

Bibliometric Analysis on Metacognition and Self-Regulation Using Biblioshiny Software

V. Devaki¹, Dr.E. Ramganes² and Dr.S. Amutha³

¹Research Scholar, Department of Educational Technology, Bharathidasan University, Khajamalai Campus, Tiruchirappalli, Tamil Nadu, India

²Senior Professor, Department of Educational Technology, Bharathidasan University, Khajamalai Campus, Tiruchirappalli, Tamil Nadu, India

³Assistant Professor, Department of Educational Technology, Bharathidasan University, Khajamalai Campus, Tiruchirappalli, Tamil Nadu, India

E-mail: ¹devakikarthick2011@gmail.com, ²eramganes68@gmail.com, ³amutha@bdu.ac.in

ORCID: ¹<https://orcid.org/0000-0002-7109-0205>, ²<https://orcid.org/0000-0002-0022-3154>,

³<https://orcid.org/0000-0002-0425-6172>

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Abstract - This study aims to conduct a systematic review of Metacognition and Self-Regulation (MSR), with a focus on current trends and contributions. Initial analysis involves Elsevier's Scopus database spanning from 1988 to 2023, with refined search parameters including source type, language, and document type. Later, bibliometric analysis was conducted using Biblioshiny software, exploring various factors derived from the Scopus core collection database (N=428) on the search title MSR. The results highlight trending topics such as cognition, engineering design, memory, and engineering education. Notably, the most prevalent co-occurrence network involves metacognition, student, and self-regulated learning. Analysis of the most influential authors, affiliated institutes, citation analysis, and source production was discussed. The objective of this paper is to assist researchers and scholars in understanding and analyzing contemporary trends in MSR, as well as suggesting further empirical research to explore additional principles related to metacognition and self-regulated learning.

Keywords: Scientific Production, Citations, Metrics, Metacognition, Self-regulated, Author Affiliation, Bibliometric Analysis, Biblioshiny Software

I. INTRODUCTION

Literature reviews are integral components of academic research, serving to consolidate existing knowledge and evaluate the current landscape within a specific field (Cropanzano, 2009; Kunisch et al., 2018). Prior to embarking on new research endeavors, scholars typically engage in a comprehensive examination of available evidence concerning a particular topic or issue. In the realms of metacognition and related approaches, strategies, and techniques used by researchers to justify their research inquiries through narrative literature. Often, these reviews lack transparency regarding the inclusion or exclusion of specific articles, books, or conference papers, with authors frequently citing evidence from journals deemed to be of 'high quality' while neglecting a broader spectrum of sources (Tranfield et al., 2003). However, relying solely on such

selective evidence can result in an incomplete representation of existing knowledge, leading to sample selection bias a statistical phenomenon wherein non-random data selection skews subsequent analysis (Hakkaraki, 2023). Consequently, narrative reviews frequently fall short in providing a comprehensive foundation for theory development and testing (Sternberg, 1991; Sutton & Staw, 1995). The importance of systematic literature reviews has long been recognized in certain fields like metacognition; however, there remains a scarcity of methodological guidance on how to effectively organize and structure such reviews and related literature (Denyer & Tranfield, 2009). This is somewhat surprising considering the abundance of resources available to researchers regarding various scientific methodologies such as survey research, experimental designs, or panel data analysis, which emphasize replicable and rigorous approaches to data collection and analysis (Bae & Ha, 2021). The essence of a systematic review lies in its methodical collection of available evidence followed by a systematic evaluation against predefined criteria, contrasting with the unsystematic approach of selectively reviewing studies deemed suitable by the researcher (Tranfield et al., 2003). Consequently, a systematic review aims to strike a balance between exhaustively identifying a broader range of publications and systematically identifying a smaller subset of studies meeting inclusion criteria, thereby contributing to the development of research agendas.

In this study, we offer a comprehensive exploration of metacognition and its significance across diverse fields, drawing upon theoretical concepts as well as employing bibliometric analysis (Utomo & Latukismo, 2022). Through this approach, we identify emerging trends and pinpoint research areas that align with contemporary needs (Arora, 2024). Pioneering investigations into metacognition can be traced back to the seminal work of Jean Piaget and Lev Vygotsky in developmental psychology. However, the

conceptual groundwork for contemporary studies began with Flavell's introduction of the term 'metacognition'. Over the past five decades, scholarly attention has predominantly centered on children's comprehension, memory, cognition, and self-awareness of their cognitive processes. This research has elucidated three key dimensions of metacognition: metacognitive knowledge, metacognitive experiences, and metacognitive regulation, which govern the management of one's cognitive functions. The intersection of metacognition and cognitive processes has prompted extensive investigation into learning challenges, particularly regarding the association of metacognitive dysfunction with schizophrenia, and the beneficial effects of metacognition for students across various profiles, including those with learning disabilities and gifted individuals. Central to these processes are self-monitoring and self-regulation, pivotal components enabling individuals to discern and control their emotions, behaviors, and cognitive activities. The cultivation of self-regulation is posited to enrich teaching and learning experiences, enhancing individuals' capacity to govern their cognitive processes effectively. Metacognition, situated within the realms of psychology and cognitive science, encompasses the introspective examination and regulation of cognitive processes. This interdisciplinary field of inquiry encompasses a multifaceted exploration of metacognitive monitoring, control, lifespan development, implications for learning and academic success, decision-making, problem-solving, neurological foundations, and individual differences. Through an amalgamation of insights from psychology, neuroscience, education, and allied disciplines, research in this domain strives to deepen our understanding of how individuals engage in self-reflection and cognitive management. This study aims to elucidate current trends and ascertain whether the focal point continues to captivate researchers' interests, particularly concerning metacognition and self-regulated learning.

