

 Review Article

Research Trends in Chemical Literacy: A Systematic Literature Review from 2013 to 2022

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Abstract

As early as 1989, the term chemical literacy was introduced. Chemical literacy refers to an individual's understanding of particle matter, reactions, laws, theories, and chemical applications in life. Research on chemical literacy has been conducted by several researchers in several countries. However, it is rare to find research that focuses on the trend of chemical literacy research with the use of systematic analysis of literature review. This study aims to analyze research on chemical literacy and look at its trends to find further research opportunities. The analysis was carried out with systematic literature review with the main material from the scopus database. Scopus is one of the most comprehensive databases of peer-reviewed journals. The literature search was conducted online in September 2022 with 1 keyword, namely chemical literacy. A total of 23 articles related to chemical literacy in the 2013-2022 span were analyzed and mapped. Based on the results of the analysis, it is known that the trend of chemical literacy research takes place fluctuatingly. Of the 9 countries in the Scopus database that research the topic of chemical literacy, Indonesia is the country with the most contributors to articles that discuss this research topic on chemical literacy.

Keywords: Chemical literacy, Research trends, Systematic literature review



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1. INTRODUCTION

As early as 1989 the term chemical literacy was introduced. Based on the scopus database, the term was discussed by authors from Riverside City College of the United States, and the University of Toronto Canada, named Douglas Bond and Missen R.W., & Smith W.R. in a review document and short survey published in the Journal of Chemical Education.

The ability to use scientific knowledge, identify questions, and draw conclusions based on existing evidence to understand and make decisions about nature and the changes caused by human activities is the definition of scientific literacy (MM, R. Y, etc., 2020). Scientific literacy is one of the achievements of science education.

Chemistry is one of the most important branches of science. The presence of chemistry allows learners to understand what is happening around them (Sirhan, 2007). Studying matter and understanding the properties of matter that are important in many disciplines such as health sciences, geography, physics,

environmental science, and economics is a common topic discussed in chemistry (Brown, LeMay, & Bursten, 2000).

One part of scientific literacy is chemical literacy (Mozeika & Bilbokaite, 2010). This literacy refers to an individual's understanding of particle matter, reactions, laws, theories, and chemical applications in life. Students who have good chemical literacy skills can apply aspects of chemical literacy skills including the ability to explain events in their lives with chemical concepts; the ability to solve problems with this understanding of chemistry; and able to understand and apply the application of chemistry in life (MM, R. Y, etc., 2020).

Research on chemical literacy has been conducted by several researchers in several countries, for example in Malaysia (Raub L.A., Arshad M.Y., Rosli M.S., Shukor N.A., 2017), United States (Raub L.A., Arshad M.Y., Rosli M.S., Shukor N.A., 2015), Indonesia (Wiyarsi A., Pratomo H., Priyambodo E., 2020), and others. However, it is rare to find research that focuses on the trend of chemical literacy research with the use of systematic analysis of literature review.

1.1 Purpose of the Study

This research focuses on chemical literacy research trends in the 2013-2022 interval with 4 research questions:

- RQ1. To what extent is the output profile of chemical literacy publications in 2013-2022?
- RQ2. To what extent is the distribution of chemical literacy publications in all countries and institutions of the world?
- RQ3. What is the pattern of chemical literacy publications in 2013-2022?
- RQ4. To what extent do Indonesian authors contribute in researching chemical literacy in 2013-2022?

2. METHODS

The article that the author analyzed was taken from the Scopus Database. According to Echchakoui (2020), Scopus contains a wider publication. In addition, Scopus is one of the most comprehensive databases of peer-reviewed journals. The literature search was conducted online in September 2022 with 1 keyword, namely chemical literacy. Specialized literature for journals, conference proceedings, title words, and years has been searched. On an initial search 73 writings on chemical literacy have been found. The writings consist of 38 conference papers, 27 articles, 2 reviews, 1 book chapter, and 1 erratum. In this study, the analysis focused on 23 articles about chemical literacy in the scopus database in the 2013-2022 period.

