https://doi.org/10.62159/ghaitsa.v7i2.1920

GHAITSA
Islamic Education Journal

RESEARCH

Received: Revised:

The title should be concise, specific, informative, and reflect the main focus of the study

Razzan Syafiq Elshahbaz[1]*, Rini Selviana Yuda[2] and Azanoel Tunim[3]

Correspondence:
Razzan Syafiq Elshahbaz
rzznel2018@ac.id

[1]Doctoral Program of Science Education, Faculty of Teacher Training and Education, Universitas Sebelas Maret, Surakarta, Indonesia
[2]Department of Chemistry, Faculty of Mathematics and Science, Universitas Sebelas Maret, Surakarta, Indonesia
[3]Department of Biology Education, Faculty of Teacher Training and Education, Universitas Sebelas Maret, Surakarta, Indonesia

Abstract

The abstract should present a concise and comprehensive summary of the entire article. It should briefly describe the background of the study, the research objective, the method employed, the main findings, and the principal conclusion or implication. The abstract must be written as a single coherent section unless otherwise specified by the journal. It should enable readers to understand the essence of the article without having to read the full text.

Authors are advised to avoid citations, footnotes, undefined abbreviations, and overly detailed explanations in the abstract. The abstract should focus only on the most important aspects of the study and should accurately reflect the content of the manuscript.

Keywords: Bibliometric analysis, Creative thinking skills, Science education, Project- based learning, PISA 2022 creative thinking

Introduction

The introduction should explain the background of the study and clearly establish the significance of the research problem. This section should begin with the broader context of the issue, followed by relevant facts, conditions, or phenomena that justify the study. Authors should then present a concise review of relevant previous studies in order to demonstrate what has already been investigated and what remains insufficiently explored.

The introduction must also identify the research gap, novelty, or specific contribution of gggk the present study. It should end with a clear statement of the research objective, research questions, or hypotheses, depending on the nature of the study. A well-written introduction should guide readers logically from the general issue to the specific purpose of the article.

The literature review provides the theoretical and conceptual foundation of the study. This section should discuss the major theories, concepts, and previous studies that are directly relevant to the topic under investigation. The purpose of the literature review is not merely to collect citations, but to build a coherent academic argument that supports the need for the study.

Authors should explain the relationships among theories, highlight agreements or disagreements in previous findings, and position the current study within the broader body of knowledge. This section may also include conceptual definitions, analytical frameworks, or a research framework if required by the journal.

The accelerating complexity of global challenges such as climate change and techno- logical disruption requires a new generation of learners equipped not only with scien- tific knowledge but also with advanced cognitive skills. Among these, CTS-SciEd has emerged as a core competency for engaging with ill-structured problems, generating innovative solutions, and fostering scientific inquiry in authentic contexts (Goodman, 2005; Lee et al., 2021). Unlike rote memorization or procedural recall, creative thinking involves originality, flexibility, fluency, and elaboration (Smedley & Smedley, 2005). These skills enable students to synthesize information and apply scientific concepts in novel and meaningfulways.

International education policy frameworks reinforce the urgency of CTS-SciEd. For the first time, the Programme for International Student Assessment (PISA) 2022 intro- duced creative thinking as a core domain, signaling its global recognition as a critical 21st-century skill (Stanfield, 2018). The PISA Creative Thinking Test evaluates students' abilities to generate, evaluate, and improve ideas across contexts, including science. This global pol- icy shift highlights the importance of developing curricula, pedagogy, and assessment systems that support creative scientific thinking.

Method

The method section should explain clearly how the study was conducted. Authors must provide sufficient detail so that readers can understand the research design and, where applicable, replicate the study. This section generally includes the type or design of research, research setting, participants or sample, data sources, instruments, procedures for data collection, and techniques for data analysis.

