

Applying Commognitive Theory in Education: A Systematic Literature Review

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ARTICLE INFO

Keywords:

commognitive framework;
mathematics education;
mathematical discourse;
systematic literature review;
bibliometric analysis

Article history:

Received 2025-11-06

Revised 2026-03-16

Accepted 2026-08-04

ABSTRACT

The commognitive framework proposed by Sfard has become an influential perspective for examining mathematical thinking as discourse. Although its application in mathematics education has expanded considerably, a comprehensive synthesis of research trends, thematic focus, and bibliometric patterns remains limited. This study systematically reviews the development of commognitive research in education. A systematic literature review following the PRISMA guidelines was conducted. Publications were retrieved from Scopus, Web of Science, ScienceDirect, and Google Scholar using Publish or Perish. After identification, screening, and eligibility assessment, 28 journal articles published between 2018 and 2023 met the inclusion criteria. Data were analyzed through descriptive synthesis and bibliometric visualization using VOSviewer. The findings indicate that Indonesia contributed the largest number of publications on commognitive research, with publication activity peaking in 2022. The reviewed studies primarily involved participants from kindergarten to higher education, including pre-service teachers. Research predominantly explored mathematical discourse, collaborative learning, problem solving, visual mediators, routines, and gender-related issues. Bibliometric analysis revealed interconnected research clusters centered on commognitive framework, discourse, collaborative problem solving, and mathematical communication, reflecting the growing diversification of research themes. The review demonstrates the increasing adoption of the commognitive framework in mathematics education and highlights its diverse applications across educational levels. It also identifies opportunities for future research, particularly in extending commognitive studies beyond mathematics education, employing longitudinal and intervention designs, and strengthening theoretical integration. These findings provide a comprehensive overview of the current state of commognitive research and offer directions for advancing both educational research and classroom practice.

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1. INTRODUCTION

The concept of *commognition* was introduced as a theoretical framework that integrates communication and cognition into a unified process of thinking and interaction (Sfard, 2008). Derived from the terms *communication* and *cognition*, commognition emphasizes the inseparable relationship

between interpersonal discourse and individual thinking, which are viewed as two dimensions of the same underlying process (Presmeg, 2016a, 2016b; Rossydhya et al., 2021). Since its introduction, the commognitive framework has received increasing attention in educational research, particularly in mathematics education, as it offers a distinctive perspective for examining how mathematical thinking is constructed, expressed, and transformed through discourse. Previous studies have applied this framework to investigate students' discursive and cognitive processes during collaborative problem-solving, as well as to analyze shifts in responsibility between teachers and students within classroom interactions. Collectively, these studies indicate that commognition provides a productive analytical lens for understanding the development of mathematical thinking through communication and social interaction. However, further investigation is still needed to clarify how commognitive processes unfold in specific collaborative problem-solving contexts and how these processes shape students' mathematical reasoning.

Shinno (2018) employed a commognitive approach in his study the evolution of learners' numeric conversation in an all-encompassing manner. This strategy empowers the scholar to evaluate the lexicon, graphic instruments, storytelling, and regular practices by which arithmetic concepts are shaped, instead of emphasizing only the terminal conclusions. One of the strengths of the commognitive framework is its capacity to reveal how learners articulate and engage with mathematical ideas. In line with Shinno, Zayyadi et al., (2019) used commognitive analysis is used to examine how learners engage in solving a problem, not merely by looking at the final answer they produce, but by considering the language they use, the procedures they carry out, and the visual narratives or mediating representations that support their reasoning throughout the process.

Some researchers examine cognitive and communication parts or components. For example, Kontorovich & Ovadiya (Kontorovich & Ovadiya, 2023a) analyzed the narrative, and Fernández-León et al. (Fernández-León et al., 2021) identified the patterns component in students' discourse. Commognitive component consists of *word use*, *visual mediator*, *narrative*, and *routine* (Presmeg, 2016a; Rossydhya et al., 2021; Sfard, 2007). This discussion is interesting and important because every human being thinks, and we can explore this thinking process to obtain new and helpful learning theories for the future. There has been research related to commognitive commons that needs to be traced systematically to analyze and synthesize comprehensively to obtain answers to several questions. Moher *et al.* said that several items can be included when reporting a systematic literature review or meta-analysis, including explaining the reason for the review.

Researchers conducting SLR can also explore how researchers provide explicit statements regarding the questions asked concerning participants or interventions. Offer a universal translation of the scientific discoveries and the prospective significance for later academic explorations (Moher et al., 2009). The questions in this research are: 1) How is the researcher's interest in commognitive keywords viewed in the country? 2) How is the development of commognitive keyword research per year?; 3) Who are the research subjects in the analyzed articles?; 4) What topics or keywords are associated with commognitive in published articles?; 5) What are the research questions used in the study?; 6) How is the bibliometric analysis of the articles analyzed?

