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RESEARCH ARTICLE

Tracing Trends in Quran Memorization and Cognitive Learning: A Bibliometric Analysis from the Scopus Database

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ABSTRACT

A thorough bibliometric examination of the body of research on memory, learning, and educational methods from 1897 to 2024 is presented in this paper. This study uses a quantitative approach to analyze 6,328 documents that were gathered from a Boolean search on a large academic database. Vosviewer, Microsoft Excel, and r/r-studio are used in the analysis to look into document and network metrics. Key findings show a consistent 4.57% yearly growth rate, with notable increases in research efforts starting in 2010. The dataset highlights the widespread interest in these subjects worldwide by displaying a wide range of sources and considerable international collaboration. Network visualizations draw attention to key concepts including memory, cognition, learning, and education as well as new developments in deep learning and e-learning. Highly cited works by writers such as Dehaene S., Cheng H-T., and Zhang H. Show how they have an impact on the conversation. This study identifies historical trends, present concerns, and future directions in cognitive and educational research, offering insightful information to scholars, educators, and policymakers. The results support continued research into cognitive processes and successful teaching methods, encouraging creativity and multidisciplinary cooperation.

INTRODUCTION

Exploring the complex connections between memory, learning, and education has drawn more attention in recent years. These cognitive processes are critical to human development and functioning, and as such, researchers in educational sciences, psychology, neurology, and other domains need to closely monitor them (Chen et al., 2016)(Mullins, 2019). Researchers can now investigate these areas through thorough bibliometric analyses, offering better insights into the patterns and trends found in the academic literature, thanks to technological improvements and data analytic tools (Hakvoort et al., 2022)(Bacalu, 2022)(Muthoifin et al., 2020)(Yahya et al., 2022)(Waston, Muthoifin, et al., 2024)(A.N. et al., 2024).

Previous research on Quran memorization and cognitive learning has often been conducted separately, without a thorough exploration of how the two areas influence each other(Andri Nirwana et al., 2024). The lack of an interdisciplinary approach leaves a gap in our understanding of the integration between Quran memorization and cognitive learning processes(Nirwana et al., 2024). Furthermore, many studies are limited to specific geographic and cultural contexts, such as the

Middle East or South Asia, thus not capturing the variation in approaches to memorization and learning across cultures and geographies(Wahid et al., 2023)(Marthoenis et al., 2019)(Mahmudulhassan et al., 2024)(Astuti et al., 2024).

The use of modern technology in Quran memorization, such as digital applications and learning aids, has not been widely studied, despite its potential for significant impact(Anwar et al., 2024). Most studies are cross-sectional, while longitudinal studies that could provide insight into the evolution of memorization and cognitive learning over time are still very limited(Waston, Wiranto, et al., 2024)(Sukisno et al., 2024)(Suwarsono et al., 2024)(Rochanah et al., 2024).

The methodologies used in previous studies have often been limited to surveys or small case studies(Huzaery et al., 2024). There is a need for more diverse and sophisticated methodological approaches, including meta- and mixed methods analyses, as well as more comprehensive bibliometric analysis techniques(Nasrulloh et al., 2024). Previous research also tends to be overly theoretical and lacks practical guidance that can be implemented by educators, policymakers, and practitioners(Firdaus et al., 2024)(Belabes, 2024)(Elbashir et al., 2024)(Heravi, 2024)(Beni, 2024)(Uthman, 2024).

Social and emotional factors that influence Quran memorization and cognitive learning, such as family support, motivation, and emotional state, have received less attention(Hidayah et al., 2024). Furthermore, individual variations such as age, gender, educational background, and learning style have not been explored in depth(Hidayat & Ashiddiqi, 2019). Studies exploring the influence of these variables could provide valuable insights for more personalized and effective educational approaches(Waston et al., 2023)(Apriantoro et al., 2024)(Rhain et al., 2022)(Rahayu & Nurrohim, 2022).

Examining a large amount of research from 1897 to 2024 on memory, cognitive function, and educational methods is the goal of this project(Setiawan & Dahliana, 2022). This research systematically evaluates the evolution of research subjects, important contributors, and collaborative networks in these domains by combining a quantitative method with a bibliometric analysis methodology (A.N. et al., 2024)(Forsyth et al., 2023).

