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Socioscientific Issue-Based Decision Making at Elementary School: Bibliometric Analysis

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Abstrak

Pengambilan keputusan merupakan kemampuan yang sangat penting dimiliki oleh individu pada saat ini, terutama dalam memecahkan masalah-masalah sosiosaintifik. Tujuan dari penelitian ini adalah untuk mengetahui tren penelitian mengenai pengambilan keputusan berbasis isu osiosaintifik di sekolah dasar dengan melakukan analisis bibliometrik data bibliografi pada artikel penelitian yang terindeks oleh Google Scholar dengan menggabungkan analisis dalam hal distribusi peta bibliometrik menggunakan aplikasi VOS viewer. Data penelitian diperoleh dari database Google Scholar melalui aplikasi manajemen referensi Publish or Perish. Proses penyaringan data dilakukan berdasarkan kata kunci "decision making and socio-scientific issues" yang terdapat pada topik, judul, kata kunci, dan ranah abstrak. Penelusuran dilakukan terhadap artikel terbitan tahun 2006 hingga 2022. Dari hasil penelusuran diperoleh 23 artikel yang relevan. Hasil penelitian menunjukkan bahwa penelitian pengambilan keputusan berbasis isu osiosaintifik paling banyak dilakukan pada tahun 2010 dan 2014. Penelitian pengambilan keputusan berbasis isu osiosaintifik masih jarang dilakukan di tingkat sekolah dasar. Jadi, dapat disimpulkan bahwa peluang untuk mengembangkan penelitian mengenai pengambilan keputusan berbasis isu sosiosaintifik di jenjang sekolah dasar sangat besar. Oleh karena itu, penelitian ini diharapkan dapat memberikan referensi dan pertimbangan dalam penelitian lebih lanjut, khususnya yang berkaitan dengan pengambilan keputusan berdasarkan isu sosiosaintifikdi sekolah dasar.

Kata kunci*: *Sosiosaintifik Isu, Pengambilan Keputusan, Sekolah Dasar, Analisis Bibluometrik

Abstract

Decision making is a very important ability possessed by individuals at this time, especially in solving socio-scientific issues. The purpose of this study was to analyze research trends regarding socio-scientific issue-based decision making in elementary schools by conducting a bibliometric analysis of bibliographic data on technical research articles indexed by Google Scholar by combining analysis in terms of bibliometric map distribution using VOS viewer software. The research data was obtained from Google Scholar database through the Publish or Perish reference management application. The data filtering process was carried out based on the keywords "decision making and socio-scientific issues" contained in the topic, title, keywords, and abstract domains. The tracing was carried out on articles published from 2006 to 2022. From the search results obtained 23 relevant articles. The results showed that research on decision making based on socio-scientific issues was mostly carried out in 2010 and 2014. Research on decision making based on socio-scientific issues was rarely carried out at the elementary school level. So, it can be concluded that the opportunity for developing research regarding decision-making based on socio-scientific issues at the elementary school level is very large. Therefore, it is hoped that this study can provide references and considerations in seeking further research fields, especially those related to decision-making based on socio-scientific issues in elementary schools.

Keywords: *Socioscientific Issues, Decision Making, Elementary School, Bibliometric Analysis*

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1. INTRODUCTION

Decision making is one of the most important competencies to be mastered by individuals. This is because every day the individual acts out as a decision maker. Decision-making is the ability to choose one alternative from various alternatives based on the results of the analysis of facts or information in solving a problem (Haupt, 2018; Mettas, 2011). Decision-making is a very important ability because every individual is always in a position to make decisions both in their personal lives such as where to live, and what job to choose, and in social matters such as which leader to choose and which team to support. They have many problems to decide in their daily life and their daily life is shaped by decisions made by themselves or others (Baysal, 2009; Uzonwanne, 2016).

The indicators of decision-making in this study are in accordance with those proposed by previous study namely: a) analyzing the causes of problems from various factors; b) identifying the impact of the problem; c) identifying alternative decisions to solve problems; d) make decisions to solve problems; e) giving reasons for choosing a decision; f) predict the impact of decision-making actions in real contexts; and g) provide an assessment of the strengths and weaknesses of the resulting decisions (Woolever & Scott, 1988).

