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THE TREND OF SOCIOLOGY OF ENGINEERING TECHNOLOGY TOPIC STUDY: A BIBLIOMETRIC ANALYSIS

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Abstract

The field of sociology is interconnected with engineering technology since engineering produces technology that designs societies and institutions. Throughout the study, trends in the sociology of engineering technology were examined. The research method was bibliometric analysis. The data source was 4,716 articles on ScienceDirect. The data were obtained from 2000 and 2023 publications using the keyword "sociology of engineering technology." The 1000 most relevant articles were analysed using an overlay visualization presented by VOSviewer. The data analysis found the highest number of reports was in 2010-2019, but the highest average number per year was in 2020-2023. The latest research topics were built environment, Covid-19, energy justice, ethnography, social science, transition, resilience, machine learning, artificial intelligence, social capital, smart city, creativity, sustainable development goals, transport, energy policy, climate policy, resilience assessment, and flood risk management. The topics of discussion were trends and suggestions for future sociology studies in engineering technology.

Keywords: Bibliometrics, Engineering technology, Sociology, VOSviewer.

1. Introduction

Engineers produce technology and are a social activist who designs societies and institutions suitable to the technology created [1]. The field of sociology is interconnected with technology since changes in technology affect social institutions, organizations, and major institutions such as family, association, and culture [2]. The social paradigm shapes technology. Social change is the function of technological innovation. Technological development is influenced by social context and influences social structure [3]. This change was accelerated by social media.

The latest report discusses some sociology of engineering technology issues. Studies have explored sociological perspectives on the most advanced forms of technology, such as computation [4], information and media [5, 6], digital [7, 8], information and communication [9], genetics [10], or digitalization of military technology [11]. I have also examined the role of technology in social issues such as climate change [12], sociological approaches to the development of biomedical technology [13], the use of technology for social movements [5], the impact of technology on human relations [7, 14], and the impact of technology on state security [11]. Aside from roles and impacts, previous research focused also on technology formation [8]. The sociology of engineering emphasizes agency in producing technologies and engineering activity's social context and substantive content [15]. Previous research shows that the sociology of engineering technology encompasses technology's forms, processes, and impacts on society. Research on the sociology of engineering technology has been reviewed on developing a particular technology [4, 9, 10]. Further research on trend topics needs to be done in studying the sociology of engineering technology. Some reports also showed that the study in the change of social by the existence of technology, such as social media [16-23].

In order to determine the novelty of the research, researchers need to know the trend of previous similar research topics [24]. This study elaborated on the trends in the sociology of engineering technology topic study. The research uses bibliometric analysis to map large quantities of bibliometric data on intellectual structure states and research topic trends [25, 26]. As a result of this study, we present (1) an overview of the topics studied in the sociology of engineering technology, (2) research trends by time and issues, and (3) the suggested topic of the future of the sociology of engineering technology study.

2. Method

The research was utilizing bibliometric analysis. Detailed information for the use of bibliometric is explained in previous studies [27, 28]. The data source is articles published on ScienceDirect. This study selected this website because it presents publication data from the oldest publisher in the world, Elsevier [27]. Then, this study adopted data and research method based on previous literature [29-36]. Search data using the keyword "sociology of engineering technology" in the term criteria. To collect publication data in the social field, publications are limited to the subject areas of "social sciences" and "art and humanities." Based on the keywords and the two fields, 4,716 articles were found between 2000 and 2023. The articles published in 2000-2009, 2010-2019, and 2020-2023 were analysed to get an overview of research topic development in certain year groups [32]. The latest group was less than ten years old because it adjusted to the study time. The

1000 most relevant articles in each year group were analysed [33]. Table 1 shows the sample data.

The VOSviewer edition 1.6.18 software was used to create and visualize bibliometric maps [29]. After that, the data were analysed by co-occurrence analysis between keywords with five-word co-words. Research topic trends are found by analysing an overlay visualization map that presents topic data based on publication time.

Table 1. Sample data.

Period	Number of articles	Number of samples	Number of Keywords	Meet the Threshold
2020-2023	1.331	1.000	3.976	81
2010-2019	2.437	1.000	3.639	80
2000-2009	948	948	2.313	30

3. Results and Discussion

3.1. Research Development in the field of sociology of engineering technology

Figure 1 shows the development of research on the "sociology of engineering technology" in the social sciences and arts and humanities subject area. The highest number of publications was from 2010-2019. The number of articles in last year's group has not shown a significant increasing trend because it has yet to reach ten years. However, if we examine the average number of articles per year in each period group, the highest average number of studies on the "sociology of engineering technology" is in the last four years. The attention of sociologist scientists to other fields of science, such as technology [30] and, conversely, the study of engineering technology using a sociological perspective [5, 7] have increased the number of studies on the topic of sociology of engineering technology."

