

Research Trend of Socio-Scientific Issues on Chemical Kinetic Materials: Literature Review

Radjawali Usman Rery¹, Tri Padila Rahmasari²

¹ Universitas Riau, Pekanbaru, Indonesia; r.usman@lecturer.unri.ac.id

² Universitas Riau, Pekanbaru, Indonesia; tri.padila6985@grad.unri.ac.id

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ABSTRACT

An individual's success in the 21st century can be measured by their ability to utilise knowledge to enhance their personal qualities. This development can be initiated by enhancing fundamental scientific knowledge. The objective of this study is to examine the correlation between research advancements and socioscientific difficulties in the field of chemistry, with the purpose of aiding advanced researchers in identifying new cutting-edge research topics. This literature evaluation includes 20 selected articles based on specific inclusion criteria: 1) past five years (2018-2020). 2) accredited by SINTA and indexed at Scopus. 3) Research opportunities in Indonesia 4) Keyword: Journal on socio-scientific issues and reaction rates. Academic journals can be discovered by utilising the search engine "Publish or Perish." The Socio Scientific Issue (SSI) technique is predominantly used to assess science literature among secondary students. The content of socio-scientific concerns reveals minimum controversion of alcohol associated with the reaction order idea. Delivering this issue will add information and modify the behavior of students in response to the spread of the issue. The outcome of this study may be utilised as a review of the study. The measuring component still minimalizes done is awariness of environment as the result of the SSI approach.

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Corresponding Author:

Radjawali Usman Rery

Universitas Riau, Pekanbaru, Indonesia; r.usman@lecturer.unri.ac.id

1. INTRODUCTION

Chemistry, as a constituent of the scientific field, plays a crucial role in the functioning of life. Certain scientific discoveries have the potential to significantly impact the overall well-being and standard of living for humans (Rubini et al., 2019a). In the developing world, the 21st century does not solely revolve around globalisation, but also encompasses the spectrum of internationalisation. Information technology can sometimes have negative effects on technology consumers (Amahoroe et al., 2020). There is a wealth of information available that focuses on debunking false information and provides technological tools to enhance literacy in this era of globalisation. An individual possessing strong analytical skills, innovative thinking, advanced reading, and problem-solving abilities is well-prepared to thrive in the 21st century. Increasing one's knowledge tends to reduce one's inclination to trust in unfounded news or conspiracy theories (Fitria & Tondok, 2022). The success of the 21st century can be measured by the extent to which

individuals are capable of utilising information to enhance their own quality. Enhancing this skill can be initiated by acquiring a solid foundation in fundamental scientific information. One area of competency that requires improvement is science literacy. Science literacy refers to an individual's ability to effectively apply their knowledge in order to find solutions that are related to science and technology in everyday life (Rubini et al., 2019).

In recent years, there has been a growing focus on the topic of science literacy. Given the global measurement of science literacy through PISA and TIMSS, it is imperative for educational studies to be adequately equipped in this area. The recent PISA research conducted over the past four years has revealed the inadequate scientific literacy skills of Indonesian students. This scenario can be substantiated qualitatively by the fact that it obtained a rating of 70 out of 78 countries in the study conducted by Schleicher in 2019. The TIMSS assessment serves as a reference for evaluating proficiency in scientific inquiry. The data collected from 2012 to 2015 indicates a significant decline in Indonesia's impact over the years (Hadi & Novaliyosi, 2013).

Some articles give improvement strategies for science literacy through the presentation of socioscientific issues. (Uzpen & Houseal, 2019; I. D. Rahayu et al., 2022; Fadly et al., 2022; Zeidler et al., 2019; Yani & Afrianis, 2022; Pratiwi et al., 2016). Previous studies identify that socio-scientific issues influences toward out of learning that is students who have identify ability, evaluate, analyze, problem synthesize in order to give the decision based on science concept application. Finding the result from socioscientific issues application in teaching and learning process various such as science literacy improvement (Puwarni et al., 2018; S. Rahayu, 2019), critical thinking ability (Mahanani et al., 2019; Pratiwi et al., 2016), environmental awareness (Susilawati et al., 2021) and ability to make the decision (Dawson & Eilam, 2022).