2. METHODS

Systematic Literature Review constitutes scholarly exploration that concentrates on a distinct query, utilizes rigorous analytical protocols, and is capable of detecting, picking, appraising, and condensing conclusions from equivalent studies (Noviana et al., 2023). The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework is followed by this investigation. To embrace a superior bibliographic evaluation regarding investigations into commognitive acquisition, the SLR was selected as the primary approach. This guideline for conducting SLR reviews is used in various research fields (Mafarja et al., 2023; Moher et al., 2009; Zynuddin et al., 2023).

2.1 Identification

The Systematic Literature Review protocol encompasses three primary tiers. The opening step involves pinpointing applicable manuscripts for the present investigation. Identification is a stage in searching literature from databases such as Scopus through Publish or Perish, ScDirect, Google Scholar through Publish or Perish, and Web of Science. The initial stage is to identify keywords (Zynuddin et al., 2023). Through selection strategies, a search string with the keyword *commognitive*, publication year 2018 - 2024, 79 articles were obtained from Scopus-indexed journals via Publish or Perish, 34 articles from ScDirect Database, 357 articles indexed by Google Scholar via Publish or Perish, and 16 articles indexed by Web of Science Database. A sum of 486 papers was discovered. This investigative quest was executed in the first month of 2024. The stipulations for acceptance and rejection can be observed in the provided manifest.

Table 1. Inclusion and Exclusion Criteria

Category	Inclusion Criteria	Exclusion Criteria
Keyword Relevance	Articles contain the keyword “commognitive” within the title, abstract, or keywords.	Articles do not contain the commognitive keyword or only mention unrelated concepts.
Publication Year	Published between 2018–2024.	Published before 2018 or after 2024.
Language	Articles written in English or Indonesian. Rationale: Indonesian articles also retain the term <i>commognitive</i> with identical spelling, allowing Indonesian-speaking researchers to analyze them accurately.	Articles written in languages other than English or Indonesian, which may hinder analysis due to language limitations.
Accessibility	Open-access articles, downloadable in full text.	Articles not downloadable, behind paywalls, or with restricted access.
Publication Type	Published in journal articles.	Articles without publication information, non-peer-reviewed documents, or sources lacking identifiable metadata.
Duplication	Unique articles included only once.	Duplicate articles removed from the dataset.

2.2 Screening

The primary sifting tier involves eradicating documents that are notated as ineligible. The inclusion criteria in this study include: there are commognitive keywords in the article, published in journals in 2018-2024, articles in English or Indonesian, and final criteria for open-access articles. Articles indicated cannot be downloaded, published have no keywords, are not commognitive in Keywords, were not published from 2018 - 2024, are not in English or Indonesian, and duplicates were removed. The reason for taking the criteria for English and Indonesian articles is that in Indonesian articles, the term *commognitive* is still written with the exact spelling, and not changed to Indonesian, so when on Google Scholar, which can also retrieve Indonesian articles, researchers whose main language is Indonesian can review the article. Apart from these two languages, researchers will have difficulty analyzing them.

2.3 Eligibility

The concluding tier of the SLR is suitability. Once the sifting operation is complete, the extant documents are personally examined and obtained. This segment validates that all picked publications fulfill the stipulations for acceptance. A more profound inquiry is executed through a critique of the label and synopsis. In instances where the title or overview is vague, the manuscript's core material will be audited (Zynuddin et al., 2023). This screening stage resulted in 28 articles, and seven articles

were discarded that had an irrelevant area of interest. Figure 1 shows a summary of the researcher's review process.