II. BACKGROUND OF THE STUDY

The realm of academic knowledge is experiencing exponential growth, with a continual influx of new articles, reports, and other materials being published daily. By 2009, the number of scholarly articles had already exceeded 50 million (JINHA, 2010), and recent years have seen even more rapid increases, partly due to the proliferation of predatory journals that churn out large volumes of low-quality research, often in open-access formats (Demir, 2018). These trends have led to an uncontrolled expansion of knowledge across various outlets and academic disciplines, making it increasingly challenging even for experts to stay abreast of new developments. The sheer volume of information, coupled with the time required to assess and evaluate it, presents significant hurdles. Researchers find it daunting to identify pertinent studies, critically appraise their content and quality, and synthesize available results (Ahmed et al., 2021). Consequently, selecting which evidence to incorporate or disregard for advancing a field of knowledge poses a considerable challenge for future research and publications.

Systematic literature reviews offer valuable solutions to address these challenges and contribute significantly to various stages of the research process. They assist in establishing a contextual framework and defining research problems, as well as in seeking theoretical underpinnings and justifying new lines of inquiry (Marinković et al., 2024). By distinguishing between existing and unresolved issues, they help researchers identify fruitful avenues for further investigation and comprehend the primary outcomes and methodologies employed in prior studies. Additionally, they serve the crucial purpose of steering researchers away from unproductive endeavors. For researchers aiming to contribute to existing knowledge, a fundamental question arises: What is already known and unknown about the subject of investigation, and where lie the promising paths for further exploration? Such reviews can pinpoint major research trends and suggest future research trajectories. Conversely, when exploring new research domains or constructing novel theories, researchers need to understand the relationship between their work and existing fields or theories. In these cases, literature reviews play a pivotal role in elucidating the new research landscape and its connections with established paradigms. Moreover, literature reviews can prove invaluable when researchers are motivated by the absence of prior research on a particular issue. Even if only a handful of relevant studies exist, a review can serve as a springboard for discussing knowledge gaps and articulating how researchers intend to address them. Furthermore, systematic literature reviews are increasingly recognized for their potential to provide insights and guidance to practitioners and policymakers. While traditionally of secondary importance in the management field, these reviews now play a vital role in informing practical interventions and policy decisions (Tranfield et al., 2003).

A critical examination of 'metacognition and self-regulation' was conducted through a bibliometric analysis, aiming to identify key sources related to the search titles 'metacognition/metacognitive/self/regulated/self-regulated' from the Scopus database (Báez-Vizcaíno, 2023). Scopus, an Elsevier multidisciplinary abstract and citation database, is widely utilized by academic institutions, researchers, and scholars for citation analysis, literature review composition, and research evaluation across various academic disciplines (Vieira & Gomes, 2009). It encompasses thousands of scholarly publications, conference proceedings, and patents, covering diverse topics in social science, arts, humanities, technology, science, and medicine (Moed et al., 2013). The database includes academic studies such as book chapters, conference papers, scholarly articles, and patents. In addition to providing article abstracts, Scopus tracks citation information, enabling researchers to gauge an article's impact and relevance by indicating the number of times it has been cited by other scholars (Boyle & Sherman, 2006). Users can explore the database for scholarly articles on specific topics using authors, keywords, or particular fields, with advanced search options available for refining results. Scopus facilitates tracking an author's publications, h-index, and citation history through author profiles. It also offers journal

metrics like CiteScore, which indicates the average number of citations received per publication in a journal over a defined period. Users can set up alerts to receive notifications when new articles meeting their criteria are added to the database (Burnham, 2006).

Furthermore, Scopus provides an API (Application Programming Interface) for developers to integrate its data into their systems or applications. Researchers often combine Scopus data with other databases and analyze them using suitable research tools to obtain comprehensive information for their work. Access to Scopus typically requires institutional subscriptions, with many universities, research centers, and libraries granting members access. Individuals affiliated with Scopus-affiliated academic institutions can also access the database through their institution's library website (Guz & Rushchitsky, 2009). As with any research

endeavor, the value of a systematic review hinges on rigorous methods and clear reporting, coupled with the application of scientific strategies to minimize potential errors and biases (Moher et al., 2010). The underlying principle of a systematic literature review is replicability, ensuring that another researcher can replicate the review process and arrive at the same set of evidence and conclusions. A systematic review entails a comprehensive search of designated databases such as Web of Science and Scopus, supplemented by additional literature that may not be accessible through these databases. It necessitates a meticulous process for analyzing and synthesizing relevant information. Although systematic reviews are not yet widespread in the management sciences, recommendations for desirable steps are beginning to emerge (Tranfield et al., 2003). The typical structure of a standalone systematic review mirrors that of a scientific article, encompassing an introduction/background section, a method.

TABLE I PUBLICATIONS ON BIBLIOMETRIC ANALYSIS IN THE PAST FIVE YEARS

Authors	Year	Title	Source Title
Tao X.; Hanif H.; Ebrahim N.A.	2023	Emerging Trends of Self-regulated Learning: A Comprehensive Bibliometric Analysis	World Journal of English Language
Poszytek P.; Hycza-Michalska M.; Brodny J.; Wawrzala P.; Gębal P.; Lisok J.; Kruszewska J.; Sigurðardóttir A.G.; Bugnova M.; Dobrowolska M.	2023	Theoretical Review of Research to Date on Competences 4.0—What Do We Know about Competences in Industry 4.0? A Status Quo Analysis	Sustainability (Switzerland)
Yu Z.; Li M.	2022	A Bibliometric Analysis of Community of Inquiry in Online Learning Contexts over Twenty-five Years	Education and Information Technologies
He X.; Singh C.K.S.; Ebrahim N.A.	2022	Quantitative and Qualitative Analysis of Higher-Order Thinking Skills in Blended Learning	Perspektivy Nauki i Obrazovania
Kiraz S.; Demir E.	2021	Global Scientific Outputs of Schizophrenia Publications from 1975 to 2020: A Bibliometric Analysis	Psychiatric Quarterly
Li J.; Antonenko P.D.; Wang J.	2019	Trends and Issues in Multimedia Learning Research in 1996–2016: A Bibliometric Analysis	Educational Research Review