3. RESULTS

3.1 Publication Output, Document Sources, and Language Sources

There are 73 written documents related to chemical literacy in the Scopus database, namely 27 articles related to chemical literacy research, as well as 46 other documents (books, conference proceedings, erratum, reviews, and short survey documents). Publications devoted to chemical literacy research based on the scopus database are shown in Figure 1.

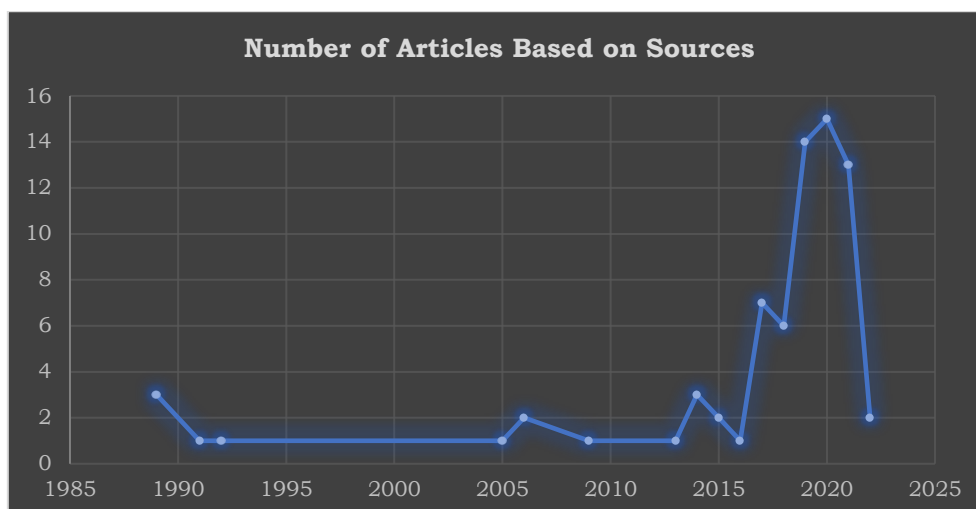


Figure 1. The Number of Documents on Chemical Literacy from the Beginning (1989) and the Last Ten Years (2013-2022)

The chemical literacy research journal articles in the 2013-2022 range based on the scopus database are shown in Figure 2 below.

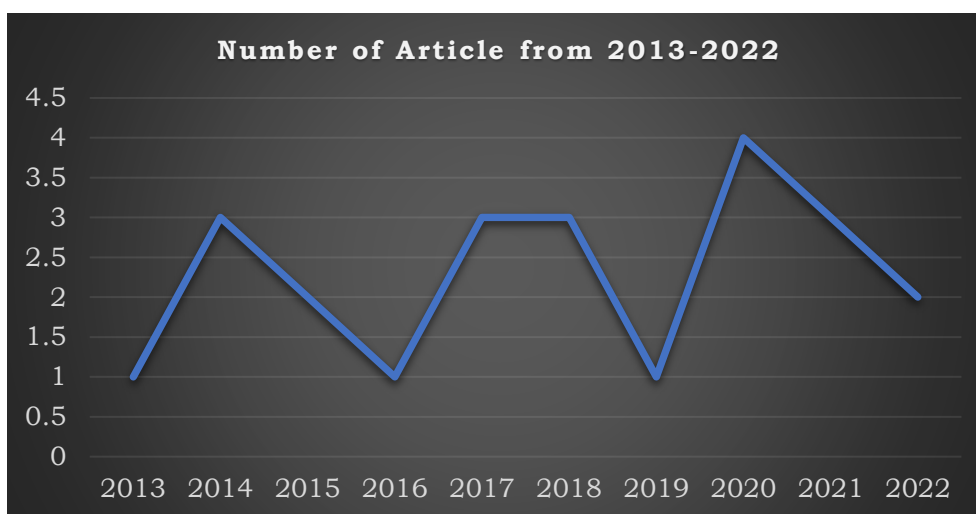


Figure 2. The Number of Documents on Chemical Literacy from 2013-2022

The number of chemical literacy documents throughout the year goes up and down. That's less than 10 documents before 2010 and more than 10 documents in 2020. Meanwhile, the number of articles based on sources shows the dominance of articles in conference proceedings (38 documents), followed by journal articles (27 documents), reviews (2 documents), books and erratum, and short survey documents accounting for the least source of documents, 1 document each. Furthermore, out of a total of 23 article documents in the 2013-2022 range, most documents use English as the language of the article (22 documents or 95.65%). The remaining documents use Indonesian (1 document or 4.35%).