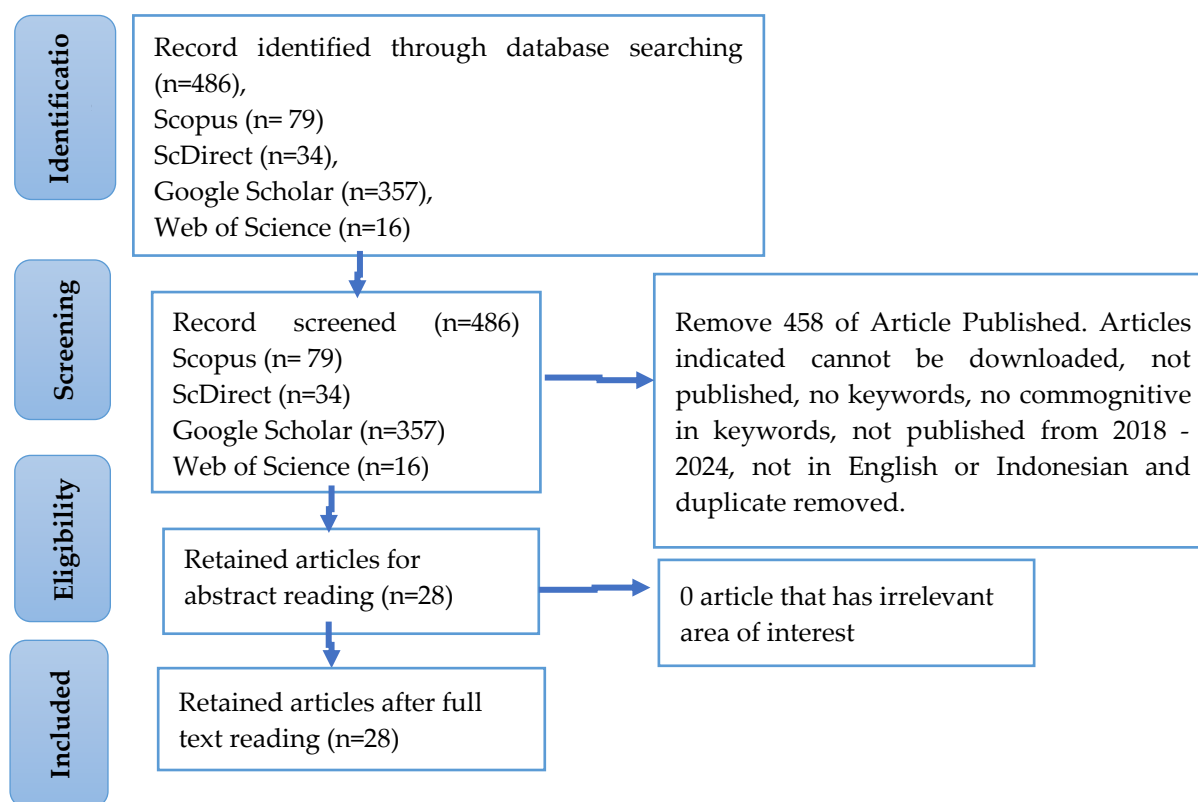


Figure 1. The flow of publications through different stages of the systematic literature review

3. FINDINGS AND DISCUSSION

The results of 28 articles that have gone through rigorous selection starting from the identification stage which obtained 486 articles, then screened again and discarded 458 articles that fell into the exclusion criteria, and through the eligibility stage again discarded 0 irrelevant articles which can be seen in the flow chart in Figure 1 have then been reviewed. The review results related to the interest of researchers from various countries in commognitive keywords, the development of research with commognitive keywords per year, research subjects in the analyzed articles, topics or keywords related to commognitive, research objectives or research questions, and bibliometric analysis of the analyzed articles are described in this section. Table 1 also provides some information such as research questions or objectives, theories obtained from research results, and suggestions or limitations of research (if applicable to the article).

3.1 The Interest of Researchers from Various Countries in Commognitive Keywords

Researchers in various countries conduct Commognitive as a research topic. Based on the results (Lefrida, 2021; Pratiwi, 2022; Zayyadi et al., 2019, 2020; Commognitive Analysis Of Students' Errors In Solving High Order Thinking Skills Problems, 2021), Indonesia is the country most discussed in this topic. Researchers from the Netherlands have conducted three studies (Karavi et al., 2022; Schüler-Meyer, 2019, 2022b). China with two studies (Lu et al., 2022; Lu, Zhang, et al., 2023), the Philippines with two articles ((Ignacio & Sison, 2022; Ombay & Roble, 2020)), Israel as the country of origin of Sfard, which boomed the term commognitive, as many as one articles can be obtained (Daher, 2020) with search results based on the set inclusion criteria. There were also studies from the Netherlands, Norway, South Africa, and Spain. There is also collaborative research between countries such as China

and Australia (Lu, Tuo, et al., 2023), Australia and Finlandia (Chan et al., 2022), Sweden, Norway, and the UK, then New Zealand and Israel, Israel and South Africa, Japan and the UK, and Sweden and Canada. The countries that became the focus of the research can be seen in the following Figure 2.



Figure 2. The Distribution of Studies Employing the Commognitive Approach by Country

3.2 Research Development with Commognitive Keywords per Year

In 2018, there were two studies related to commognitive. In 2019, four articles discussed commognitive. In 2020 and 2021, there were four articles per year discussing commognitive. In 2022, there were 11 articles discussing commognitive, and in 2023, there were three articles discussing commognitive. The following presents the statistical visual interpretation based on the bar chart that has been generated figure 2.