Section defining sampling and analysis procedure, a results section outlining key findings, and a discussion and conclusion section elucidating theoretical contributions or proposing new research directions. In order to know the reviews on bibliometric related article pertaining to metacognition and self-regulated learning was collected from the Scopus database. The search result shows 20 documents out of that the relevant source of six articles were discussed and listed in Table I. The area of bibliometric analysis was done on the self-regulated learning community of inquiry in an online learning context, higher-order thinking skills in blended learning, competencies 4.0, schizophrenia, and multimedia learning. In 2019, Li Jingwei et al. article published in the journal Educational Research Review analysed the trends and issues in multimedia from 1996 to 2016. The article provided an overview of 411 peer-reviewed articles. The research analysis found the highest co-occurrence of keywords like cognitive load, research trends, and cluster analysis while studying the issues related to an individual's attention and cognitive learning using multimedia (Li et al., 2019).

The authors Kiraz Seda Demir Emre examined findings from the Web of Science database on the topic of schizophrenia using the bibliometric method. Additionally, Spearman's correlation coefficient was used to study the interrelationship between the publication count in a country, its corresponding

gross domestic product and human development index values (Kiraz & Demir, 2021). Yu Zhonggen and Li Ming's article, the Community of Inquiry Framework for 25 years, uses bibliometric analysis. It uses CitNetExplorer's clustering techniques to analyse the top ten authors, sources, organisations, and nations and employs VOS viewer to create citation networks (Yu & Li, 2022). In another study, the research articles published between 2011 and 2020 on the topic of 'Higher-order thinking skills' were collected from the Scopus database. The authors used bibliometric inquiry and visualisation to study the top keywords, the most common topics, and the influential countries (He et al., 2022). The article by (Poszytek et al., 2023) examines a much broader view of competencies 4.0 and covers language competencies that form the larger category of social competencies, including communication skills. In 2023, Tao Xue et al. created a core collection from the Web of Science database and studied self-regulated learning using bibliometric analysis. The study used suitable bibliometric software and the VOS viewer for visualisation to determine the most influential country, most influential journal, and related criteria (Tao et al., 2023). From this brief review, it transpires that the bibliometric analysis of MSR has been booming in recent years, revealing its application across diverse fields such as General Psychology, Clinical Psychology and learning, and special education. The systematic review on the

search title MSR are discussed in detail under the next following section.

III.METHODOLOGY

The data utilized for conducting bibliometric analysis to explore research trends on metacognition and self-regulation was sourced from the Scopus database. The data collection was done in December 2023 via the Scopus website's search tab, which offers two search engines: one for searching within documents and another for searching across documents. The search was conducted using keywords related to the topic, including "metacognition,"

"metacognitive," "self," "regulated," and "self-regulated." The search yielded 428 documents published between 1988 and 2023. Subsequently, two different analyses were conducted. The first one involved preferred reporting items for systematic analysis to refining the data through the Scopus database. The analysis was focused on document type, language, and source type. Specifically, the analysis was limited to articles published in English-language journals, resulting in the identification of 284 relevant articles. Figure 1 illustrates that the analysis was refined to include only journal articles in English. The second analysis was performed using Biblioshiny Software (BS), encompassing the entire dataset of 428 documents.