Decision making can occur in personal contexts such as choosing which clothes to wear, choosing a seat in class, choosing what food to buy, making friends with anyone, where to go to school, what major to take, and decision making in a social context, such as who will be chosen to be the class leader or head of the study group, and how it interacts with the environment (Baysal, 2009; Rahayu et al., 2019). As a result, it is one of the most important life skills and decisions made on the spot, on time, accurate and appropriate will lead to positive changes in the individual life and wrong decisions will affect the life of the individual negatively (Gati & Kulcsár, 2021; Tatlilioğlu, 2014).

On social context and human interaction with the environment the importance of decision making at this time is due to challenges on a local, national and global scale regarding socio-scientific issues faced by society today, which are increasingly complex, so they need to be understood and resolved (DeBoer, 2011; Mambrey et al., 2020). Decision making as part of the problem solving process greatly determines the quality of problem solving because it is closely related to the ability to think creatively to produce the necessary alternatives and think critically to evaluate these alternatives and the decision-making process does not end with the decision being made but the need to think about how to apply the decision to solve the problem (Baysal, 2009; Yurtseven et al., 2021). Based on this, practicing decision-making based on socio-scientific issues can already be implemented from elementary school age (Bacanlÿ, 2011; Kaşkaya & Calp, 2017; Öncül, 2013).

Socioscientific issues include the conceptual relationship between science, technology, and society. This will be sufficient to create effective learning and conceptualize learning contexts that allow students to engage in discussion, critical thinking, and decision-making processes (Klosterman & Sadler, 2010; Ottander & Simon, 2021). Besides that students' understanding of socioscientific issues allows them to make more informed decisions about real-life problems and social dilemmas and it is important for them to be aware of them (Hastürk & Ökkeşoğulları, 2021; Yerdelen et al., 2018).

Currently, the development of research trends in decision making based on socio-scientific issues can be analyzed using several techniques. Bibliometrics is a research data analysis method through the analysis of article publications in several sources at a certain time period. Research using bibliometric analysis has been carried out, especially regarding decision making and socio-scientific issues. However, the research analysis is still separate, such as the bibliometric mapping of decision-making criteria (Yu et al., 2018), bibliometric mapping of socio-scientific issues on physics learning (Arika et al., 2021; Deta et al., 2021), and bibliometric mapping on general socio-scientific issues (Evren Yapicioğlu, 2020).

Based on these statements, researches on bibliometric analysis of socio-scientific issues-based decision making in elementary schools have not been widely carried out, especially to describe research developments using the VOSviewer application. Therefore, this study aims to map bibliometric analysis of articles on socio-scientific issues-based decision making sourced from Google Scholar using VOSviewer software. This study can be used as a reference for conducting and determining future research themes, especially those related to socio-scientific issues-based decision-making in elementary schools. The novelty of this research specifically explores decision approaches based on socioscientific issues in elementary schools. This can be considered as a significant contribution in the field of education and learning.

2. METHODS

The bibliometric analysis method is a method that has the aim of reviewing literature, namely exploring, evaluating and examining a number of scientific data on a research theme (Arika et al., 2021; Dede & Ozdemir, 2022; Nandiyanto et al., 2021). In this research, bibliometric analysis was carried out by analyzing article data based on research from publications published in journals indexed by Google Scholar. Data collection was carried out using a management reference application, namely Publish or Perish. This software is used to conduct a literature review of socio-scientific issue-based decision making. The keywords used in data collection are decision making and socio-scientific issues. The articles used were published from 2006 to 2022 with data obtained in December 2022. The collected articles were then exported into two file types: research information system (.ris) and comma separated value format (*.csv). VOSviewer is intended for visualizing and evaluating trends using bibliometric maps. Used to describe 3 variations of mapping publications, consisting of network visualization, density visualization, and network-based overlay visualization (co-citation) between existing items.

3. RESULTS AND DISCUSSION

Results

Publication Data Search Results

Research data regarding decision-making based on socio-scientific issues was collected through the application of Publish or Perish. The Google scholar database was used as the data source. As the results, it was obtained 33 articles on decision-making based on socio-scientific issues. The metadata data from the articles obtained consisted of article citations, author names, article titles, years of publication, article sources, journal publishers, and article URLs. Publication data were analyzed using VOSviewer and shown in Table 1.