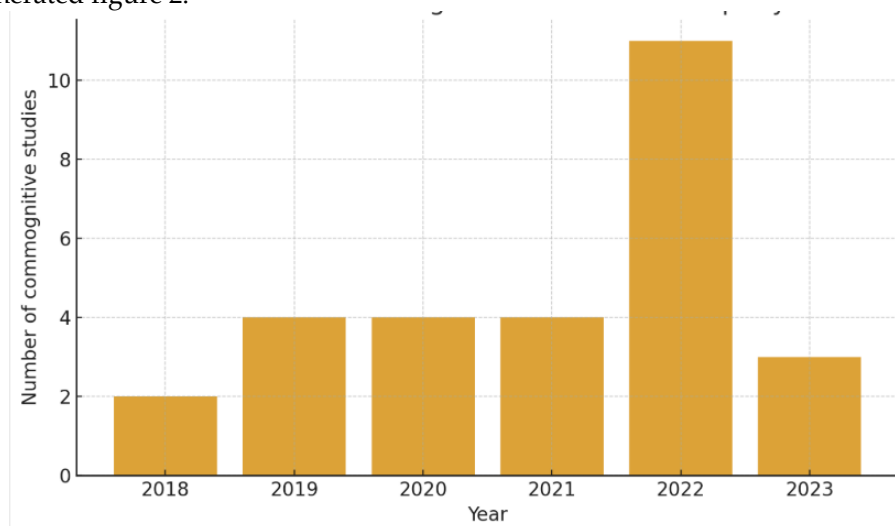


Figure 3. Statistical Visual Interpretation

When viewed from the VoS Viewer, Figure 3 visualizes yellow as the term that appears in 2023, green for publications in 2022, and purple for publications in 2019.

3.3 Research Subjects in the Analyzed Articles

The subjects most studied by researchers are primary and secondary education levels, 17 out of 28 studies. The research started from kindergarten to high school / equivalent education units. Twelve articles examined prospective teachers or students who came from mathematics education majors. There is also one article that examines outside the math education department and one that focuses on prospective elementary school teacher students.

3.4 Topics or Keywords Associated with Commognitive

Research with the commognitive is mainly associated with discourse, in which mathematical discourse describes how the commognitive process occurs. Researchers use commognitive and look at school mathematics, university mathematics, pre-service primary teachers, secondary-tertiary transition, school-university transition, tertiary discourse transition, kindergarten, primary school, high school, and primary mathematics education.

3.5 Research Objective or Research Question

There are various goals that researchers aim to achieve; for example, researchers describe each learner's communication using Sfard's exploratory and ritualized discourse. The scholar intended to describe the standard of arithmetic dialogue across quadruplet early childhood sessions located in Norway. The researcher used a commognitive lens to analyze the various research objectives.

Research objectives and research questions are essential to direct researchers in a study. The results of the research must answer the research questions posed. In some studies, researchers only use one research question. Other studies use up to two to three research questions. The research objectives and research questions have been summarized in Table 1 below.

3.5 Bibliometric Analysis of Analyzed Articles

The proverb "an image carries the weight of a thousand terms" implies that dense or varied notions, which are sometimes difficult to articulate, are transmitted with greater velocity via a solitary illustration. Despite this classic observation being validated by myriad experiments, cognitive studies reveal that the fusion of written language and imagery generates a deeper, more lasting impression (Knox & Kontorovich, 2022). The academic inquiry employed the VOS viewer application to execute a relational diagram of the 28 articles; this process sought to ascertain the links between various researches and the central pillars that integrate commognitive concepts with secondary domains. The results of this bibliometric analysis are also another form of evidence that supports the results of manual reviews conducted by researchers. 57 items were grouped into seven clusters. Commognitive lenses associated with concept, mathematical discourse, mistake, participant, problem, student, visual mediator, and word use were identified in green. Overlay Visualization for Commognitive can be seen in Figure 4.