For quantitative studies, authors should describe the variables, population and sample, sampling technique, instruments, and statistical analysis. For qualitative studies, authors should explain the participants or informants, setting, data collection techniques, trustworthiness procedures, and methods of analysis. For research and development studies, the development model, stages, validation process, trial procedures, and data analysis should be clearly described. The method should be written in a precise, systematic, and objective manner.

Data Collection

Table 1 presents a detailed overview of the search terms employed in the Scopus and ERIC databases to retrieve literature related to CTS within the framework of science education. Searches were conducted on 30 April 2025 in two databases: Scopus and ERIC.

Table 1 The specific search in the scopus and ERIC databases

Search	Search Term(s) in the Scopus and ERIC
S1	(“creative thinking” OR creativity OR “divergent thinking”) AND (“science education” OR “science teaching” OR “science classroom” OR STEM OR “STEM education”) AND (PUBYEAR > = 2015 AND PUBYEAR < = 2025) AND (LIMIT-TO (DOCTYPE, “ar”)) AND (LIMIT-TO (LANGUAGE, “English”))
S2	The descriptors include “creative thinking,” creativity, or “divergent thinking” in conjunction with “science education,”“science instruction,” or STEM. Fields: Abstract, Title, Descriptors. Filters: Peer-reviewed, Journal Articles, English, 2015–2025.

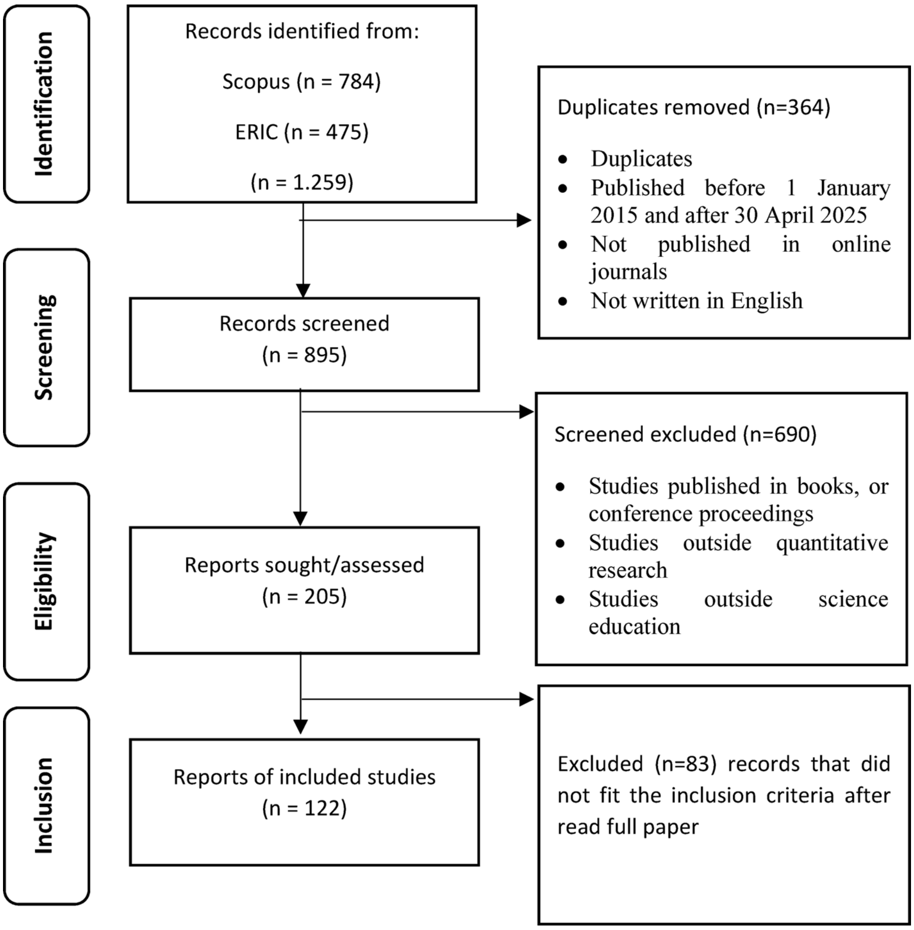

Fig. 1 PRISMA flow diagram

Data Analysis

Bibliometric analyses included:

Table 2 Search keywords and inclusion/exclusion criteria

Category	Inclusion criteria	Exclusion criteria
Publication period	Studies published from January 2015 to 30 April 2025	Studies published before January 2015
Language of publication	Full-text available in English	Full-text available in other languages
Study Materials	Studies published in peer-reviewed journals rated in Scimago Journal	Studies published in books, confer- ence proceedings
Document Type	Studies conducted in science education fields	Studies outside science education (such as those in medical, nursing, therapy, rehabilitation, or gaming) fields)
Subject Area	Education (and related Scopus categories relevant to science education)	Studies outside education (e.g., business, linguistics) were excluded

Results

General Characteristics

The results section presents the findings of the study in a clear and systematic way. Authors should report the outcomes of the analysis objectively and in direct relation to the research questions or objectives. Data may be presented in the form of text, tables, figures, or graphs where necessary. Each table or figure should be referred to and explained briefly in the text.

Authors should avoid repeating all numerical details from tables in the body text. Instead, this section should emphasize the most important findings and patterns. The results section should focus on what was found, not yet on why it happened or how it should be interpreted in depth.

Spesific Characteristics

Between 2015 and 2025, research on CTS-SciEd expanded substantially, producing 122 peer-reviewed journal articles across 77 outlets (Table 3). The corpus shows an annual growth rate of 12.13%, indicating sustained scholarly attention. Articles received an average of 10.54 citations per paper (total ≈ 6,394), demonstrating that CTS-SciEd is gaining academic influence.

Table 3 Main information

Description	Results
Main information about data	
Timespan	2015–2025
Sources (Journals, Books, etc.)	77
Documents	122
Authors' Collaboration	
Single-authored docs	13
Co-authors per document	3.43
International co-authorships %	12.3
Document Types	
Article	122

Citation Trends

Figure 3 presents average annual citations per article. Citation impact fluctuated but showed renewed momentum after 2016, with notable peaks in 2016 (3.8), 2019 (3.71), and 2022 (5.47). Lower averages in 2023–2025 reflect recency bias, as newer works have had limited time to accrue citations. These patterns indicate that while citation influence is episodic, CTS-SciEd research is increasingly visible in the international literature.

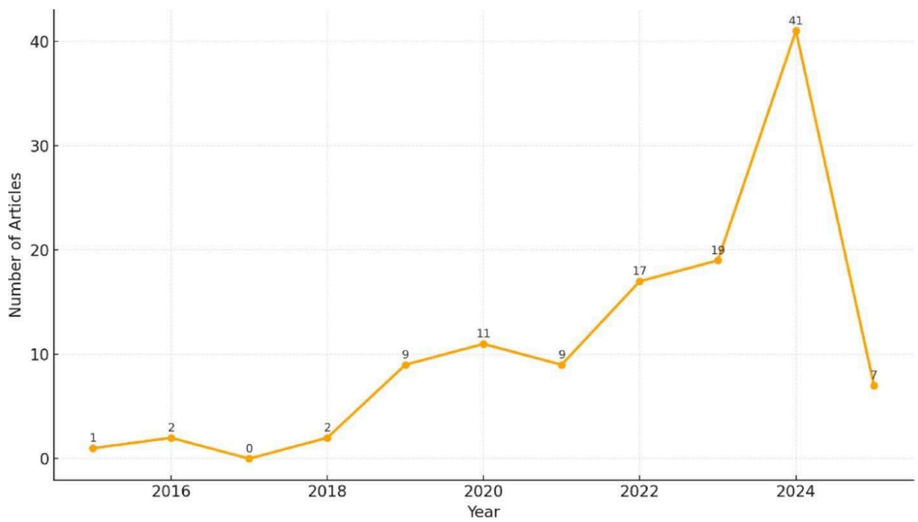

Fig. 2 Annual scientific production

Discussion

The discussion section is intended to interpret the findings of the study. In this section, authors should explain the meaning of the results, relate them to the research objectives, and connect them with relevant theories and previous studies. The discussion should demonstrate whether the findings support, extend, or contradict earlier research.