The teacher plays a crucial role in determining the success of the teaching and learning process while presenting scientific subjects. A training session conducted in Europe by Levinson (2018) targeted pre-service teachers specialising in scientific education. The outcome of this training is the creation of instructional materials focused on the presentation of socioscientific themes. A proficient science educator facilitates the selection of a topic based on the characteristics of socioscientific challenges (Levinson, 2018). This article presents the findings of a literature study on the presentation of socioscientific content in chemical kinetic materials. This literature is anticipated to serve as a reference for teachers in effectively presenting scientific concepts during lessons, hence enhancing students' science literacy skills.

Socioscientific issues is a discussion of issues related to scientific issues in life that require scientific solutions based on student knowledge. The reaction rate material contains several explanations related to environmental issues, such as the controversy over the use of carbide for fruit ripening related to the catalyst factor, and the prohibition on consuming alcohol related to the calculation of the reaction order.

So far, no research has been conducted to see the development of research on socioscientific issues. Socioscientific research in the form of applying learning models, developing modules and also student worksheets has been carried out a lot (Puwarni et al., 2018; I. D. Rahayu et al., 2022) as a reference for advanced researchers in finding innovative research topics, of course, an analytical study is needed regarding the distribution of the research issues in question. In this study, an analysis was carried out on research based on socioscientific issues that had been carried out so far. Research questions in this study include: 1) what is the socioscientific content that has so far been carried out in educational research? 2) what content is presented on socioscientific research issues? 3) what is the most capacity building focuses on implementing socioscientific issues?.

2. METHODS

The research method uses a literature review or library study. The data presented is in the form of secondary data obtained through the Publish of Perish 8 search engine with the keywords socioscientific inquiry-based learning, socioscientific issues, reaction rates, and chemical kinetics. The total journals analyzed in this article are 20 journals that found in the predetermined inclusion criteria. The inclusion criteria for the journals analyzed are: (1) the timeframe for publication of journals in the last 5 years (2018-

2022); (2) use both Indonesian and English; (3) in the form of articles indexed by Scopus or SINTA and open access; (4) discusses scientific issues in chemical kinetics material.

Articles obtained according to predetermined inclusion criteria were then analyzed based on several specifications set by the researchers including research content, research materials, and research methods. The data obtained is then tabulated into tables and diagrams to facilitate analysis and drawing conclusions in order to find solutions from the research conducted. Tabulation of data into tables was carried out by researchers after reading the abstracts of each article. After data reduction, the researcher then coded the data found so that conclusions were obtained in the form of numbers and descriptions carried out through in-depth analysis.

3. FINDINGS AND DISCUSSION

3.1 Socioscientific Issues (SSIs)

Today, the world is faced with various global problems. The role of science as a science that is closely related to life is needed. But currently, science does not have a role in creating curiosity and participation of the younger generation in world life. This irony provides a knowledge that science is the key to understanding and finding solutions to face future challenges (Rundgren & Chang Rundgren, 2018).

SSI-based education aims to achieve functional scientific literacy by producing students who can analyze, synthesize, evaluate and make the right decisions (Zeidler et al., 2019). This provides a necessity for the application of SSI in science learning, while the essence of SSI itself is not only to teach science concepts but more broadly to see the influence of science-based decision making on the student's environment, improve students' argumentation abilities, and ethical sensitivity (Zeidler et al., 2019; Tidemand & Nielsen, 2017).

Presentation of socioscientific issues includes issues, problems, questions, dilemmas that can trigger students' ability to make decisions about a problem (Tidemand & Nielsen, 2017). The problems presented are problems that are currently being hotly discussed and demand solutions accompanied by scientific thinking and linkages with scientific concepts (Chen & Xiao, 2021). Beside related to scientific concepts, the issues presented must also have a relationship with ethics and morals (Dalaila et al., 2022).

In the recent decade, teacher arranged their learning using a curriculum based on issues. Socioscientific issues based on the 4-pillars model (Eilks et al., 2018) that explained in Table 1.