Table 1. Publication Data of Socio-Scientific Issues (SSI)-based Decision Making

No	Authors	Title	Year	Cites	Refs
1	R Khishfe	Nature of science and decision making on socioscientific issues	2006	2	(Khishfe, 2022)
2	S Eggert, S Bögeholz	Students' use of decision-making strategies with regard to socioscientific issues: An application of the Rasch partial credit model	2010	204	(Eggert & Bögeholz, 2010)
3	Hs Chang, Hj Lee	College students' decision-making tendencies in the context of socioscientific issues (SSI)	2010	53	(Chang & Lee, 2010)
4	Ma Guimarães, Wlp Carvalho…	Moral reasoning in decision-making regarding socioscientific issues: the human genetic improvement example	2010	0	(Guimarães et al., 2010)
5	V Dawson, K Carson, G Venville	Argumentation, decision-making and socioscientific issues	2010	1	(Dawson, 2018)

No	Authors	Title	Year	Cites	Refs
6	Sa Yoon	Using social network graphs as visualization tools to influence peer selection decision-making strategies to access information about complex socioscientific issues	2011	77	(Yoon, 2011)
7	F Böttcher, A Meisert	Effects of direct and indirect instruction on fostering decision-making competence in socioscientific issues	2013	70	(Böttcher & Meisert, 2013)
8	I Ju, H Lee	Patterns of middle school students' value-judgement and decision-making on biotechnology-related socioscientific issues	2013	5	(Ju & Lee, 2013)
9	M Kim, R Anthony, D Blades	Decision making through dialogue: A case study of analyzing preservice teachers' argumentation on socioscientific issues	2014	54	(H. Kim & Lim, 2014)
10	M Sakschewski, S Eggert, S Schneider…	Students' Socioscientific Reasoning and Decision-making on Energy-related Issues—Development of a measurement instrument	2014	76	(Sakschewski et al., 2014)
11	Kj Farrant	Teaching socioscientific issues and ethical decision-making: a self-study: a thesis presented in partial fulfilment of the requirements for the degree of Doctor of …	2014	1	(Farrant, 2014)
12	H Kim, H Lim	Elementary science gifted students' perceptions of decision-making activities on socioscientific issues	2014	7	(M. Kim et al., 2014)
13	M Kim	The Complexity of Scientific Knowledge on Socioscientific Issues: A Study of Students' Decision Making on Local Issues in Western Canada	2015	0	(M. Kim, 2015)
14	B Steffen, C Hößle	Assessment of decision-making in socioscientific issues by teachers: Negating one's own abilities or mastering a challenge?	2015	0	(Steffen & Hößle, 2015)
15	U Bossér, M Lindahl	Positioning students as participants in discussions and decision-making on socioscientific issues (SSI)	2016	0	(Bossér & Lindahl, 2016)

No	Authors	Title	Year	Cites	Refs
16	K Emery, D Harlow, A Whitmer…	Compelling evidence: An influence on middle school students' accounts that may impact decision-making about socioscientific issues	2016	26	(Emery et al., 2016)
17	Hp Rizal, P Siahaan, G Yuliani	Implementation of socioscientific issues instruction to fostering students' decision making based gender on environmental pollution	2017	8	(Rizal et al., 2019)
18	Hp Rizal, G Yuliani, P Siahaan	The relationship of science knowledge and decision-making based on gender on socioscientific issues	2019	1	(Rizal et al., 2017)
19	U Betul Cebesoy, Sn Chang Rundgren	Embracing socioscientific issues-based teaching and decision-making in teacher professional development	2021	5	(Cebesoy, 2021)
20	L Ladachart, L Ladachart	Preservice biology teachers' decision-making and informal reasoning about culture-based socioscientific issues	2021	8	(Ladachart & Ladachart, 2021)
21	Y Zhu, A He	The effects of a collaborative argumentation intervention on Chinese students' socioscientific issues decision-making	2022	0	(Zhu & He, 2022)
22	Ws Frhod, Aa Abdulwahed	Knowledge management processes and their relationship to decision-making in socioscientific issues for secondary school biology teachers	2022	0	(Frhod & Abdulwahed, 2022)
23	J Mun, M Kim, Sw Kim	How Seventh-Grade Students Experience the Complexity of Socioscientific Issues Through Decision Making on the Autonomous Vehicle Issue	2022	0	(Mun et al., 2022)