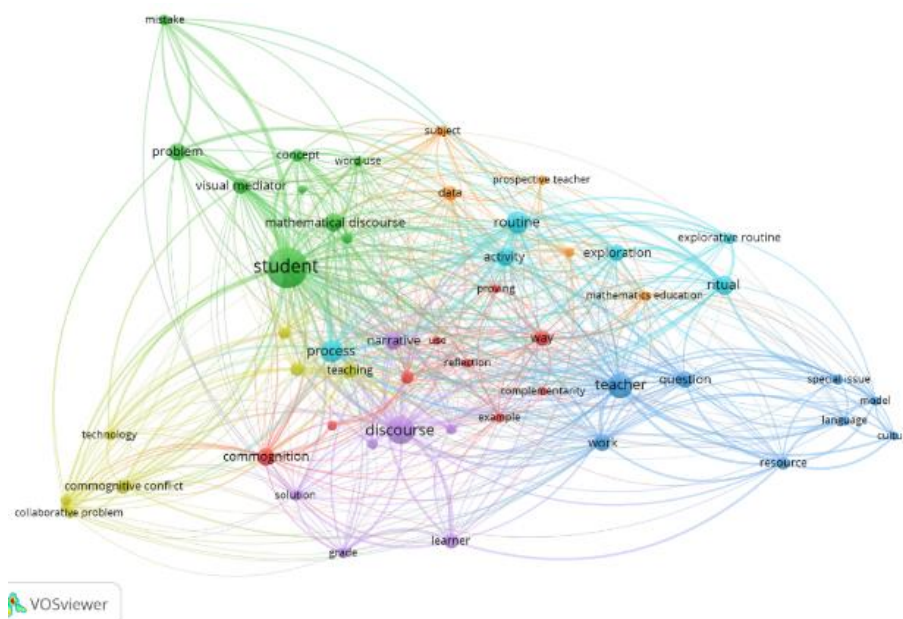


Figure 4. Overlay Visualization for Commognitive

Bibliometric analysis was also conducted in terms of keywords. In Figure 5, the data can be interpreted that there are studies that link commognitive with problem-solving and routines, which are part of the commognitive component, as seen from the yellow-green colour. Linking pedagogical discourse, elementary number theory and cognition. An interdependence is also evident between commognitive framework, collaborative learning, and discourse. As well as linking with gender and collaborative problem-solving.

The visualization of commognitive keywords can be seen in Figure 4. In the figure, there are interconnected nets, and various colours that show groups of interconnected keywords; for example, the purple colour in Figure 4 is complementarity and commensurate which is connected to collaborative problem-solving and gender differences. There are also topics of subsections of the commognitive component that are explored in depth, such as rituals and explorative, which are divisions of routines associated with discourse.

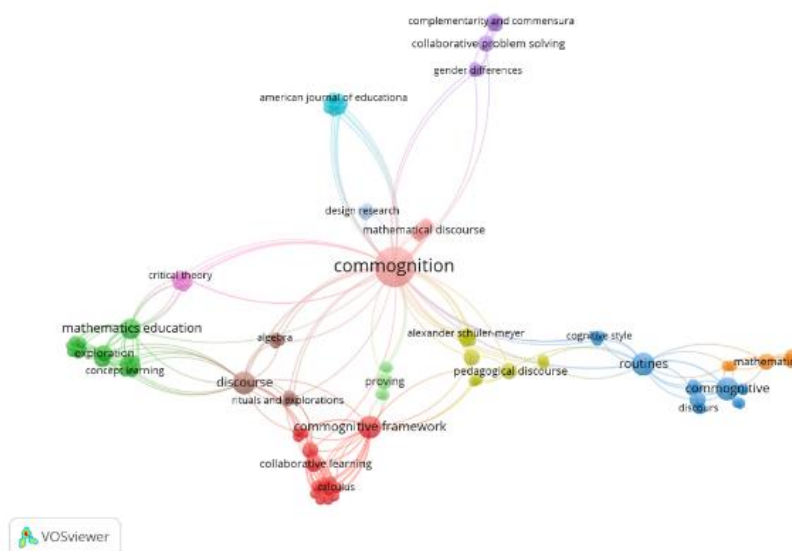


Figure 5. Visualization of Commognitive Keywords

Figure 6 presents the overlay visualization of keyword co-occurrence by publication year. In this visualization, colors represent the temporal distribution of the studies, with yellow indicating the most

recent publications (2023) and blue representing the earliest publications included in the review (2019).