Using a Boolean search on a large academic database, the data was painstakingly gathered, and advanced software tools including Microsoft Excel, VosViewer, and r/r-studio were used for analysis (Chowdhury & Khandoker, 2024)(Calvet et al., 2023).

This research is important because it can show how dynamic scholarly communication is and point to key studies that have influenced how we currently perceive memory and learning processes. This work depicts the historical trajectory of various research fields and identifies new patterns and potential gaps in the literature by using sophisticated data visualization tools and a thorough literature assessment (Supitayakul et al., 2023)(Sautière et al., 2019). It is anticipated that the results of this bibliometric analysis will offer insightful information to scholars, instructors, and legislators who want to improve teaching methods and cognitive development plans (Thomson et al., 2018)(Lemos & Quinalha, 2023).

By providing a solid framework for further research and multidisciplinary collaborations, we hope to add to the current conversation about cognitive and educational research with the thorough analysis provided in this work (Waston, Amini, et al., 2024)(Dunbar, 2022). The study techniques used, the outcomes of the document and network analyses, and the significance of these discoveries in furthering our understanding of memory and learning are all covered in length in the parts that follow.

All things considered, this analysis offers a thorough picture of the state of scholarly research from 1897 to 2024, emphasizing significant developments, contributions, and areas of interest within the

academic community. To provide significant bibliometric information from articles on the topic, mapping was done to address the following queries:

1. What were the key topics and developments in the research on memory, learning, and education between 1897 and 2024?

2. Who are the most influential authors in the field of memory, learning, and education research, and what are the most widely cited works?

3. How have developments in technology impacted the development of memory and learning research areas, especially concerning e-learning and deep learning?

4. How has the annual growth rate of publications in the fields of education, learning, and memory altered throughout the study?
5. How has the geographic distribution of research contributions in the areas of memory, learning, and education changed over the past few decades?

6. How do the themes and keywords identified through bibliometric analysis reflect the evolution of research focus over time?

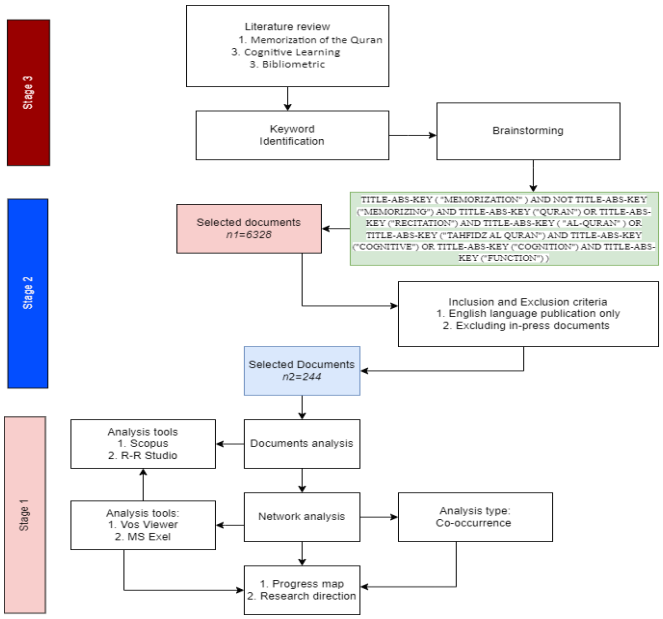
2. MATERIALS AND METHODS

This study uses a quantitative method with a comprehensive bibliometric analysis approach, including document and network analysis (A.N. et al., 2024)(Jones et al., 2022). Data was collected through a Boolean search on the database from 1897 to 2024, conducted on July 27, 2024, at 10:42. R/R-Studio software, Vos Viewer, and Microsoft Excel were used for document analysis, citations, and networking (Rassadnikov & Kupriyanova, 2023)(Waston, Wiranto, et al., 2024).

The stages of the study include: The researcher conducts a literature review to ensure the relevance of the research and identify gaps in bibliometric topics. The study also helped determine the right keywords for the scope of the study, then, a search using the Boolean operator in Scopus TITLE-ABS-KEY ("memorization") AND NOT TITLE-ABS-KEY ("memorizing") AND TITLE-ABS-KEY ("Quran") OR TITLE-ABS-KEY ("recitation") AND TITLE-ABS-KEY ("al-quran") OR TITLE-ABS-KEY ("tahfidz al quran") AND TITLE-ABS-KEY ("cognitive") OR TITLE-ABS-KEY ("cognition") AND TITLE-ABS-KEY ("function")) produced 6328 documents.