Table 1. The 4-pillars model of SSIs

Objectives	Criteria for selecting issues and approach	Methods	Structure of lesson plans
Education through science	Authenticity	Authentic media	Textual approach and problem analysis
Scientific literacy	Relevance	Student-oriented learning and laboratory work	Clarifying science background
Promotion of evaluation skills	Evaluation undetermined in a socio-scientific respect	Learner-centered instruction and cooperative learning	Resuming the socioscientific dimension
Promotion of communication skills	Allows for open discussion	Methods structuring controversial debating	Discussing and evaluating different points of view
Learning science	Deals with questions from science and technology	Methods provoking the explication of individual opinions	Meta-reflection

The author reduces data on 20 journals that discussed the SSI approach. Since 2018, the tendency of SSI research to be carried out is related to increasing scientific literacy skills,

argumentation/explanation abilities, higher-order thinking, and environmental awareness. Research trends regarding SSI discussion over the last 5 years are presented in Table 2.

Table 2. SSI Research Data for the Last 5 Years

No	Reference	Material	Approach	Y	Subject
1.	(Purwaningrum & Fauziah, 2021) – R&D	Global warming	Model Inquiry with SSI approach	<i>Scientific reasoning</i>	Natural science of Junior High School
2	(Mudawamah, 2020) – R&D	Environmental pollution	Scientific approach-based SSI	Learning outcome Science literature	Natural Science of Junior High School
3	(Winarni et al., 2022) – Survey Research	Natural science material	SSI approach	-	University
4	(Sunarti & Nurul Fadilah, 2019)	Environmental Pollution	PBL model-based SSI	Critical thinking ability	Natural science of Junior High School
5	(Siska et al., 2020)(S. Rahayu, 2019)	Biology material	SSI approach	Scientific argumentative	Biology
6	(S. Rahayu, 2019) – exploration	Chemistry material	SSI approach	Science literature and transferable ability	Senior High School chemistry
7	(Purwani et al., 2018)	Biodiversity	SSI approach	Science literature	Senior High School
8	(Sa'adah et al., 2022)	Global warming	SSI approach	Critical thinking ability	Senior High School
9	(Septidiani et al., 2018)	-	<i>Guided Inquiry</i> and SSI approach	Science literature	Junior High School
10	(Salim & Prasetyo, 2018)	-	STEM based SSI	Science literature	Junior High School
11	(Handayani & Hastuti, 2018)	Global warming	SSI approach	Environmental literature	Junior High School
12	(Nurlatifah et al., 2018)	Reaction rate	Learning Cycle 7E and SSI approach	Argumentative ability	Junior High School
13	(Saija et al., 2022)	Thermochemistry & reaction rate	SSI with strategy OE3C	Science literature	Senior High School
14	(Mahanani et al., 2019)	Reaction rate	Inquiry context SSI	Scientific explanation	Senior High School
15	(Susilawati et al., 2021)	-	SSI approach	Environmental awerness	University
16	(Dalaila et al., 2022)	System immune	SSI Modul	Science Literature	Senior High School
17	(Khasanah & Setiawan, 2022)	Addictive substace	E-LKPD SSI	Science Literature	Senior High School
18	(Rubini et al., 2019b)	Global warming	PBL context SSI	Science Literature	Senior High School
19	(I. D. Rahayu et al., 2022)	Fuel/crude oil	SSI approach	Science Literature	Senior High School
20	(Yani & Afrianis, 2022)	Reaction rate	SSI approach	Science Literature	Senior High School

Based on the research trend in the last 5 years, the aspects measured by the SSI approach are presented in Figure 1.