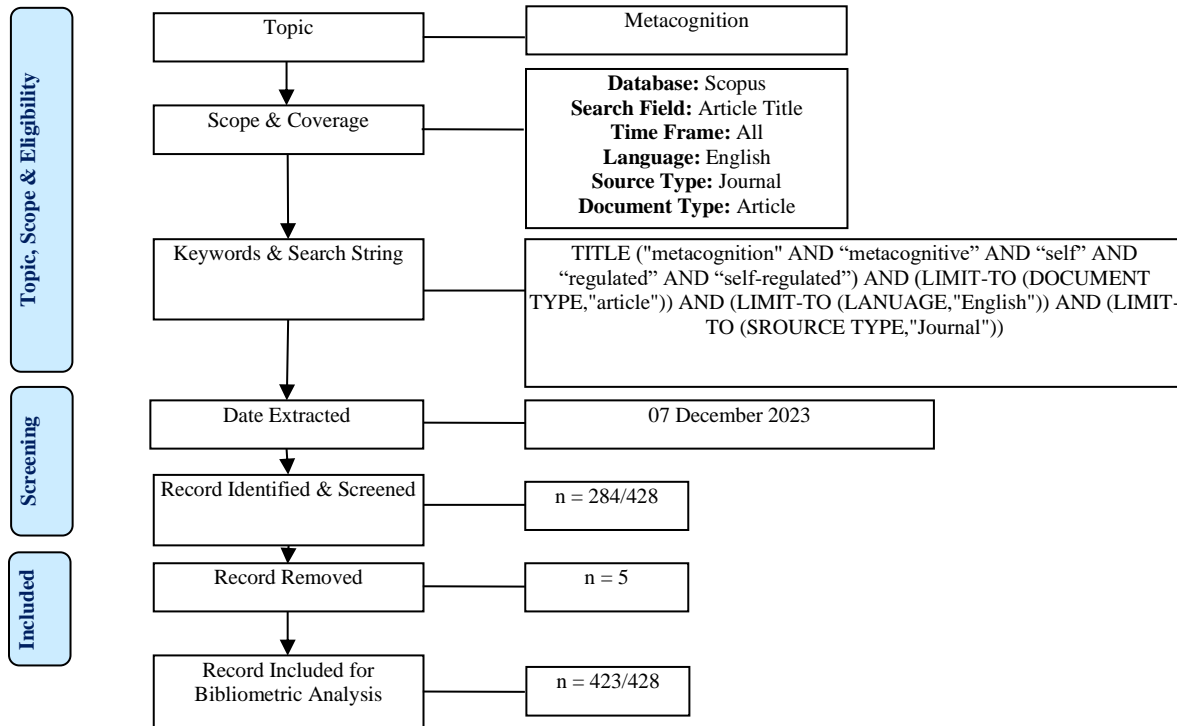


Fig. 1 Flow Diagram of the Search Strategy Using the Scopus Database; Source: (Zakaria et al., 2020)

This approach facilitated a comprehensive examination of research trends in the domain of metacognition and self-regulation by capitalizing on the functionalities of the Scopus database and specialized bibliometric analysis software (Aria & Cuccurullo, 2017). For the second analysis, the data source was also obtained from the Scopus database. Scopus allows for exporting results in various file formats such as CSV, RIS, BibTeX, and Plain text, and supports integration with reference management tools like Mendeley, RefWorks, Zotero, and EndNote. The data obtained from Scopus was meticulously analyzed by importing the BibTeX file into BS, as it exclusively reads imported BibTeX files. BS operates using the R-package, which can be freely downloaded from the bibliometrix.org website's homepage. To utilize the Bibliometrix and BS tools for analysis, it is essential to download and install the latest version of the R-package from <https://cran.r-project.org/>. This ensures a seamless and efficient analysis of bibliometric data obtained from the Scopus database. The installation of the R-package can be done according to specific operating system (OS)

requirements, as R-package is available for Linux, MacOS, and Windows platforms. After the initial installation, it is necessary to download the most recent version of Rstudio from www.rstudio.com (Jaichandran, R. et al., 2019). Before importing results from the Scopus database, it is crucial to ensure proper installation of both the R-package and Rstudio (Gandrud, 2018). Once this is confirmed, Rstudio for non-coders should be opened, and the command "install.packages("bibliometrix")" must be typed. Subsequently, the command "library(bibliometrix)" should be executed, followed by the command "biblioshiny ()". Executing the "biblioshiny ()" command in Rstudio directs the user to the BS tool. At this point, the downloaded BibTeX file can be imported into BS by selecting the relevant source, which in this case is the Scopus data. BS then processes the Scopus data for bibliometric analysis. During the analysis, five articles are filtered out due to discrepancies. One of the document sources displays the year of publication as 2024, while the remaining four documents lack complete reference details. Consequently, 423 documents are utilized for the

bibliometric analysis and discussed under various factors are interpreted in the next section.

IV. RESEARCH QUESTIONS

Considering the aforementioned, the following research questions have been selected for the study.

RQ1. What is the scope of the published literature in this specific area of study?

RQ2. What is the annual scientific production in the research field on MSR?

RQ3. Which scholarly journals cover the literature of this field, and which ones are considered the most prominent and how?

RQ4. Who are the leading authors in this field, and which institutions are more productive in this field?

RQ5. Which articles are considered the most impactful within this field?

RQ6. How each countries have contributed to this literature and their collaboration with other countries?

RQ7. What are the trending topic and most frequently used keywords in the field of study?

V. RESULTS AND ANALYSIS OF DATA

An essential stage in conducting a systematic review involves analyzing and synthesizing the existing evidence, which hinges on several factors including the quantity of studies included, the research methods employed by each study, the quality of evidence, and the chosen analytical or visualization techniques. When dealing with systematic reviews comprising a limited number of studies unsuitable for meta-analysis, researchers may opt to create tables summarizing criteria such as the research question, analysis context, methods used, sampling method, and key findings. For systematic reviews with larger samples, the analysis may be influenced by the type of evidence uncovered. If the evidence is predominantly qualitative or if studies vary greatly in methodology, qualitative techniques such as thematic coding and categorization can be utilized to extract insights from the studies. Alternatively, quantitative systematic reviews involve the systematic collection of primary studies. If the data permits, researchers may also statistically amalgamate findings and provide an analytical overview using meta-analytical approaches such as meta-analytic structural equation modeling or meta-analytic regression analysis (Combs et al., 2019). Here, with the included dataset of 423 documents, the study analysed the research questions mention under section IV and the interpretations was discussed.

RQ1. What is the Scope of the Published Literature in this Specific Area of Study?

Table II presents a breakdown of the types of documents analyzed in the context of MSR literature, offering insights into the breadth and composition of the scholarly sources studied through bibliometric methods. Among the primary sources utilized for this analysis, articles emerge as the predominant category, comprising 297 instances. Additionally, the examination encompasses a significant number of conference papers, totalling 73, indicating the relevance of research presented at academic conferences within the MSR domain. Further contributing to the dataset are three books and 23 book chapters, underscoring the inclusion of scholarly contributions from these formats.

TABLE II DOCUMENT TYPES USED FOR BIBLIOMETRIC ANALYSIS

Document Type	Total Publications
Article	297
Article conference paper	1
Book	3
Book chapter	23
Conference paper	73
Conference review	1
Erratum	1
Letter	1
Review	23
Total	423

Moreover, the analysis considers a single instance each of erratum, letter, and review, demonstrating a comprehensive approach to encompassing diverse document types within the study. Beyond document types, the scope of the literature examined extends across educational levels, encompassing both school-level and higher education contexts. Furthermore, the disciplinary coverage spans various fields, including general education, special education, and nursing education, suggesting a multidisciplinary approach to understanding MSR-related issues. In summary, Table II provides a detailed overview of the sources and disciplinary diversity within the MSR literature, facilitating a comprehensive understanding of the research landscape in this field.