Based Table 1 show the results of the analysis of each article, only 23 articles were used for analysis in this study. Based on the results of the analysis, the number of article citations is 604. The number of citations per year is 16, the number of citations per article is 17.6, the average number of authors in the articles used is 2, and all articles have an average h-index of 6, and g -index is 23.

The Development of Research in the Field Of SSI- Based Decision Making

Based on the analysis of research data regarding decision-making based on socio-scientific issues, it was obtained data that the development of research on this topic is show in Table 2.

Table 2. Development of Research in the Field of SSI-Based Decision Making

Year of Publications	Number of Publications
2006	1
2010	4
2011	1
2013	2
2014	4
2015	2
2016	2
2017	1
2019	1
2021	2
2022	3

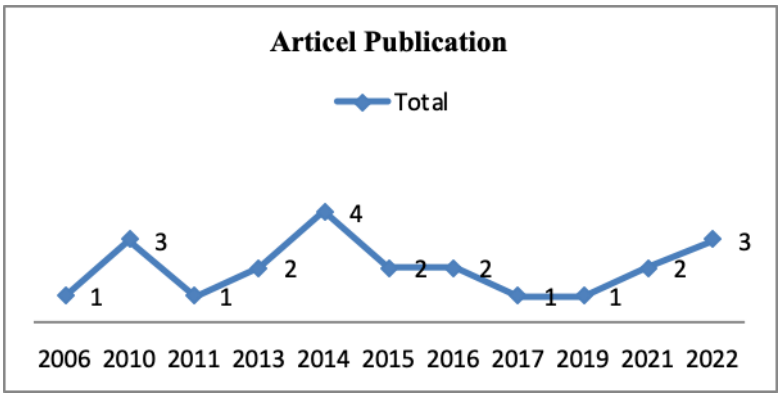
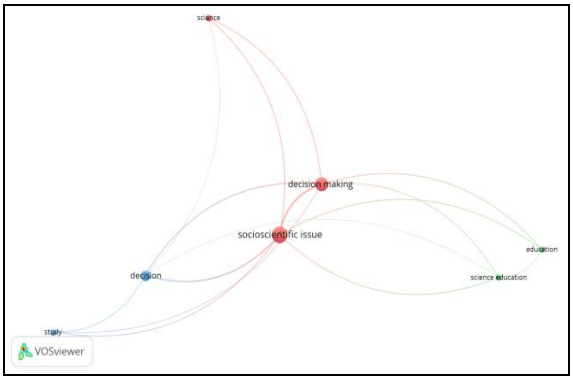


Figure 1. Development of Articles Publication of SSI-based Decision Making

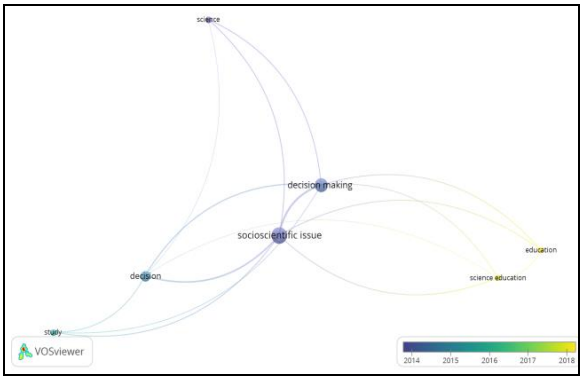
Based on the data in Table 2 and Figure 1, the development of research regarding SSI-based decision making had increased and decreased in the time span from 2006-2022. Most research on this topic was conducted in 2010 and 2014 with four studies each.