3.2 Publication Distribution of Countries and Institutes

Based on 23 articles on chemical literacy contained in the scopus database in the 2013-2022 time frame, there are 9 countries that contribute to research on chemical literacy.

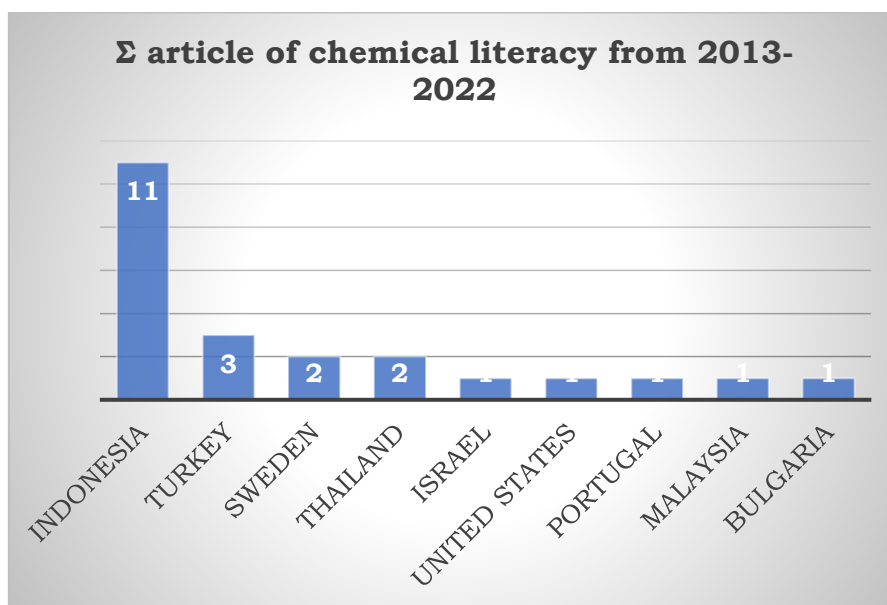


Figure 3. Number of Articles Based on Countries

Indonesia is the country with the highest number of article publications with 11 articles on this topic of chemical literacy. Then followed by Turkey (3), Sweden (2), Thailand (2), Israel (1), the United States (1), Portugal (1), Malaysia (1) and Bulgaria (1).

Table 1. Number of Articles Across Institution

Institution	Number of Articles
Yogyakarta State University, UNY, Indonesia	4
Ataturk University, Turkey	3
Universitas Negeri Malang, Indonesia	2
Malmö University, Sweden	2
Khon Kaen University, Thailand	2
Universitas Pendidikan Indonesia, UPI, Indonesia	1
Universitas Negeri Semarang, UNNES, Indonesia	1
Universitas Sebelas Maret, Indonesia	1
Universitas Negeri Makassar, Indonesia	1
Summit Institute of Development, Indonesia	1
Israel Institute of Technology, Israel	1
University of Colorado Denver, United States	1
Institute of Education, Campus de Gualtar, Portugal	1
Universiti Teknologi Malaysia, Malaysia	1
SWU "Neofit Rilski" Bulgaria	1

Indonesia was ranked first with 11 articles from several institutions, followed by other countries from various institutions. Yogyakarta State University is the most contributing institution with 4 articles, followed by other institutions (see Table 1).

3.3 Publication Patterns: Source Titles (Journal)

Table 2 illustrates the journals that have contributed the most to chemical literacy research. Chemistry Education Research and Practice is the journal with the most articles on the topic of chemical literacy research.