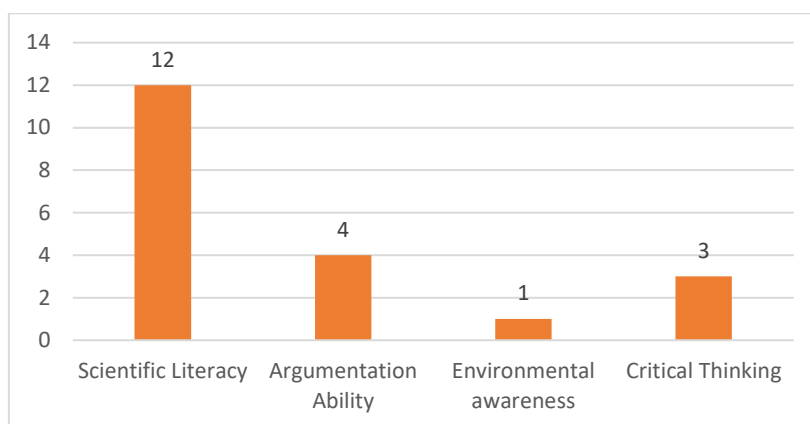


Figure 1. Measurement Aspects in SSI Approach Research

Most studies measure scientific literacy science because the presentation of challenges in SSI demands students to explore relevant publications and sources to discover solutions that will be put forward at the end of the learning meeting. Researchers believe that the importance of measuring scientific literacy based on measuring parts of PISA literacy ability. PISA as one of the benchmarks for international measuring once every 4 years shows that the scientific literacy abilities of Indonesian students are remained in the poor category. This is what causes academics to assume that scientific literacy is a crucial feature to measure its performance. So far the study on the SSI approach has yielded outcomes that can promote scientific literacy, but has not yet reached the high category.

Related to the importance of scientific literacy which aims to improve students' life skills such as the ability to argue. The SSI approach is also considered to be able to improve this skill through the ability to express and synthesize information related to the issues presented. One of the reasons for the importance of this skill is because students consider that learning chemistry is not important to talk about because it does not have a direct effect on life. (Nurlatifah et al. 2018). So, a presentation of learning that can deliver new understanding to students that their role as students has benefits for life is needed.

Not only that, critical thinking ability is also a measurement aspect in the SSI approach research. This is supported by the low critical thinking ability of students at school. Previous research stated that one of the causes of this low ability was the lack of activities to analyze information in the learning process. So far learning in schools only requires an understanding of the material that students can do by rote memorization. The essence of the material being taught has not been considered important, this can be overcome with the SSI approach which demands more synthesis and evaluation of articles that can help find solutions to issues. Indirectly, information search and synthesis activities can improve students' critical thinking ability.

One of the characteristics of the issues presented in the SSI is an environmental issue. Presentation of this issue will raise awareness of students as part of an environment or society that must participate in protecting it. This is included in one ability, namely environmental awareness or environmental awareness. However, measurements related to environmental awareness are still minimal for researchers in Indonesia to carry out. This can be a recommendation for future researchers in implementing the SSI approach. The issues presented in the SSI approach relate directly to the environment.

3.2 Synthesis of SSI content on Chemical Kinetics material

There are 4 articles in this study that are used as the main article per the content of the discussion, namely SSI in chemical kinetics material.

Table 3. Main Article Research Finding

Researcher	Year	Achievement Target	SSI Content
Intan Mahanani, Sri Rahayu, Fauziatul Fajaroh	2019	Students' Ability of <i>scientific explanation</i> improved	(1) Controversy about the relaxation of alcoholic beverage sales in Indonesia
Muhammad Saija, Sri Rahayu, Fauziatul Fajaroh, Sumari	2022	Students' science literature improved	(1) Controversy of drinking alcohol in Indonesia; (2) exhaust gases from motor vehicles
Siti Nurlatifah, Erman	2018	Students' argumentative ability improved	(1) Motorized vehicles damage coastal areas; (2) seawater acidification; (3) use of bio-detergent in the future

According to Mahanani et al., (2019) have conducted research on the effect of inquiry learning in the SSI context on scientific explanation abilities in the matter of reaction rates. The context presented is in the form of the relationship between SSI in the order of reaction material by raising the issue of the controversy over alcoholic beverages. The results of this study provide a conclusion that SSI has an effect on improving students' scientific explanations. The importance of scientific explanation is because in the future students as part of society are not only required to just understand scientific concepts but also take part in discussions related to global phenomena.

An OE3C learning model in the SSI context was implemented by (2019) on the matter of reaction rates providing an increase in students' scientific literacy skills. The measurement of scientific literacy uses 24 items of multiple choice scientific literacy questions (Cronbach Alpha = 0.717). The results of this measurement are in line with the questionnaires distributed, students state that learning by presenting SSI provides an opportunity to think and determine the role of science in the environment.