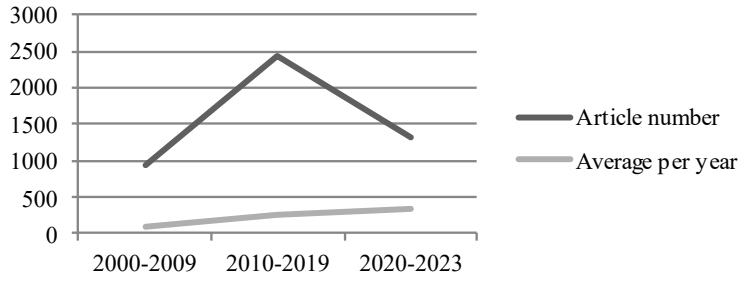

Fig. 1. Level of development of research on the sociology of engineering technology.

3.2. Visualization sociology of engineering technology topic area trend

Table 2 shows some topics that appeared in the 2020-2023 period. Research related to the sociology of engineering technology in three periods based on analysis mapping and visualization is divided into 5-8 clusters.

Table 2. Sociology of engineering technology topic area in three periods.

No.	Period		
	2000-2009	**2010-2019**	**2020-2023**
1	Bibliometric, environmental policy, epistemology, ethics, history, knowledge, uncertainty	Actor-network theory, Canada, complexity, environment, interdisciplinarity, law, models, modernity, multi-level perspective, politics, risk, socio-technical, sustainability, united states, water.	Built environment, Covid-19, energy justice, epistemology, ethics, ethnography, knowledge, qualitative research, risk, science and technology, smart cities, space, sustainability transitions, urban development, urban planning.
2	China, higher education, innovation, post-secondary education, public health, social capital, sustainability	Biotechnology, climate change, energy, energy efficiency, expertise, governance, innovation, interdisciplinary research, science and technology, social science, sociology, standards, synthetic biology, technology adoption, UK.	Collaboration, diversity, energy, energy research, higher education, interdisciplinarity, social sciences, systematic review, teamwork, transition, uncertainty.
3	Culture, globalization, migration, mobility, neoliberalism, politics	Bibliometric, China, engineering, engineering education, ethics, gender, higher education, nanotechnology, renewable energy, social science, STEM, technology, technology transfer.	Artificial intelligent, automation, digital divide, engineering, machine learning, resilience, review, safety, social capital, social media, technology.
4	Canada, gender, internet, science, technology, UK	Content analysis, culture, design, management, measurement, organizational culture, organization, policy, power, research.	Automated vehicle, bibliometric, blockchain, governance, innovation, institutions, research agenda, smart city, social network analysis, sustainable development.
5	Environment, planning, safety	Creativity, disciplines, healthcare, India, internet, media, social media, social network analysis, social networks, urban planning.	Bibliometric analysis, creativity, education, electric vehicles, gender, literature review, STEM, technology adoption.
6		Development, education, interaction, science, society, university.	Agriculture, bibliometric, developing countries, mobility, public transport, sustainability, sustainable development goal, transport.
7		Epistemology, globalization, governmentality, institutions, political economy.	Africa, climate policy, energy efficiency, energy policy, energy transition, social innovation, sociotechnical imaginaries.
8		Entrepreneurship, knowledge, knowledge management, resilience.	Adaptation, China, climate change, communication, flood risk management, resilience assessment, urban resilience.

The topics were built environment, Covid-19, energy justice, ethnography, qualitative research, smart cities, space, sustainability transitions, urban development, collaboration, diversity, energy research, social sciences, systematic review, teamwork, transition, artificial intelligent automation, digital divide, machine learning, automated vehicle, blockchain, research agenda, smart city, social network analysis, sustainable development, electric vehicles, literature review, agriculture, developing countries, climate policy, energy policy, energy transition, social innovation, sociotechnical imaginaries, adaptation, communication, flood risk management, resilience assessment, and urban resilience. Some issues have been studied [4, 9, 4, 10, 12].

VOSviewer provides an overlay visualization that illustrates the topic discussion trend based on the article's publication time [31]. VOSviewer presents data on the latest research topics in bright yellow. Figure 2 shows the latest topics in 2000-2009 bibliometrics, ethics, China, higher education, post-secondary education, mobility, and Neoliberalism. Education was still a new topic in the 2000s. Engineering technology in education was studied in sociology education in the 2010s [32]. Ethics and Neoliberalism were the social science paradigm of technology [3].

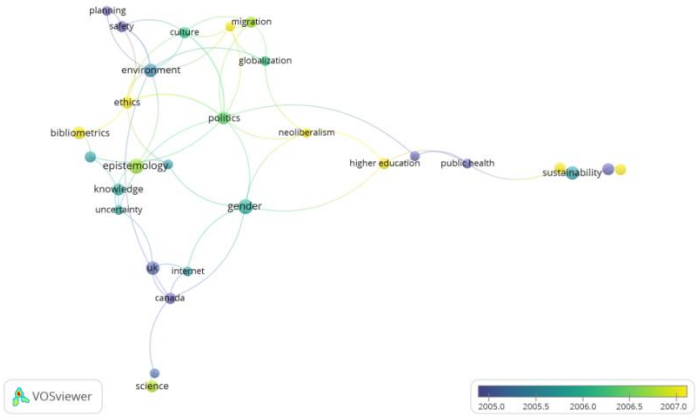

Fig. 2. Overlay visualization in 2000-2009.