Table 2. Number of articles Across Source Titles

Source Title	Number of Articles
Chemistry Education Research and Practice	4
Journal of Turkish Science Education	3
International Journal of Instruction	3
Jurnal Pendidikan IPA Indonesia	2
Frontiers in Education	2
International Journal of Science Education	1
Australian Journal of Teacher Education	1
Journal of Chemical Education	1
Advanced Science Letters	1
Kasetsart Journal of Social Sciences	1
Indonesian Journal of Chemistry	1
Bulgarian Chemical Communications	1
European Journal of Educational Research	1
Asia-Pacific Forum on Science Learning and Teaching	1

3.4 The Contribution of Indonesian Researchers on Chemical Literacy

In total, Indonesia contributed 11 article documents contained in the scopus database related to chemical literacy in the last ten years out of a total of 26 documents. Table 3 below shows the research titles as Indonesia's contribution regarding Chemical Literacy research.

Table 3. Research Title about Chemical Literacy Among Indonesian Institution

No	Research Title	Year	Journal
1	Literasi kimia mahasiswa pgsd dan guru ipa sekolah dasar	2014	Jurnal Pendidikan IPA Indonesia
2	Chemical literacy of teaching candidates studying the integrated food chemistry ethnosciences course	2017	Journal of Turkish Science Education
3	Development and validation of an integrated assessment for measuring critical thinking and chemical literacy in chemical equilibrium	2018	International Journal of Instruction
4	Development and validation of an integrated assessment instrument to assess students' analytical thinking skills in chemical literacy	2018	International Journal of Instruction
5	Exploring and comparing content validity and assumptions of modern theory of an integrated assessment: Critical thinking-chemical literacy studies	2019	Jurnal Pendidikan IPA Indonesia
6	Vocational high school students' chemical literacy on context-based learning: A case of petroleum topic	2020	Journal of Turkish Science Education

7	Chemical literacy: Performance of first year chemistry students on chemical kinetics	2020	Indonesian Journal of Chemistry
8	Promoting Students' Scientific Habits of Mind and Chemical Literacy Using the Context of Socio-Scientific Issues on the Inquiry Learning	2021	Frontiers in Education
9	A Rasch analysis of item quality of the chemical literacy assessment for investigating student's chemical literacy on chemical rate concepts	2021	European Journal of Educational Research
10	Students' scientific literacy skill: The starting point of chemistry learning in the junior high school	2021	Asia-Pacific Forum on Science Learning and Teaching
11	The Effectiveness of a SOIE Strategy Using Socio-scientific Issues on Students Chemical Literacy	2022	International Journal of Instruction

The importance of chemical literacy for Indonesia is related to how students are able to appreciate nature by utilizing the science and technology they have mastered (Nisa et al., 2015).

Table 4. The Score and Rank of Indonesian Student at PISA

Year	Score	Rank
2000	393	38 from 41 countries
2003	395	38 from 40 countries
2006	393	50 from 57 countries
2009	383	60 from 65 countries
2012	383	64 from 65 countries
2015	403	62 from 70 countries

(Rusilowati et al., 2019)

In addition, it is also related to the low literacy ability of science / chemistry students as evidenced by the results of the Programme for International Students Assessment (PISA) survey that from 2000 to 2015 showed that the level of science literacy achievement of Indonesian students was still at a low level (Imansari, et al. 2018). As of 2015, Indonesia's PISA ranking related to science literacy is still among the bottom 10 from other countries.

Thus, as an effort to improve the science / chemistry literacy skills of students in Indonesia, researchers and observers of education in Indonesia conduct various researches on chemical literacy associated with students to present the best solutions in the form of learning models or methods, and so on.

4. CONCLUSION

Based on the results of the analysis, it is known that the trend of chemical literacy research takes place fluctuatingly in the 2013-2022 time frame. Of the 23 articles and 9 countries that contribute to research on chemical literacy, Indonesia is the country with the most article contributors that discusses this chemical literacy topic with 11 articles. Yogyakarta State University is the most contributing institution with 4 articles, followed by other institutions in Indonesia. The importance of chemical literacy for Indonesia, one of which is related to efforts to improve the ability of students and improve Indonesia's PISA ranking in the aspect of science literacy.

Conflict of Interest

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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