RQ2. What is the Annual Scientific Production in the Research Field on MSR?

In the study of MSR research, certain authors stand out for their prolific contributions to the field, evident through their productive publications. The temporal progression of MSR research is visually depicted in Figure 2, showcasing a consistent rise in annual scientific output from 1988 to 2022. Notably, the period from 1988 to 2008 exhibited relatively lower research productivity, followed by a gradual increase starting from 2009, growing at an average rate of 14% annually. Subsequently, the years spanning from 2009 to 2023 witnessed a significant surge in scientific production within the MSR domain. This graphical representation, Table III likely presents detailed data regarding the total number of studies conducted each year over the past 15 years in the field of Mixed-Signal Regulation (MSR) or a related area of research. This Table III would offer a comprehensive

breakdown, year by year, showcasing the quantity of research undertaken within the specified timeframe. By examining this data, researchers can discern patterns, trends, and fluctuations in research activity over time, aiding in the understanding of the evolving landscape of MSR research.

TABLE III ANNUAL SCIENTIFIC PRODUCTION OF RESEARCH

Year	Annual Production of Research for the past 15 years
2023	39
2022	42
2021	35
2020	33
2019	35
2018	27
2017	34
2016	24
2015	19
2014	25
2013	17
2012	20
2011	20
2010	13
2009	14

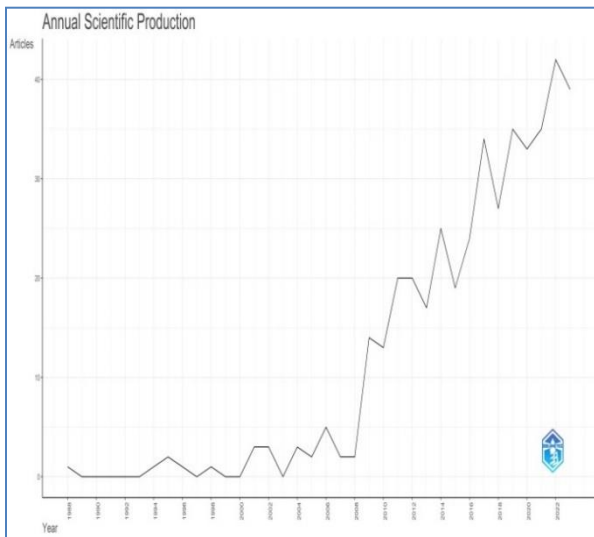


Fig. 2 Annual Scientific Production of Research

Additionally, this information could be valuable for assessing the overall growth and trajectory of the field, identifying key periods of increased activity or areas warranting further investigation.

RQ3. Which scholarly journals cover the literature of this field, and which ones are considered the most prominent and how?

The most relevant article source is from the journal source titled 'Metacognition and Learning', wherein 25 articles are available. The bibliometric analysis of the most suitable source shows a total of 255 entries from 423 documents. The top 10 journals are listed in Table IV. The second and third sources are from the 'Lecture Notes in Computer Science' and 'Learning and Individual Differences', which published 19 and 12 articles, respectively. The journal titled 'Frontiers in Psychology' published 11 articles, and the other sources such as CEUR workshop proceedings, and Journal of

Experimental Psychology: Learning, Memory, and Cognition have published 6 articles. The remaining other listed in Table IV, have 5 published articles among the top ten sources listed.

Three levels of key metrics are needed to determine the frequency of articles cited from a source, which are journal-level, article-level, and author-level information. Additionally, citation, speed, and acceptance rate are also required. All these metrics help academic studies and the development of research and take full benefit of research advancements.

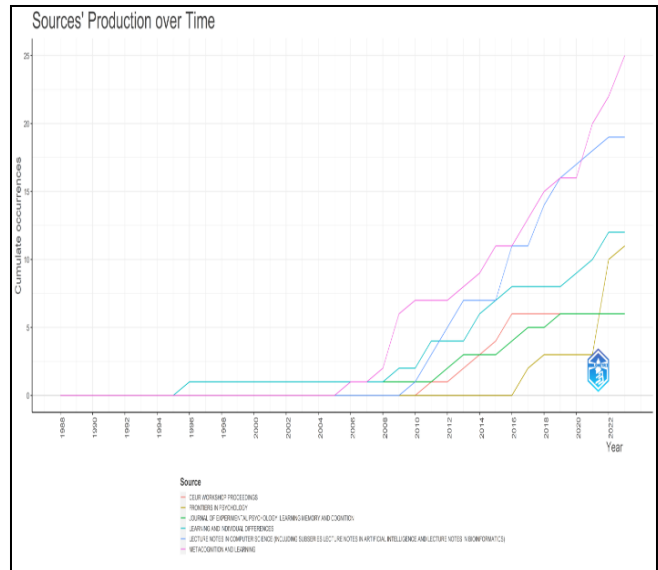


Fig. 3 Sources Production Over Time

Figure 3 shows the year-wise cumulative occurrence of the source production. In 1995, the source titled 'Lecture Notes in Computer Science' showed a greater publication rate than all the other sources. Then, from the year 2007, the source titled 'Metacognition and Learning' leads the available sources. The multi-faceted view of the sources can be understood from the local impact of the source. The researcher can get more information on the average number of citations received by a journal in a given calendar year about all the items published in the preceding three years using CiteScore. This crucial information certainly helps the research community to understand the emerging trends of research in a particular topic. Another quantitative method of research impact is the h-index. The h-index compares the quality and quantity of academic production and performance. It provides a statistic for assessing the overall effect of an author's work and helps to identify the contextual relevance of highly cited publications. Let's assume a certain number of citations are evenly distributed throughout a certain number of publications. In this case, the g-index effectively represents the highest value of the h-index that can be attained. The variant to illustrate the h-index is the m-index. It is the ratio of the h-index to the number of years from the time when the paper of the research is published. Table IV shows the Source Local.