Furthermore, filtration uses the Boolean operator from Scopus (LIMIT-TO SUBJAREA, "arts")) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (SRCTYPE, "j")) AND (LIMIT-TO (LANGUAGE, "english")) In total it produced 244 documents.

The bibliography search results were saved in the EndNote X9 application and saved into a CSV file to be opened in the Excel or Numbers application. The saved files were then checked and the metadata was completed (Salem, 2020). In the end, bibliometric analysis was used in this study to determine the annual quantity of documents based on journals, authors, affiliations, nations, and fields of study. Scopus analyzer and R/R-Studio were utilized for this purpose. VOSViewer was used to study the document network visualization, and Microsoft Excel was used to handle the data (Ifdil et al., 2023). The details can be seen in the following figure:



Figure

3. RESULTS AND DISCUSSION

3.1 Document Analysis

Table 1. Summary of the review

	Result
Primary information about the data	
Timespan	1897:2024
Sources (Journals, Books, etc)	3505
Documents	6328
Annual Growth Rate %	4.57
Document Average Age	12.7
Average citations per doc	16.59
References	198320
DOCUMENT CONTENTS	
Keywords Plus (ID)	19404
Author's Keywords (DE)	12994
AUTHORS	
Authors	15782
Authors of single-authored docs	1376
AUTHORS COLLABORATION	

Single-authored docs	1483
Co-Authors per Doc	3.16
International co-authorships %	13.73
DOCUMENT TYPES	
article	4030

Note. This table is taken from the Scopus Database

The dataset, comprising 6,328 items, covers 1897 through 2024 and comes from 3,505 sources, including books, journals, and conference papers. These documents have an average age of 12.7 years, an annual growth rate of 4.57%, and an average of 16.59 citations per document. There are 198,320 references cited in all of the publications combined. 12,994 author-provided keywords and 19,404 unique keywords are included in the dataset. 15,782 different authors have contributed in total; 1,376 of them have written documents on their own. 1,483 of the 6,328 papers have a single author. 3.16 co-authors on average per manuscript, and 13.73% of the papers involve international collaboration. 4,030 documents in total are categorized as articles. This dataset provides a thorough picture of the academic literature, emphasizing its importance as indicated by citations and its breadth, expansion, and collaborative character.

Documents by year

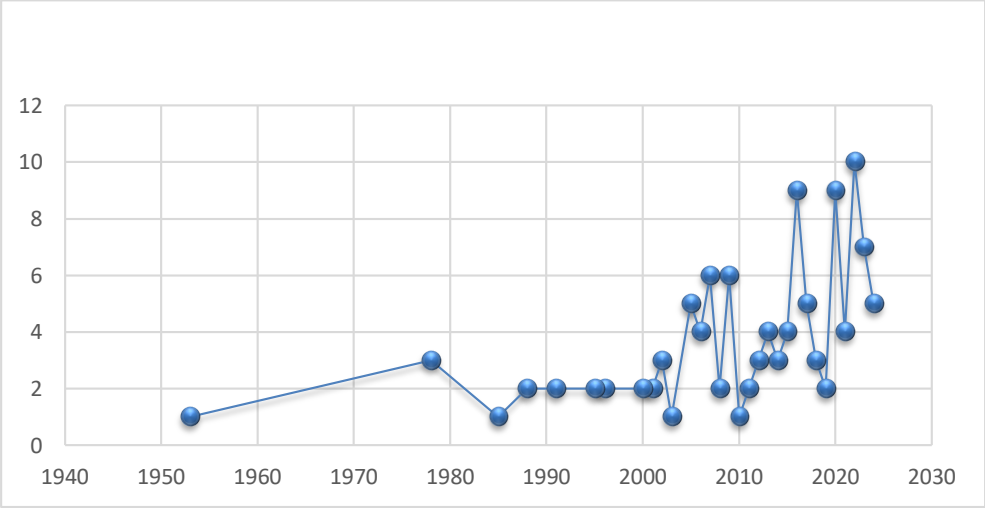


Figure 2. Analyze year

Note. This Figure is taken from the Scopus Database

A time series chart showing the total number of events or data points recorded each year between 1950 and 2023 is shown in Figure 1. The data points first indicate a slight growth, with sporadic oscillations, from 1950 to approximately 1980. Up until the late 1990s, the trend after 1980 is largely constant with just little deviations. Data point frequency has increased noticeably since 2000, especially after 2010. The graph shows notable data peaks and troughs from the 2010s and the first part of the 2020s, denoting increased and decreased activity times. The greatest values, which show a substantial increase in occurrences over earlier decades, are found between 2010 and 2023.