Nurlatifah et al. (2018) applied the 7E learning cycle model with socio scientific issues on the reaction rate material that can improve students' argumentative abilities. Presenting the material context with scientific issues will encourage students to debate based on conflicts and social science problems so that it can facilitate students in collecting facts that are close to their lives. This can indirectly train students' ability to present their arguments against a social conflict.

3.3 SSI Content Analysis on Reaction Order Discussion

Some articles that discuss SSI in reaction rates suggest that one of the scientific issues related to the reaction order is the controversy over alcoholic beverages in Indonesia. (Mahanani et al., 2019 ; Pratiwi et al., 2016; Saija et al., 2022). The controversy over alcoholic beverages in Indonesia is related to the concept of order of reaction.

Ethanol is a type of alcohol consumed by humans from several types of alcoholic beverages. In the body, alcohol undergoes a metabolic process to produce acetaldehyde. The concentration level of the ethanol consumed will still produce a zero-order reaction. The process of alcohol metabolism in the body goes according to the following reaction:



When servings containing alcohol are consumed by humans, ethanol will be absorbed through the blood. Its concentration has decreased constantly until it reaches 0. Usually, a person's weight will affect the length of time of metabolism. A 70kg body weight takes about 2.5 hours to oxidize the ethanol contained in a 12-ounce can of beer (Cederbaum, 2012).

Based on explanation of the alcohol controversy, the teacher can explain two scientific concepts at once through the metabolism of alcohol and the process of diffusion into the blood. The process of

alcohol metabolism is a zero order reaction step, while the process of diffusion into the blood is a first order reaction. The complete stages are explained in picture 2.

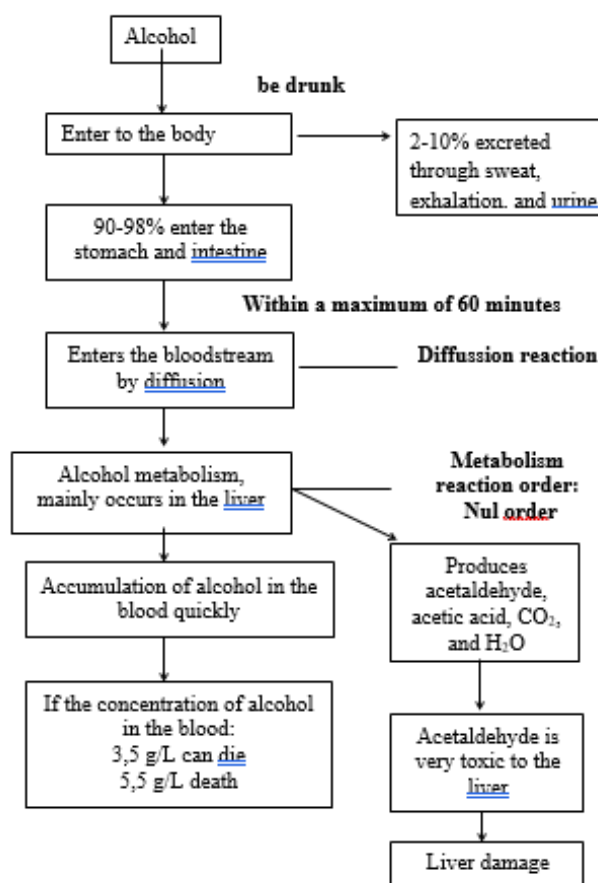


Figure 2. Steps of Alcohol Metabolism in the Body

4. CONCLUSION

The socioscientific approach is an approach that gives a presentation of issues associated with the science concept being studied. Research in the last 5 years as a whole has carried out aspects of measuring scientific literacy but has still been minimal in measuring aspects of environmental awareness. This can be a recommendation for further research as the dependent variable. So far, the discussion of reaction orders in chemical kinetics has been limited to calculations and formulas, in the presentation of SSI aspects that can be seen from the issue of alcohol controversy. The SSI content presented in detail in this journal can be a reference for the preparation of SSI in the presentation of chemical kinetics learning.

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