TABLE IV SOURCES OF LOCAL IMPACT

Element	Articles	h_index	g_index	m_index	TC	NP	PY_start
Metacognition and Learning	25	15	25	0.833	1560	25	2006
Learning and Individual Differences	12	10	12	0.357	623	12	1996
Lecture Notes on Computer Science (including subseries lecture notes on Artificial Intelligence and Bioinformatics)	19	9	15	0.643	247	19	2010
Frontiers in Psychology	11	6	11	0.857	1043	11	2017
Journal of Experimental Psychology: Learning, Memory, and Cognition	6	6	6	0.333	347	6	2006
British Journal of Educational Psychology	5	5	5	0.5	125	5	2014
Instructional Science	5	5	5	0.227	82	5	2002
Journal of Educational Psychology	5	5	5	0.333	346	5	2009
Learning and Instruction	5	5	5	0.385	480	5	2011
British Journal of Educational Technology	5	4	5	0.8	117	5	2019

Impact, which is a reliable report for the researcher to know the details about the notable source to be cited for a research paper. The search on the title MSR displays the source 'Metacognition and Learning' with a 15 h-index, 25 g-index, 0.833 m-index, with a Total Citation (TC) of 1560. The Number of Publications (NP) is 25, and this source begins in the Year of Publication (PY), which is from 2006. The second source of local impact is 'Learning and Individual Differences', with an h-index of 10, g-index of 12, m-index of 0.357, TC of 623, NP of 12, with the PY beginning from 1996. The bibliometric analysis search results provided by Biblioshiny show 209 entries for source local impact. Out of these, the top 10 entries are listed in Table IV. This provides the researcher with more information about the source to be cited for the research article on the topic 'Learning and Individual Difference'.

RQ4. Who are the leading authors in this field, and which institutions are more productive in this field?

This section helps a researcher know about the most influential authors on a given topic, thereby enabling them to write the literature review and the introduction sections of a research article effectively. In the bibliometric search of MSR for the years 1988-2023, the most productive author is found. The Table V provides information on the number of articles authored by different individuals. Azevedo R leads the list with 29 articles, indicating significant contributions to academic literature, likely across various research areas. Following Azevedo R is Taub M published 12 articles, reflecting a substantial but comparatively smaller contribution to scholarly work. Lawanto O and Santoso HB have authored 9 and 8 articles respectively, showcasing their notable involvement in academic research. Bouchet F and Kramarski B each have contributed 7 articles, suggesting consistent contributions to the field. Efklides A follows published 6 articles, while Conlan O, Jarvela S, and Karlen Y have authored 5 articles each, demonstrating their active participation in academic discourse. This Table V sheds light on the research productivity of individual authors, providing insights into their scholarly output and potential areas of expertise.

TABLE V MOST INFLUENTIAL AUTHOR

Authors	Articles
Azevedo R	29
Taub M	12
Lawanto O	9
Santoso HB	8
Bouchet F	7
Kramarski B	7
Efklides A	6
Conlan O	5
Jarvela S	5
Karlen Y	5

The Biblioshiny Software analyse most influential universities and interpret top ten productive universities in research. The Table VI shows the highly influential universities and corresponding authors as sourced from the Scopus database. North Carolina State University has authored 26 scholarly articles pertaining to the subject matter, indicative of its substantive engagement and scholarly prowess across diverse disciplinary domains, notably encompassing the spheres of science and engineering.

McGill University, esteemed for its global prominence and multifaceted scholarly pursuits, has contributed 14 scholarly articles to the discourse, thereby underscoring its steadfast dedication to the advancement of knowledge in the domain of self-regulated learning. With a corpus of 10 scholarly articles, Utah State University's notable involvement underscores its eminence in educational and psychological research, particularly in elucidating efficacious pedagogical strategies conducive to self-regulated learning paradigms. The University of Central Florida, distinguished as one of the preeminent educational institutions in the United States, has produced 8 scholarly articles, emblematic of its substantive contributions and diverse scholarly perspectives within the realm of self-regulated learning research. These academic institutions exemplify a steadfast commitment to scholarly excellence and intellectual inquiry within the domain of self-regulated learning, each enriching the scholarly landscape with distinctive insights and contributions aimed at advancing pedagogical theory and practice.

TABLE VI MOST RELEVANT AFFILIATION

Affiliation	Articles
North Carolina State University	26
McGill University	14
Utah State University	10
University of Central Florida	8
University of California	7
University of Illinois at Urbana-Champaign	7
University of Memphis	7
Aristotle University of Thessaloniki	6
Bar-Ilan University	6
Kent State University	6

RQ5. Which articles are considered the most impactful within this field?

TABLE VII MOST RELEVANT COUNTRIES OF CORRESPONDING AUTHOR

Country	Articles	SCP	MCP
USA	105	93	12
Germany	21	17	4
Canada	14	8	6
China	14	11	3
United Kingdom	14	11	3
Switzerland	12	9	3
Israel	11	11	0
Australia	10	9	1
Netherlands	9	4	5

Ernesto Panadero's paper titled "A Review of Self-regulated Learning: Six Models and Four Directions for Research", published in the journal *Frontiers in Psychology* in 2017, received 952 citations (Panadero, 2017). The corresponding author, Bjork's article "Self-Regulated Learning: Beliefs, Techniques, and Illusions", published in 'The Annual Review of Psychology' in 2013, was cited 872 times (Bjork et al., 2013). The third top corresponding author, G Schraw's article "Promoting Self-Regulation in Science Education: Metacognition as Part of a Broader Perspective on Learning", published in the journal 'Research in Science Education' in 2006, received 732 citations (Schraw, 2001). Author Efklides obtained 575 citations for his article titled "Interactions of metacognition with motivation and affect in self-regulated learning: The MASRL model", published in 'Educational Psychologist' in 2011 (Efklides, 2011). The top ten corresponding authors with the citations received are graphically presented in Figure 4. Thus, this interpretation helps the researchers to understand the highly cited articles and most impactful author who search articles on the topic of MSR.