Documents by author

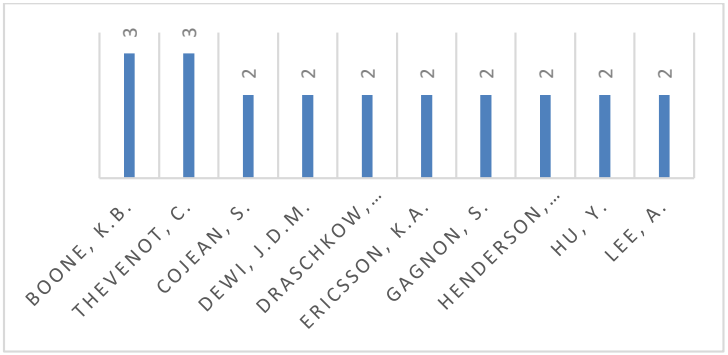


Figure 3. Analyze Author
Note. This Figure is taken from the Scopus Database

The bar graph in Figure 3, "Author Name's Chart," displays the total number of publications by different writers. With three publications apiece, BOONE, K.B. and THEVENOT, C. are the authors who contributed the most. The other authors have two publications between them: COJEAN, S., DEWI, J.D.M., DRASCHKOW, D., ERICSSON, K.A., GAGNON, S., HENDERSON, J.M., HU, Y., and LEE, A. The distribution of these authors' publication contributions is well depicted in this chart, with BOONE, K.B., and THEVENOT, C. being the most prolific authors in this group.

Documents by source

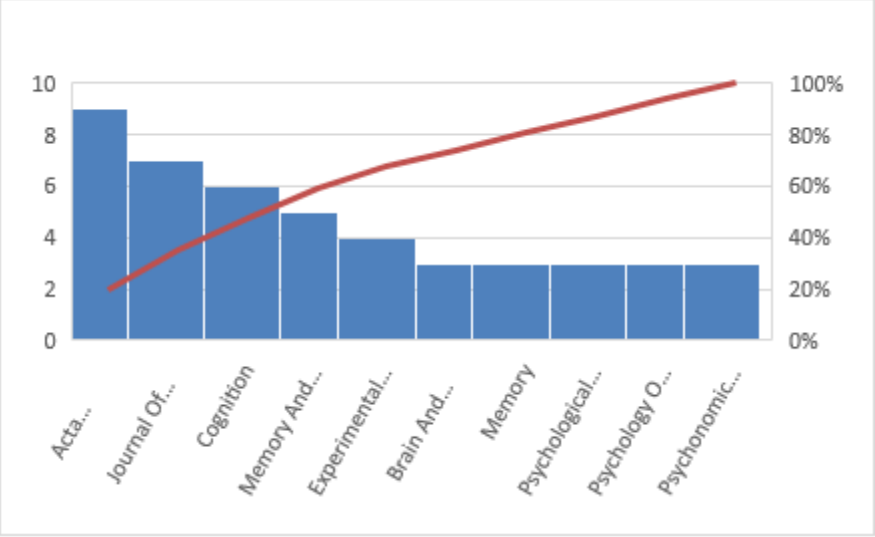


Figure 4. Analyze Source

A bar and line chart displaying the distribution and cumulative proportion of sources is shown in Figure 2, The orange line shows the cumulative proportion, and the blue bar chart shows the frequency of publications from different sources.
With nine publications, the source tagged “Acta Phycological” has the most frequency (Marno et al., 2016). "Journal Of Experimental Phycology Learning Memory and Cognition (Sukino et al., 2024)." comes next with seven publications, and "Cognition" comes next with six (Ring et al., 2023). “Experimental Phycology (van der Ham et al., 2010) .” Brain And Cognition”, “Memory”, "Psychological Of Music", and "Psychonomic Bulletin and Review (Ring et al., 2023)(Uczkiewicz, 2023)(Hegarty & North, 2022)(Jiang & Cowan, 2020)."