Visualization of topic area of SSI-based decision making using VOSviewer

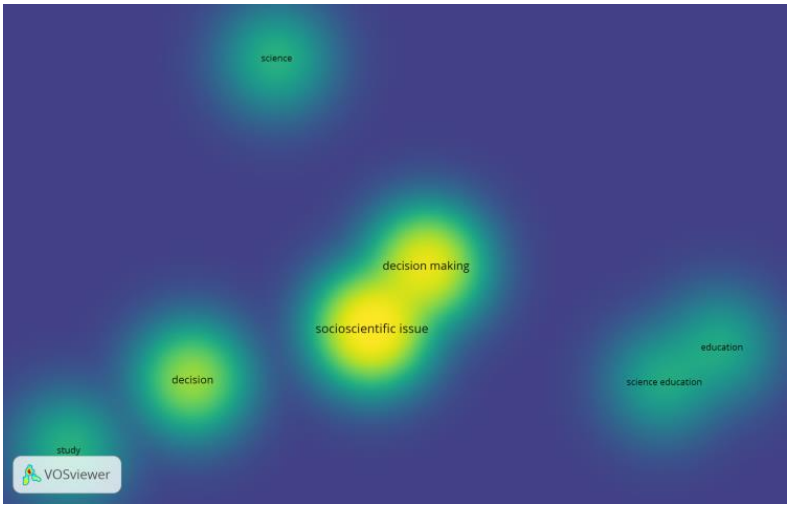
The topics regarding SSI-based decision making were analyzed using computational mapping. In this study, it used VOS viewer. The results showed that through computational mapping, 7 items were found. The items were divided into 3 clusters. The first cluster is decision making, science, and socio-scientific issues. The second cluster consists of two items, namely education and science education. And the third cluster consists of two items, namely decision and study. The appearance of computational mapping using VOS viewer is show in Figure 2.



(a) Network Visualization



(b) Overlay Visualization



(c) Density Visualization

Figure 2. Visualization of SSI-Based Decision Making

Mapping visualization in this study was analyzed through 3 schemes, namely network visualization, overlay visualization, and density visualization. The relationship between terms visualized in the form of a network or line originated from one term to another. As can be seen from Figure 2(a), there are circles that have different colors, circle sizes and labels that are connected to each other by a line. The size of the labeled circle shows a positive correlation with the appearance of the term in the title and abstract. The density visualization shown in Figure 2(b) shows that research related to SSI-based decision making was mostly carried out in 2014. Meanwhile, the density visualization shown in Figure 2(c) explains that the more yellow the color is applied, the more research has been carried out, and conversely if the yellow color is dark or fades and blends into the background, it means that research on the topic is scarce. dapat diperoleh data bahwa penelitian mengenai pengambilan keputusan pada bidang pendidikan khusunya di sekolah dasar masih jarang dilakukan dan dapat menjadi peluang penelitian lanjutan mengenai pengambilan keputusan berbasis isu sosiosaintifik. Based on this, it was obtained the data that research on decision-making in the field of education, especially in elementary schools, is still rarely carried out and can be an opportunity for further research on SSI-based decision making.

Discussion

Based on the results of the analysis of research trends on decision-making and socioscientific issues, interesting findings were found where the results of the research analyzed in this study showed that there was not too much research on decision-making in

general or not yet specific contexts. Whereas in reality there are several models in decision making such as rational, intuitive, dependent, and avoidance decision making (Yu et al., 2018; Yurtseven et al., 2021).

Research on socio-scientific issue-based decision making with various decision-making models is very important in the context of sustainable education and solving social problems caused by developments in science and technology which are increasingly complex every day (Arika et al., 2021; Deta et al., 2021). Apart from that, the results of decision making will have a greater impact on various aspects of life, one of which is in the field of education. Therefore, research opportunities regarding socioscientific issue-based decision making in a more specific context using decision-making models are very open in research in the field of education.

The socioscientific issue paradigm as a result of the study analysis in this research found that socioscientific issues are still widely studied in the field of science, so socioscientific issues are rarely studied in the social field. Meanwhile, according to previous study is very important to integrate socioscientific issues in the social field because socioscientific issues are social problems related to science, technology, and society. as a result of developments in science and technology (Yerdelen et al., 2018).