Figure 3 shows the latest topics in 2010-2019: interdisciplinarity, law, models, sociotechnical, China, social science, STEM, organizational culture, India, urban planning, political economy, and resilience. Education topics shifted from higher and post-secondary education to science, technology, engineering, and mathematics (STEM) topics. The newest topics in 2000-2009 were not the latest topics in 2010-2019 except for China. STEM research emphasizes the societal context in implementing engineering and technology education [34]. Organizational culture, a topic suggested at the beginning of technological sociology, is still relevant from 2010-2019 [2].

The new topics in the 2020-2023 time period in Fig. 4 were built environment, Covid-19, energy justice, ethnography, social science, transition, resilience, machine learning, artificial intelligence, social capital, smart city, creativity, sustainable development goals, transport, energy policy, climate policy, resilience

assessment, and flood risk management. The newest topic in 2010-2019 and 2020-2023 was social science and resilience. Sociological studies on technology supporting human life during the Covid-19 pandemic have increased [35, 36]. This has been confirmed from previous studies in the transformation in several aspects of life [37-43].

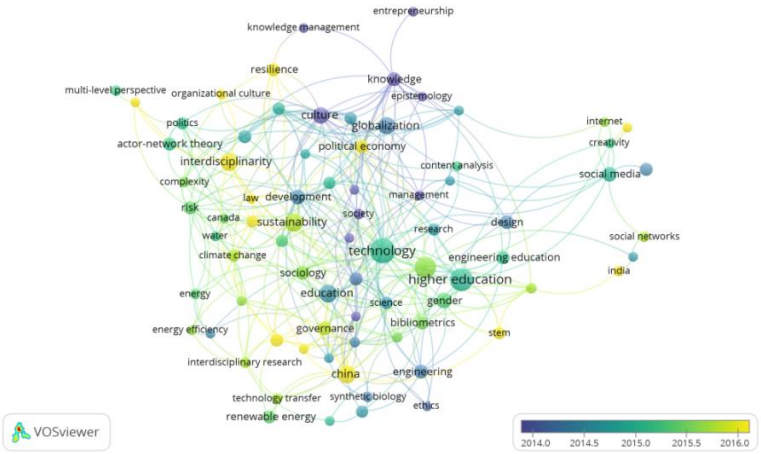

Fig. 3. Overlay visualization in 2010-2019.

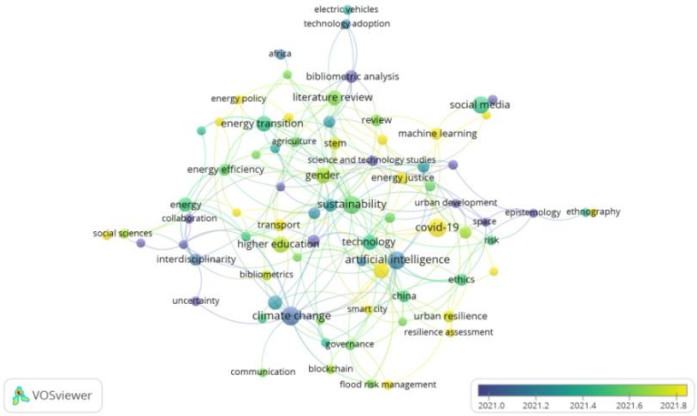

Fig. 4. Overlay visualization in 2020-2023.

Recent topic trends indicate a shift from the methodological side where attention to ethnography exists, and bibliometrics is no longer the current method. Forms of technology such as machine learning and artificial intelligence are the most recent topics in the latest period. Machine learning has been studied [11]. The previous studies did not elaborate on the type of technology suggested [4-11]. Trends from 2000-2023 indicated suggestions for social issues such as energy justice, transition, resilience, social capital, creativity, and sustainable development goals. The updated topics also suggested the study of environmental issues such as the built environment, energy policy, climate policy, resilience assessment, and

flood risk management. The previous study has elaborated on climate issues [12]. This study gives additional data for the use of bibliometric in giving research trend, as discussed in other reports [44-49].

4. Conclusion

The focus of this study was on the sociology of engineering technology topic study of trends in the field. This study conducted a bibliometric analysis using VOSviewer software. The data source was published on ScienceDirect in 2000-2023. The data obtained is based on the keyword "sociology of engineering technology" in terms of criteria in the subject areas "social sciences" and "art and humanities." The data are grouped into three periods to determine research topic trends between periods. The research found the highest number of articles was in 2010-2019, but the highest average number per year was in the 2020-2023 period. Overlay visualization analysis using VOSviewer software found five clusters in the 2000-2009 period and eight clusters in the 2010-2019 and 2020-2023 periods. The latest research trend topics were built environment, Covid-19, energy justice, ethnography, social science, transition, resilience, machine learning, artificial intelligence, social capital, smart city, creativity, sustainable development goals, transport, energy policy, climate policy, resilience assessment, and flood risk management. A trend from 2000-2023 highlighted the ethnographic method, recent technology, and social and environmental issues. Those are topics to investigate in future study.

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