From the start at the first source, the cumulative percentage line grows gradually until it reaches 100% at the last source. This shows that these sources add to the overall dataset together, with "Acta Phycological" and "Journal of Experimental Phycology Learning Memory and Cognition" making the most contributions. The distribution of publications across various sources and their cumulative impact on the dataset is effectively depicted in the graphic (Waston, Mahmudulhassan, Andri Nirwana, & Muthoifin, 2024)(An, 2023).

Documents by country

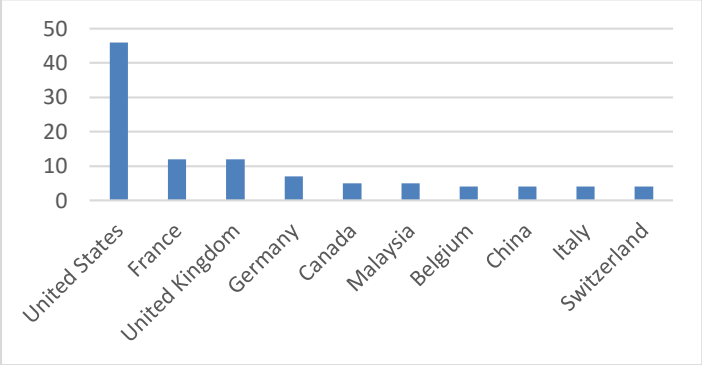


Figure 5. Analyze country

In Figure 4, "Country," the distribution of publications is shown as a pie chart. The United States makes up the greatest portion of the pie chart (45%), meaning that over half of the publications come from this nation. The two countries with the second-highest contributions are France and the United Kingdom, both contributing 11% of the publications. Germany makes up 7%, Malaysia is at 5%, and Canada is at 5%. The countries of Belgium, China, Italy, and Switzerland account for 4% of all publications. This graph illustrates how the United States dominates the publishing scene, while China and several European nations also make important contributions.

Documents by affiliation

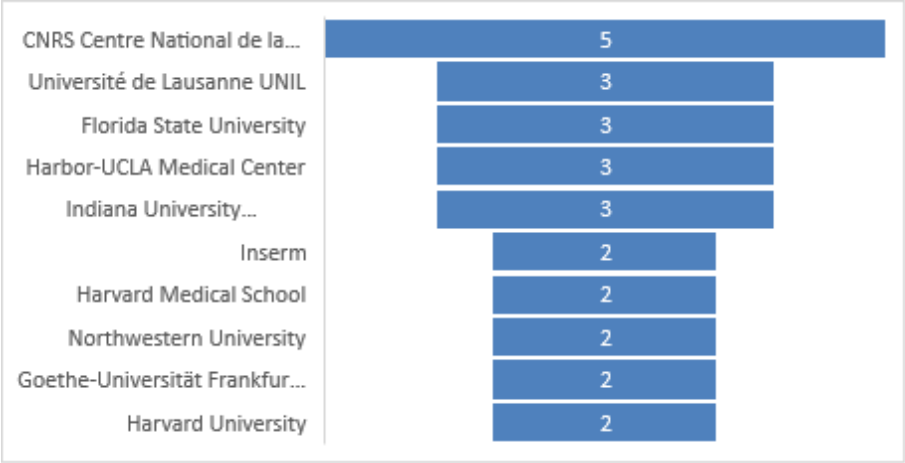


Figure 6. Analyze Affiliation

The horizontal bar graph in Figure 5, "Affiliation Chart," shows how many publications are linked to different universities. With five papers, the CNRS Centre National de la Recherche Scientifique is the top contributor. After that, three papers each from Indiana University Bloomington, Florida State

University, Harbor-UCLA Medical Center, and Université de Lausanne UNIL. Inserm, Harvard Medical School, Northwestern University, Goethe-Universität Frankfurt, and Harvard University are among the other institutions that have two publications. The CNRS Centre National de la Recherche Scientifique stands out as the most prolific institution, and this graphic emphasizes the considerable contributions made by these institutions to the dataset.

Three-field plot.