It is important to study socioscientific issues in a social context because if done so, it will contribute to a better understanding of socioscientific issues. Apart from that, there are several other reasons, namely 1) there will be an understanding of in-depth social problems such as the causes, impacts and factors that influence these problems; 2) there will be an understanding of the social changes that occur and how to adapt to the social changes that occur; 3) innovative alternative solutions will be created to overcome socioscientific issues; 4) research results can be used in developing policies for better community development (Cebesoy, 2021; Farrant, 2014). Therefore, opportunities for further research regarding socioscientific issues in a social context are very open and very necessary to be carried out.

Decision making and socioscientific issues resulting from the analysis in this research are still rarely carried out at the elementary school level. Meanwhile, socioscientific issues are issues that are present in students' daily lives or can be interpreted as concrete learning resources and this is very appropriate to the cognitive development of elementary school students who are still in the concrete operational phase (Nuangchalerm, 2010; Rahayu et al., 2019). This is a good opportunity for further research on decision making and socioscientific issues at the elementary school level.

Apart from that, the importance of research regarding socio-scientific issue-based decision making in elementary schools is as an effort to prepare future generations to be able to overcome social problems resulting from more complex developments in science and technology. Several benefits will be obtained from research that studies decision making based on socio-scientific issues in elementary schools, namely 1) a holistic education will be created where students' understanding of problems will be understood in depth, meaning that social problems are caused by various factors, including economics, science and technology; 2) will train creative and critical thinking skills for elementary school students; 3) students will become active citizens in responding to social problems caused by developments in science and technology; and 4) train students to make decisions from various alternative solutions created by students so that they will be better prepared for more complex problems in the future (Steffen & Hößle, 2015; Tatlilioğlu, 2014).

However, of course there will be several challenges in implementing research on decision making based on socioscientific issues in elementary schools, including 1) curriculum and learning, meaning that there needs to be a good understanding of the curriculum so that the implementation of decision making based on socioscientific issues can be in accordance with competencies and materials that are in accordance with the curriculum.

those used in elementary schools; 2) teacher competency, meaning that in training decision-making abilities based on socio-scientific issues, teachers are needed who have competencies in line with 21st century learning; 3) involvement of students' parents, meaning that there is a need for good communication between educators, parents and the community because learning in training decision making based on socioscientific issues will be very closely related to students' daily lives; and 4) social and cultural context, meaning that learning by practicing decision making based on socioscientific issues must take into account social and cultural differences in local communities (Rizal et al., 2017; Sakschewski et al., 2014). However, with the various challenges that exist, implementing decision making based on socioscientific issues in elementary schools is a good thing to prepare elementary school students as a good generation in the future.

If research on decision making and socioscientific issues is to be carried out in the field of education, apart from only studying the perceptions of educators and students regarding decision making and socioscientific issues as well as studying student profiles regarding decision making and socioscientific issues, in fact apart from studying these things, research can be conducted that focuses on studying optimizing decision making based on socioscientific issues using strategies, approaches, teaching materials and innovative learning models because these factors can influence students' decision making abilities. Studies related to SSI-based decision making were minimally carried out at the elementary school level so that it would be a great opportunity to carry out research on this matter in elementary schools.

The limitation of this study is that bibliometric analysis was only conducted on research with the keywords 'decision making and socio-scientific issues'. The technical research data used in the bibliometric analysis is limited to studies published in journals and proceedings and indexed by Google Scholar. For further studies, we will analyze research data on SSI-based decision making more broadly without focusing on the Google Scholar database, for example using the Scopus, Web of Science, and CrossRef databases

4. CONCLUSION

This study aims to determine research trends regarding socio-scientific issues (SSI)-based decision making in elementary schools by conducting a bibliometric analysis of bibliographic data of research articles on SSI-based decision making indexed by Google Scholar by combining analysis in terms of the distribution of bibliometric maps using VOSviewer software. Publish or perish is a reference management application used to collect data in this study. The data obtained is the result of filtering based on the keywords of "decision making and socio-scientific issues". The bibliographical data used in this research concerns topic areas, titles, keywords, and abstracts. From the search results, 23 relevant articles were published from 2006 to 2022. The results showed that the studies on SSI-based decision making were mostly carried out in 2010 and 2014.

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