Authors are encouraged to explain why the findings emerged as they did and what implications they have for theory, practice, policy, or future research. A strong discussion goes beyond description by showing critical analysis and academic interpretation. This section should not simply repeat the results, but rather provide a deeper understanding of their significance.

This bibliometric and thematic analysis reveals both the growth and fragmentation of research on CTS-SciEd. The findings not only map productivity patterns, collabora- tion networks, and thematic clusters but also contribute to theory, pedagogy, and policy while identifying specific research gaps. The discussion is structured to respond directly to the seven research questions. RQ1, on publication trends, is interpreted through its theoretical contribution, showing how growth in CTS-SciEd reflects socio-construc- tivist and creativity frameworks. RQ2 and RQ3, concerning author productivity and journal outlets, inform both teaching implications and research community structures. RQ4, focused on country contributions, is linked to policy contexts and international benchmarks. RQ5 and RQ6, on keywords and subject areas, are connected to educa- tional theories, mapping bibliometric clusters onto socio-constructivism and Torrance's framework. Finally, RQ7, on thematic evolution, is used to identify research gaps and future directions. In this way, each research question is explicitly addressed within the broader theoretical, pedagogical, and policy-oriented dimensions of the discussion.

Theoretical contribution

Addressing RQ1 on publication trends, this study demonstrates that the rapid growth of CTS-SciEd research after 2015 is not only quantitative but also signals a theoretical con- solidation of the field. The rise of inquiry- and project-based learning clusters reflects socio-constructivist perspectives (Tsai, 2018), emphasizing that creativity in science education is co-constructed through social interaction, collaboration, and negotiation of meaning, rather than being a purely individual attribute.

The thematic patterns align closely with Torrance's (Lyons & Farrell, 1994) four dimensions of creativity: fluency, flexibility, originality, and elaboration. For example, bibliometric clusters around hypothesis generation and modeling represent fluency and flexibility, while clusters linked to design-based science illustrate originality and elaboration. This indicates that the expansion of CTS-SciEd research reflects a shift from seeing creativity as divergent idea generation toward recognizing its need for convergent scientific validation.

This study extends theoretical understanding by showing how the dominance of PjBL, IBL, and SSI within the CTS-SciEd clusters reflects not only pedagogical trends, but specific cognitive mechanisms aligned with established creativity theories. For example, inquiry-based learning operationalizes Vygotsky's socio-constructivist view of creativity as a socially mediated process, where learners co-construct hypotheses through dialogic reasoning (Bencze et al., 2020; Hardiyanto & Wijayanti, 2023; Walker & Zeidler, 2007). Meanwhile, project-based learning aligns with Torrance's dimensions of flu- ency and flexibility, as it compels students to generate multiple design alternatives and switch between representational forms (e.g., models, simulations, prototypes). Similarly, SSI evoke originality and elaboration, as learners must construct contextually grounded yet scientifically valid responses to morally and environmentally complex problems. By mapping bibliometric clusters onto these theoretical dimensions, this review demon- strates that CTS-SciEd is not only generative (divergent) but also constrained by epis- temic norms of scientific validity a defining feature that distinguishes scientific creativity from general creativity.

The results reinforce the discipline-specific nature of creativity in science. Unlike gen-

eral creativity, which values novelty irrespective of context (Dolan et al., 2011; Sadler & Zeidler, 2009), CTS-SciEd requires ideas to be empirically testable, conceptually accurate, and communicable within disci- plinary norms (Chadwick et al., 2021). Thus, bibliometric synthesis not only maps research growth but also helps refine theoretical definitions of scientific creativity by embedding it within epis- temic practices of science.