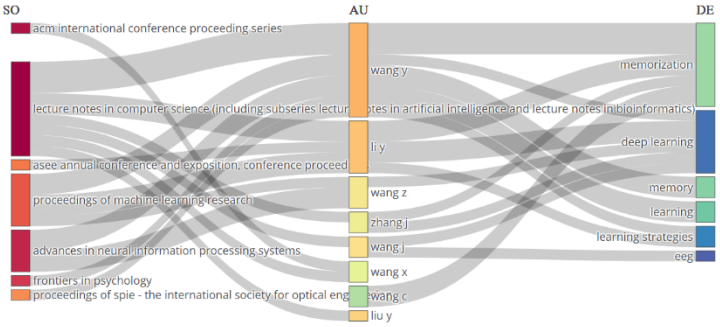


Figure 7. Tree Field Plot

The correlations between the three fields are shown graphically in Figure 6, "Three Field Plot," which includes Source (SO), Author (AU), and Keywords (DE). A Sankey diagram is used in the plot to show the relationships and data flow between these fields. The journals and conference proceedings listed on the left side of the page include "ACM International Conference Proceeding Series," "Lecture Notes in Computer Science," "ASEE Annual Conference and Exposition," "Proceedings of Machine Learning Research," "Advances in Neural Information Processing Systems," "Frontiers in Psychology," and "Proceedings of SPIE - The International Society for Optical Engineering (Takakura et al., 2019)(Giam et al., 2022)(Alsheeb & Hodges, 2019)(Ricci et al., 2018)(Liu et al., 2020)(Wiysahnyuy & Valentine, 2023)(Molteni et al., 2009)."

Prominent authors including Wang Y, Li Y, Wang Z, Zhang J, Wang J, Wang X, Wang C, and Liu Y are listed in the middle section along with the sources in which they have published. The keywords that best represent the main areas of research for these authors are highlighted on the right side of the plot: "memorization," "deep learning," "memory," "learning," "learning strategies," and "EEG."

The relationships between the domains are shown by the flow lines; for example, whose writers published in which sources and the key terms related to their work. This graphic visualizes the publication landscape in the dataset by showing the relationships between various sources, authors, and keywords.

Corresponding aothors

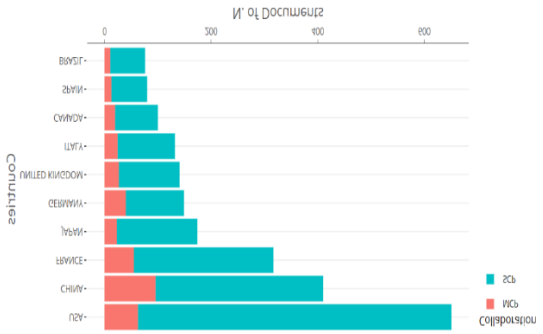


Figure 8. Corresponding Authors Countries Analyze

The bar graph in Figure 7, "Corresponding Authors Countries Chart," shows the total number of papers that corresponding authors from different nations have authored, broken down by kind of collaboration. The countries are listed on the y-axis, while the number of documents is represented on the x-axis. Multiple Country Publications (MCP), shown in red, and Single Country Publications (SCP), shown in blue, are the two categories of collaboration that are distinguished in the chart.

Next in order of most documents is the United States of America; next comes China, France, Japan, Germany, the United Kingdom, Italy, Canada, Spain, and Brazil. The USA makes up a sizable amount of MCP, a sign of intense international cooperation, and SCP also makes up a sizable portion. Although it has a higher share of SCP, China also exhibits a significant quantity of MCP. Similar patterns may be seen in France, Germany, and the United Kingdom, which demonstrate their participation in both internal and international cooperation by displaying a combination of MCP and SCP.

SCP is mostly found in Brazil, Italy, Spain, Canada, Japan, and Italy, suggesting a greater focus on domestic research efforts and a lower amount of international collaboration. This graph sheds light on the level of international collaboration among corresponding authors from various nations as well as the geographic distribution of research contributions.