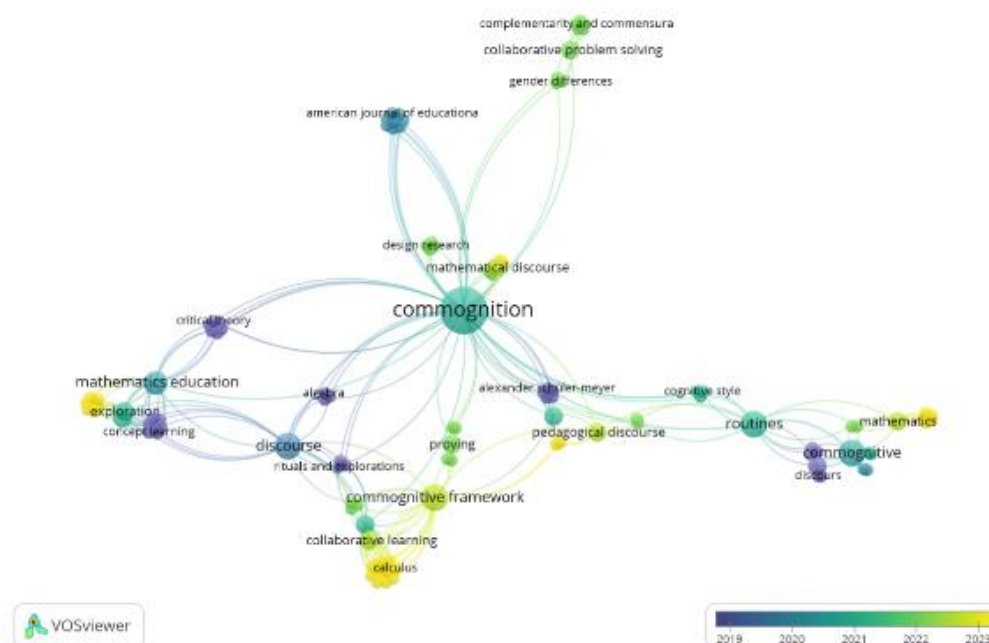


Figure 6. Overlay Visualization of Commognitive keywords viewed from Year of Publication

Table 2. Summary of articles that met inclusion criteria

Characteristics	Categories	Number of Studies
Publication Year	2018	2
	2019	4
	2020	4
	2021	4
	2022	12
	2023	3
Educational Level	Kindergarten–Primary	3
	Secondary School	14
	Higher Education (Undergraduate/Pre-service Teachers)	11
Research Focus	Mathematical discourse	12
	Problem solving	8
	Teacher education	4
	Collaborative learning/CPS	4
Commognitive Components	Word use	✓
	Visual mediator	✓
	Narrative	✓
	Routine	✓
Research Design	Qualitative	Dominant
	Mixed methods	Limited
	Experimental/Intervention	Few

Table 3. Summary of Studies Included in the Review (n=28)

No.	Authors	Participants	Research Focus	Main Findings
1	Roberts & Roux (2019)	Grade 8–9 students	Linear equation discourse	Students predominantly demonstrated ritual rather than exploratory discourse.
2	Ombay & Roble (2020)	Students	Mathematical modelling	Mathematical activity involved dynamic shifts between ritual and exploratory discourse.
3	Zayyadi et al. (2019)	Junior high school students	Mathematical problem solving	Students mainly relied on ritual routines during problem solving.
4	Toscano et al. (2019)	Pre-service primary teachers	Didactical discourse	Commognitive theory effectively analyzed teacher discourse during mathematical tasks.
5	Schüler-Meyer (2019)	University students	Transition to tertiary mathematics	Commognitive conflicts emerged during conceptual transition.
6	Chan et al. (2022)	Low-achieving students	Mathematical equivalence	Interactive learning artifacts promoted exploratory mathematical discourse.
7	Trouche et al. (2023)	Pre-service teachers	Pedagogical commognition	Pedagogical knowledge involved all commognitive components with varying emphasis.
8	Zayyadi et al. (2020)	Grade 10 students	Trigonometric functions	Teacher guidance facilitated students' transition from ritual to exploratory routines.
9	Ombay & Roble (2020)	K–12 students	Repetition with complex variation	Complex variation improved students' commognitive competence.
10	Hundeland et al. (2020)	Kindergarten children	Mathematical discourse	Classroom discourse quality differed across kindergartens and influenced learning opportunities.
11	Shinno & Fujita (2022)	Primary school students	Mathematical proof	Students gradually developed proof through evolving discourse routines.
12	TURCOMAT (2021)	Students	HOTS problem solving	Errors occurred across word use, visual mediators, narratives, and routines.
13	Lefrida (2021)	University students	Derivative learning	Students' discourse remained largely ritualistic across commognitive processes.
14	Pratiwi (2022)	Secondary school students	Algebraic functions	Traditional teaching emphasized ritual routines rather than exploratory discourse.
15	Gavilán-Izquierdo et al. (2022)	Undergraduate students	Graph theory	Commognitive conflicts provided opportunities for instructional improvement.
16	Gallego-Sánchez et al. (2022)	Secondary mathematics teacher	Pedagogical routines	Exemplary instructional routines supported conceptual understanding of derivatives.
17	Daher (2020)	School students	Collaborative discourse	Communication gaps and discourse development were identified through commognitive analysis.
18	Kontorovich & Ovadiya (2023)	Transition students	Quantified statements	Meta-level discourse shifts supported advanced mathematical reasoning.
19	Schüler-Meyer (2022)	Transition students	Opportunities to learn	Guided exploration enhanced discourse development during mathematical transition.