Conclusion

The conclusion should provide a concise answer to the research objective or research questions. It should summarize the main findings and clearly state the contribution of the study. The conclusion must be based entirely on the discussion and should not introduce new data or arguments.

Authors may also include brief recommendations or implications if required by the journal. However, the conclusion should remain focused, direct, and proportional to the scope of the study.

By consolidating thematic evolution, authorial contributions, and collaboration pat- terns, this review offers practical tips for researchers, educators, and policymakers. It positions CTS-SciEd not as an optional enrichment but as a core competence for science education, essential to prepare learners for innovation, problem-solving, and informed participation in addressing complex global challenges.

Acknowledgements

State supporting institutions, funding, author contributions, and other required declarations when necessary..

References

Bencze, L., Pouliot, C., Pedretti, E., Simonneaux, L., Simonneaux, J., & Zeidler, D. (2020). SAQ, SSI and STSE education: defending and extending “science-in-context.” *Cultural Studies of Science Education*, *15*(3), 825–851. https://doi.org/10.1007/s11422-019-09962-7

Chadwick, R., McLoughlin, E., & Finlayson, O. E. (2021). Teachers’ experience of inquiry into socioscientific issues in the Irish lower secondary science curriculum. *Irish Educational Studies*, *0*(0), 1–23. https://doi.org/10.1080/03323315.2021.1964565

Dolan, T. J., Nichols, B. H., & Zeidler, D. L. (2011). Using Socioscientific Issues in Primary Classrooms. *Journal of Science Teacher Education*, *22*(7), 561–561. https://doi.org/10.1007/s10972-010-9220-1

Goodman, A. (2005). Three Questions about Race, Human Biological Variation and Racism. *Anthropology News*, *46*(6), 18–19. https://doi.org/10.1525/an.2005.46.6.18

Hardiyanto, B., & Wijayanti, A. (2023). Pemetaan Konflik Antar Etnis Jawa Dan Etnis Serawai Di Desa Sri Kuncoro Kecamatan Pondok Kelapa Kabupaten Bengkulu Tengah. *Jurnal Ilmiah Idea*, *2*(1), 14–33. https://doi.org/10.36085/idea.v2i1.5330

Lee, J. K., Aini, R. Q., Sya’bandari, Y., Rusmana, A. N., Ha, M., & Shin, S. (2021). Biological Conceptualization of Race: The Unintended Consequence of Korean College Students’ Learning of Biology. *Science and Education*, *30*(2), 293–316. https://doi.org/10.1007/s11191-020-00178-8

Lyons, C. C. U., & Farrell, M. C. U. (1994). Teaching Tolerance : Multicutural and anti-racist education. *McGill Journal of Education*, *29*(1), 5–14. http://mje.mcgill.ca/index.php/MJE/article/view/8145/6073

Sadler, T. D., & Zeidler, D. L. (2009). Scientific literacy, PISA, and socioscientific discourse: Assessment for progressive aims of science education. *Journal of Research in Science Teaching*, *46*(8), 909–921. https://doi.org/10.1002/tea.20327

Smedley, A., & Smedley, B. D. (2005). Race as biology is fiction, racism as a social problem is real : Anthropological and historical perspectives on the social construction of race. *American Psychologist*, *60*(1), 16–26. https://doi.org/10.1037/0003-066X.60.1.16

Stanfield, J. H. (2018). The Myth of Race and the Human Sciences. *Black Reflective Sociology*, *64*(3), 197–214. https://doi.org/10.4324/9781315432892-11

Tsai, C. Y. (2018). The effect of online argumentation of socio-scientific issues on students' scientific competencies and sustainability attitudes. *Computers and Education*, *116*, 14–27. https://doi.org/10.1016/j.compedu.2017.08.009

Walker, K. A., & Zeidler, D. L. (2007). Promoting discourse about socioscientific issues through scaffolded inquiry. *International Journal of Science Education*, *29*(11), 1387–1410. https://doi.org/10.1080/09500690601068095