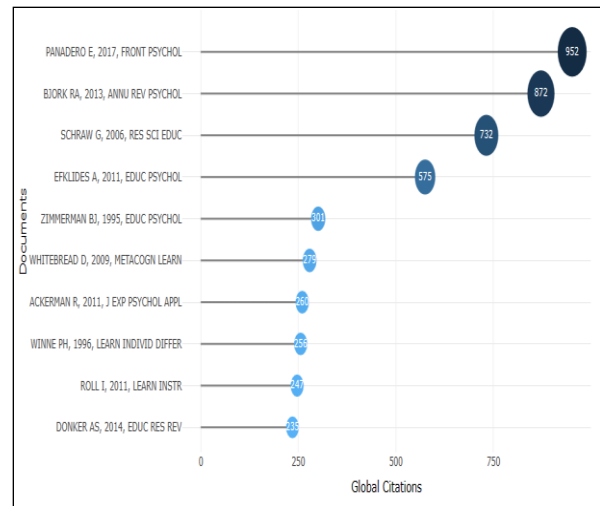


Fig. 4 Most Cited Document

RQ6. How each countries have contributed to this literature and their collaboration with other countries?

To analyse the social network across papers, Figure 5 depicts collaboration between countries and publications. Single-Country Publication (SCP), also known as intra-country publication, is found to be higher when compared to Multiple-Country Publication (MCP) or inter-country publication. Bibliometric analysis shows that among the top ten productive countries, the USA tops the list. The analysis shows that countries like Israel, Greece, Spain, Romania, and Estonia do not collaborate with other countries when it comes to producing research publicat

The Table VII presents an analysis of research articles categorized by country of origin, delineating between single-country publications (SCP) and multiple-country publications (MCP). The tabulated data offers insights into the geographic distribution and collaborative patterns within research on the subject matter. Among the total articles analyzed, the United States emerges as the most prolific contributor, accounting for approximately one-third of the total publications. This dominance aligns with the country's robust research infrastructure and extensive investment in academic endeavors. Germany, Canada, China, and the United Kingdom follow suit, each contributing a notable number of articles to the discourse. These findings underscore the global nature of research on the topic, with contributions emanating from diverse geographical regions.

Interestingly, while the majority of publications are single-country endeavors, representing the autonomy and expertise of individual research communities, a substantial portion comprises collaborative efforts across multiple countries. This phenomenon reflects the increasing recognition of the interdisciplinary nature of the subject and the imperative for cross-border cooperation in addressing complex research questions. Notably, Israel stands out as a country with a high proportion of SCP, indicative of its self-sufficiency and innovation in research endeavors pertaining to the subject matter. Overall, the data elucidates the

multifaceted landscape of research on the topic, characterized by both national and international collaboration, and underscores the collective effort aimed at advancing knowledge and understanding in the field of study.

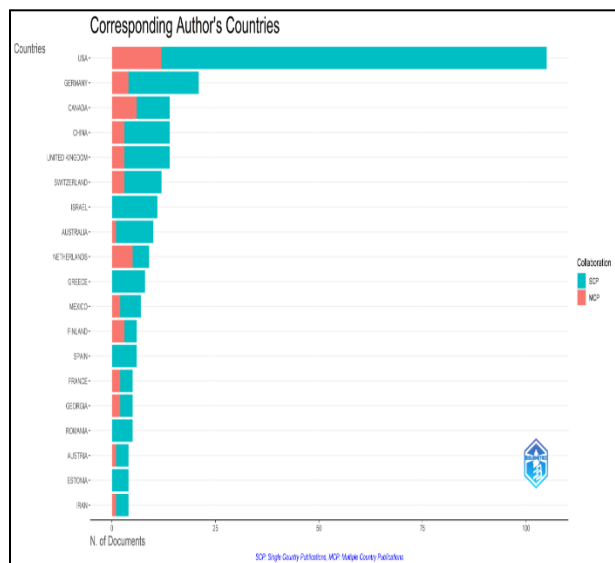


Fig. 5 Corresponding Author's Countries

RQ7. What are the trending topic and most frequently used keywords in the field of study?

On analysing 423 documents the most frequently used keywords related to the search title MSR the trend topic can be understand from the Table VIII. The tabulated data delineates the prevalence of distinct thematic elements within the context of the trend topic under scrutiny. With cognition prominently featured with a frequency of 30, it signifies a pervasive emphasis on cognitive processes within the discussed domain.

Moreover, attention garners substantial attention with a frequency of 11, underscoring its recognized significance within the discourse, possibly indicative of its crucial role in cognitive frameworks or educational methodologies. Memory, referenced 13 times, emerges as another salient aspect, suggestive of its pertinence in understanding learning mechanisms or educational practices.

