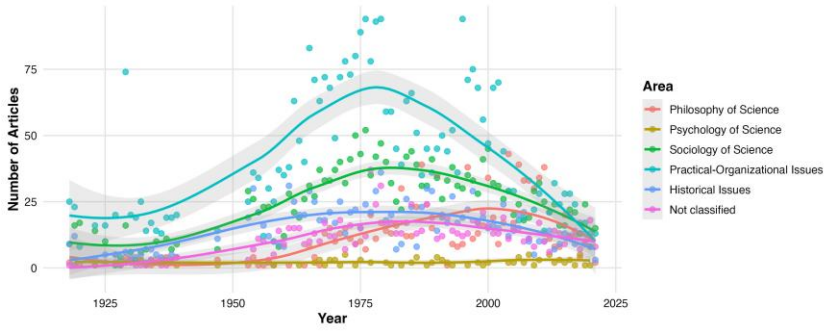

Figure 1. The number of articles per year across areas.

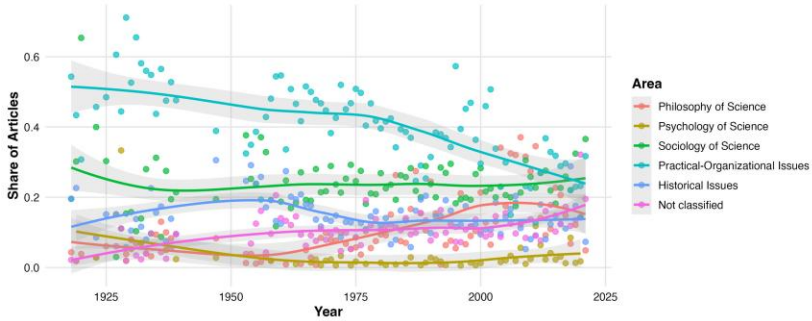

Figure 2. The share of articles across areas and years.

Figures 3 and 4 present the results broken down by individual journals. It is clear that the majority of articles were published in the main Polish Academy of ciences journal, Nauka (Polska), and primarily dealt with practical-organizational matters.

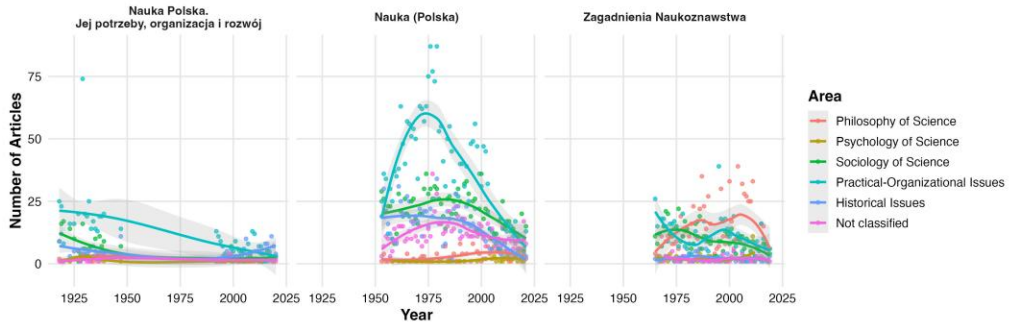

Figure 3. The number of articles per year across areas for each journal separately.

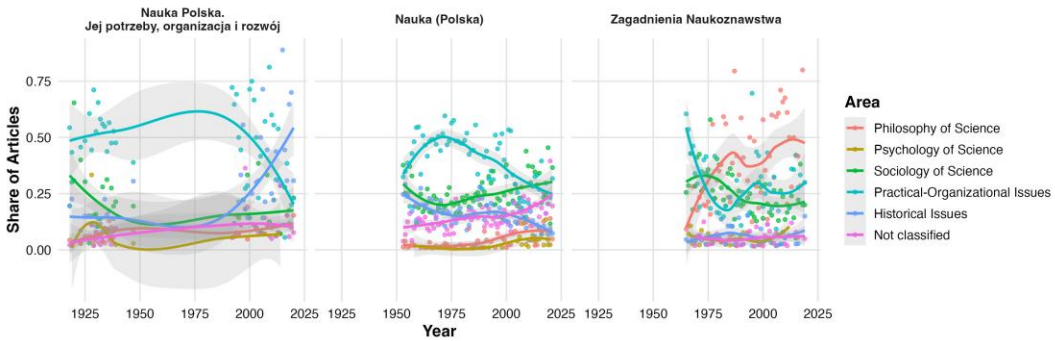

Figure 4. Share of articles across areas and years for each journal separately.

Interestingly, the profile of Zagadnienia Naukoznawstwa appears to be more philosophical-theoretical, aligning not only with the Polish approach to SoS but also with the emerging Soviet SoS, which emphasized a philosophical foundation rather than the sociological perspective more prevalent in the West during the same period (Aronova, 2011).

Conclusion and plans

This study highlights the distinct disciplinary identity and foundations of the SoS in Poland. Unlike the contemporary portrayal of SoS as a data-driven, emerging field, its roots in Poland reveal a well-established tradition that spans over a century. The key themes addressed in Polish SoS reflect both global intellectual trends and local historical circumstances, particularly the need to reconstruct the state and its scientific institutions following Poland's regaining of independence in 1918.

The results of our classification demonstrate that the thematic areas proposed by the Ossowskis remain relevant for understanding the historical trajectory of the science of science (SoS) in Poland. Some topics, particularly those related to the psychology of science, have been fading, even though they were crucial not only for SoS in the early 20th century but also for scientometrics (Godin, 2007). Moreover, the increasing share of unclassified articles in recent years indicates a diversification of approaches within the field. This evolution suggests that contemporary SoS is moving beyond the traditional framework, incorporating new methodologies and perspectives. Further research is needed to explore these developments and assess their implications for the field's future.

Our findings show the importance of recognizing the historical and cultural context in shaping the evolution of academic disciplines. The Polish case offers valuable insights into how SoS has been conceptualized and practiced in different geopolitical settings. Understanding these variations is essential for a more nuanced appreciation of the global history of science studies. The next phase of our research will involve extracting references from footnotes to analyze cited works. This will allow us to assess the extent to which the scientific discourse in Polish SoS journals has been localized, focusing predominantly on Polish authors and issues, versus its engagement with global scholarship. It will also enable an exploration of how this balance has shifted over the past century.

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