No.	Authors	Participants	Research Focus	Main Findings
20	Christiansen et al. (2023)	Mathematics classrooms	Theoretical perspectives	Multiple theoretical lenses complemented one another in classroom analysis.
21	Swidan & Daher (2019)	Mathematics students	Logic and set theory	Mathematical discourse developed through word use, narratives, visual mediators, and routines.
22	Heyd-Metzuyanim & Graven (2019)	Students	Fraction learning	Ritual routines frequently generated commognitive conflicts.
23	Valenta & Enge (2022)	University students	Mathematical proving	Feedback and questioning promoted reroutinization of mathematical practices.
24	Lu, Zhang, et al. (2023)	Teacher–student pairs	Online collaborative problem solving	Alternating commognitive responsibility enhanced collaborative learning.
25	Lu, Tuo, et al. (2023)	Student pairs and groups	Collaborative problem solving	Pairs showed higher commognitive performance than larger groups.
26	Kontorovich & Ovadiya (2023)	Undergraduate tutors	Tutor reflection	Narratives supported tutors' professional reflection on teaching.
27	Zulu (2023)	Pre-service mathematics teachers	Visualization and self-discourse	Visualization and self-discourse enhanced mathematical problem solving.
28	Lu, Zhang, et al. (2023)	Student pairs	Commognitive conflict	AI-supported visualization facilitated diagnosis of commognitive conflicts.

Discussion

This systematic literature review provides a comprehensive overview of the development of commognitive research in mathematics education between 2018 and 2023. The findings indicate a steady increase in scholarly interest in the commognitive framework, particularly after 2020, with publication activity reaching its highest level in 2022. This trend reflects the growing recognition of Sfard's commognitive theory as a valuable framework for understanding mathematical thinking through discourse rather than treating cognition and communication as separate constructs (Sfard, 2007, 2008). The increasing number of publications also suggests that researchers have expanded the application of the framework from describing students' mathematical communication to investigating broader educational issues, including teacher education, collaborative learning, proof construction, and technology-supported learning.

One notable finding is that Indonesia contributed the largest number of studies included in this review. This trend demonstrates the increasing interest of Indonesian mathematics education researchers in discourse-oriented learning theories, particularly those emphasizing communication as the foundation of mathematical thinking. Several studies conducted in Indonesia employed the commognitive framework to analyze students' mathematical problem-solving processes, discourse patterns, and pedagogical practices (Lefrida, 2021; Rossydhya et al., 2021; Zayyadi et al., 2019, 2020). However, the concentration of studies within a single country also indicates an imbalance in the geographical distribution of research. Although contributions from Europe, Israel, China, Australia, South Africa, and the Philippines continue to expand, further empirical investigations across diverse educational systems are needed to strengthen the international generalizability of commognitive research.

The review further demonstrates that the commognitive framework has been implemented across multiple educational levels, ranging from kindergarten to higher education. Nevertheless, the majority of studies focused on primary, secondary, and pre-service teacher education. This distribution is consistent with the original purpose of commognitive theory, which seeks to explain how learners participate in mathematical discourse while gradually transitioning from ritualized to exploratory routines (Sfard, 2007). Studies involving younger learners highlighted how classroom discourse shapes

opportunities for mathematical learning (Hundeland et al., 2020), whereas investigations in higher education primarily examined conceptual transitions, mathematical proving, and undergraduate discourse (Kontorovich & Ovadiya, 2023; Schüler-Meyer, 2019, 2022a). These findings suggest that the framework is sufficiently flexible to investigate mathematical learning throughout different stages of education.

The thematic analysis reveals that mathematical discourse remains the dominant research focus within commognitive studies. Most reviewed articles investigated students' use of mathematical language, narratives, routines, and visual mediators while solving mathematical problems or participating in classroom discussions. These four components represent the core analytical elements proposed by Sfard (2008), and their continued use demonstrates the theoretical consistency of contemporary commognitive research. Beyond discourse analysis, researchers have increasingly examined collaborative problem solving, visualization, teacher discourse, pedagogical routines, and proof construction (Chan et al., 2022; Lu, Zhang, et al., 2023; Shinno & Fujita, 2022). The emergence of these topics indicates that the framework has evolved beyond descriptive analyses of classroom communication toward broader investigations of collaborative learning and instructional design.