TABLE VIII TREND TOPIC OF THE STUDY

Trend Topic	Frequency
psychological aspect	5
engineering design	5
cognition	30
reading	8
attention	11
curricula	8
memory	13
surveys	7
hypermedia systems	6
engineering education	18

Engineering education, with a frequency of 18, signifies its notable presence within the trend topic, potentially implicating pedagogical methodologies or curriculum frameworks tailored for engineering disciplines. Conversely,

psychological aspects and engineering design manifest with similar frequencies of 5, indicative of their concurrent relevance within the discourse, possibly suggesting interdisciplinary intersections or holistic considerations in addressing the trend topic. The mention of curricula, reading, surveys, and hypermedia systems, with frequencies ranging from 6 to 8, further diversifies the thematic spectrum, illustrating the multifaceted nature of the trend topic and the varied lenses through which it is examined or approached within scholarly discourse. The most trended topic on MSR presently is 'autoregulation'. Figure 6 shows a lot of research being carried out on related areas like human experiments, curriculum, knowledge, articles, e-learning, metacognitive awareness, human psychology, child, and metacognition from 2006 to 2023. Some of the topics like memory, ageing, learning, and knowledge have been frequently used and researched for more than a decade.

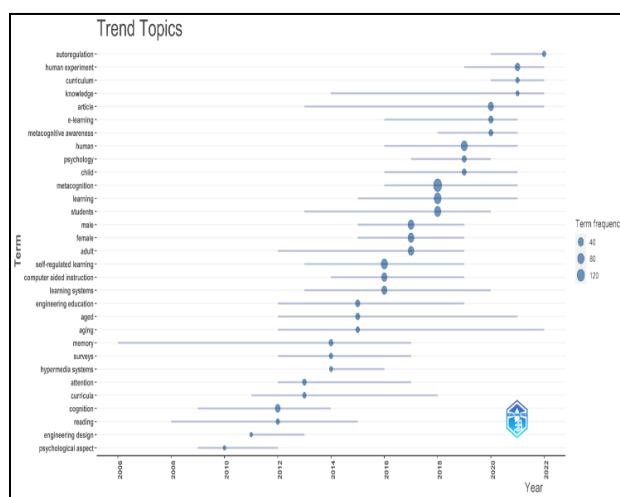


Fig. 6 Trending Topics

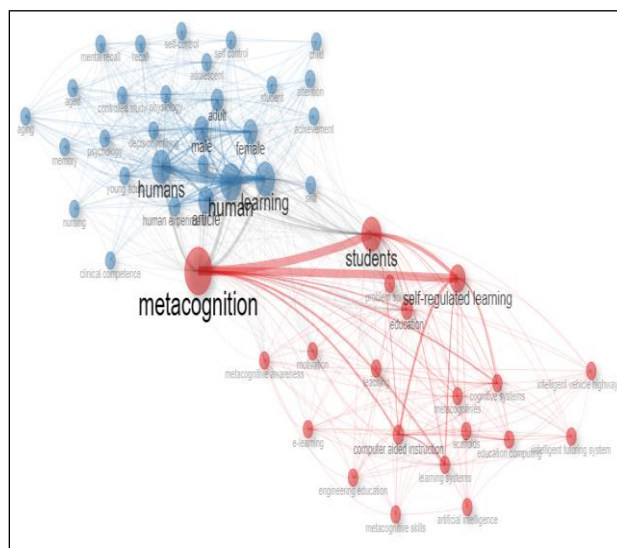


Fig. 7 Co-occurring Network of Keywords

The researcher can rationalise his study using the analysis of a trending topic may lead to the finding the research gaps. This helps to identify and fulfil contemporary research needs by using the trending topics.

Visualisation of co-occurrence in keywords after analysing from 423 document sources is shown in Figure 7. The words ‘metacognition’, ‘students’, ‘self-regulated learning’, ‘human’, ‘humans’, ‘learning’ was occurred frequently in many of the document sources. Therefore, from the above analysis of Scopus core collection database is reviewed using BS to analyse the publications produced in the time frame 1988-2023. The above result gives an ample detail towards bibliometric analysis on MSR using BS.

VI. CONCLUSION

The R programming environment's biblioshiny is a software utility designed to make bibliometric analysis and visualisation easier. It functions as a graphical user interface (GUI) intended to make bibliometric analysis tasks more efficient. Researchers who may not be very experienced with programming or command-line interfaces are the target audience for this GUI. Users can import bibliographic data from a variety of sources, including Web of Science, Scopus, PubMed, and other citation databases, using Biblioshiny's user-friendly point-and-click interface. The software offers features for data cleaning and preparation after it has been imported, including deduplication, author name standardisation, and handling missing or insufficient data. Then, using the features of R packages users can do a variety of bibliometric analyses, such as citation analysis, co-authorship analysis, keyword analysis, and network analysis. With its user-friendly interface, Biblioshiny seeks to democratise bibliometric analysis by improving accessibility and usability for academics from a variety of academic fields. The article describes several techniques, each with advantages and disadvantages, for visualising literature reviews. Setting a minimum citation threshold for articles to be included in citation network mapping, for instance, is typically necessary. However, when a lot of papers are displayed, it may become difficult to understand them all. This cutoff frequently leaves out more recent publications, which tends to favour older ones in the display. Certain papers require years to receive recognition and citations, particularly in disciplines that develop more slowly. Researchers may manually evaluate current articles in order to remedy this. The most referenced papers, authors, and academic institutions for collaboration, popular keywords, and the breadth of MSR research may all be found through bibliometric analysis. This paper makes an effort to map out and assess future directions for metacognition and self-regulated learning research and helps the research community view the sights and continues to be a hot issue for academic investigation. Certain papers require years to receive recognition and citations, particularly in disciplines that develop more slowly. Researchers may manually evaluate current articles in order to remedy this. The most referenced papers, authors, and academic institutions for collaboration, popular keywords, and the breadth of MSR research may all be found through bibliometric analysis. This paper makes an effort to map out and assess future directions for metacognition and self-regulated learning research and

helps the research community view the sights and continues to be a hot issue for academic investigation.

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