The bibliometric analysis further supports these findings by illustrating the evolution of research themes over time. The network visualization identifies strong connections among keywords such as commognitive framework, mathematical discourse, problem solving, collaborative learning, visual mediator, and routine. Overlay visualization also demonstrates that earlier studies primarily focused on understanding mathematical discourse and conceptual learning, whereas more recent publications have increasingly examined collaborative problem solving, technology-supported learning, and visualization of commognitive conflicts (Lu, Tuo et al., 2023; Lu, Zhang, et al., 2023). This progression reflects an important shift from describing discourse toward designing learning environments that intentionally facilitate productive mathematical communication.

Despite the increasing number of publications, several research gaps remain evident. First, most studies employed qualitative case study approaches that analyzed relatively small samples within specific classroom contexts. While these designs provide rich descriptions of discourse development, they limit the generalizability of the findings. Second, longitudinal investigations examining how learners' mathematical discourse develops over extended periods remain scarce. Third, intervention studies designed to evaluate the effectiveness of instructional strategies based on commognitive principles are still limited. Consequently, future research should incorporate mixed-methods and longitudinal designs to examine how instructional interventions influence students' transition from ritualized to exploratory discourse over time.

Another notable gap concerns the disciplinary scope of commognitive research. Nearly all studies identified in this review were conducted within mathematics education. Although this focus is theoretically appropriate because commognitive theory originated from mathematics learning, its underlying principles may also contribute to understanding discourse in science education, engineering, language learning, or interdisciplinary STEM contexts. Expanding the application of the framework beyond mathematics would provide valuable evidence regarding its broader educational relevance and theoretical robustness.

This review also highlights methodological implications for future systematic reviews. Although the reviewed studies consistently adopted the four fundamental components of commognitive analysis, considerable variation exists regarding research design, participant characteristics, and analytical procedures. Future reviews may benefit from incorporating quality appraisal frameworks and more comprehensive database coverage to strengthen methodological rigor. Furthermore, integrating bibliometric techniques with thematic synthesis offers a more comprehensive understanding of research development than relying solely on descriptive summaries.

Overall, the findings demonstrate that commognitive theory has become an established analytical framework for investigating mathematical learning through discourse. The growing diversity of research topics, educational contexts, and methodological approaches reflects the maturation of this research area. Nevertheless, future investigations should move beyond descriptive discourse analysis

toward longitudinal, experimental, and interdisciplinary studies that strengthen both the theoretical development and practical application of the commognitive framework. Such efforts will contribute to a deeper understanding of how mathematical communication supports conceptual development and will provide stronger evidence for designing classroom practices that promote meaningful mathematical learning.

4. CONCLUSION

Preliminary research has been described in this study to inform readers of the use of commognitive keywords in the learning process. It can be concluded that Indonesia is one of the countries that discusses commognitive a lot. The development of publications per year from 2018, which only had two publications, then the average in 2019, 2020, and 2021 was four articles, jumped up in 2022 with 12 articles and fell back in 2023 with two articles. The subjects that have been studied range from kindergarten to university students. Commognitive, which is a form of interpersonal and intrapersonal communication relationship, is often seen through mathematical discourse. When viewed from the research questions and research objectives, this study looks at the commognitive aspects of the research subjects in solving mathematical problems both individually and in collaborative problem-solving. Finally, the bibliometric results also support the manual findings conducted by researchers and strengthen the results presented. The findings of this study provide a foundational framework for future research within the commognitive tradition, offering both methodological insights and empirical data that can be extended to broader educational contexts.

Teachers' recognition and understanding of this commognitive in the future will have a positive impact. When teachers realize the need to provide word use habituation, do various kinds of visual mediators to students, such as using concrete, iconic, and symbolic media, routines, both ritual and explorative, and narrative will make students have good communication and cognition skills. In addition to looking at students' commognitive in solving math problems. Future researchers can also look at the commognitive of prospective teachers or teachers in teaching subject matter in the classroom. for example, in mathematics subjects, researchers can examine how teachers teach mathematics based on a commognitive lens. The development of learning tools, such as teaching materials also needs to make commognitive theory the basis for its development.

This research still has limitations in how to collect articles. Due to time constraints, researchers only collected articles that were open access. The database also needs to be added, for example, taken from the main database Scopus, Garuda <https://garuda.kemdikbud.go.id/>, PubMed, Dimensions, Directory of Open Access Journals (DOAJ), and other databases.

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