Most Global Cites Document

Paper	Total Citations	TC per Year	Normalized TC
ZHANG H, 2018, INT CONF LEARN REPRESENT, ICLR - CONF TRACK PROC	2625	375.00	100.12
CHENG H-T, 2016, ACM INT CONF PROC SER	2137	237.44	103.04
DEHAENE S, 2001, COGNITION	1734	72.25	20.65
OHNO T, 2011, NAT MATER	1438	102.71	63.31
REBER AS, 1967,	1272	21.93	5.56
HAN B, 2018, ADV NEURAL INF PROCES SYST	1172	167.43	44.70
FLORY J, 2004, J AM MED ASSOC	839	39.95	20.99
LE GOUES C, 2012, IEEE TRANS SOFTWARE ENG	756	58.15	37.88
TALLON-BAUDRY C, 1998, J NEUROSCI	756	28.00	23.49
THOMAS R, 1973, J THEOR BIOL	686	13.19	14.89

Table 2. Most Global Documents Cited

Note. This table is taken from the Scopus Database

Table 2 lists the most globally cited documents, providing a comprehensive overview of highly influential research papers across various fields. Here is an explanation of the table within the paragraph: The table includes the following columns: "Paper," "Total Citations," "TC per Year," and "Normalized TC."

1. Paper: This column lists the lead author and publication year, along with the source or conference where the paper was published. Each paper represents a significant contribution to its respective field.

2. Total Citations: This column indicates the total number of times each paper has been cited by other research works. A high citation count reflects the paper's impact and influence on subsequent research.

3. TC per Year: This column shows the average number of citations the paper receives per year since its publication. This metric helps to understand the ongoing relevance and impact of the paper over time.

4. Normalized TC: This column provides a normalized citation count, adjusting for the field and age of the paper. This normalization allows for fairer comparisons between papers from different disciplines and publication years.

Example Explanations:

-ZHANG H, 2018, INT CONF LEARN REPRESENT, ICLR - CONF TRACK PROC: With a total of 2625 citations and an impressive average of 375 citations per year, this paper has the highest normalized TC of 100.12, indicating its significant influence in the field of learning representation.

- CHENG H-T, 2016, ACM INT CONF PROC SER: This paper has 2137 citations with a yearly average of 237.44, and a normalized TC of 103.04, showing its considerable impact in its field since its publication.

-DEHAENE S, 2001, COGNITION: Despite being older, this paper has amassed 1734 citations with an average of 72.25 per year, and a normalized TC of 20.65, highlighting its long-standing influence in cognitive science.

-OHNO T, 2011, NAT MATER: With 1438 citations and an average of 102.71 citations per year, this paper has a normalized TC of 63.31, reflecting its significant contributions to materials science.

-REBER AS, 1967: This older paper has 1272 citations, averaging 21.93 per year, with a normalized TC of 5.56, indicating its foundational role in its field despite being less frequently cited annually.

-HAN B, 2018, ADV NEURAL INF PROCESS SYST: With 1172 citations and an average of 167.43 per year, this paper's normalized TC of 44.70 signifies its important contributions to neural information processing systems.

-FLORY J, 2004, J AM MED ASSOC: Garnering 839 citations with a yearly average of 39.95, this paper has a normalized TC of 20.99, underscoring its impact on medical research.

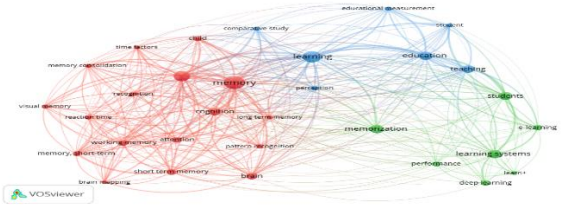
-LE GOUES C, 2012, IEEE TRANS SOFTWARE ENG: This paper has 756 citations, averaging 58.15 per year, with a normalized TC of 37.88, highlighting its influence in software engineering.

-TALLON-BAUDRY C, 1998, J NEUROSCI: With 756 citations and an average of 28 per year, this paper has a normalized TC of 23.49, indicating its significant contributions to neuroscience.

-THOMAS R, 1973, J THEOR BIOL: This paper's enduring influence on theoretical biology is demonstrated by its 686 citations, which come in at an average of 13.19 per year and a normalized TC of 14.89, despite its age.

These publications rank among the most cited worldwide, attesting to their wide-ranging impact and significance in their respective domains. The high citation counts and normalized TC values highlight their continued relevance and contribution to ongoing research and knowledge advancement.

3.2 Network Analysis



Co-Occurrence Network Analysis

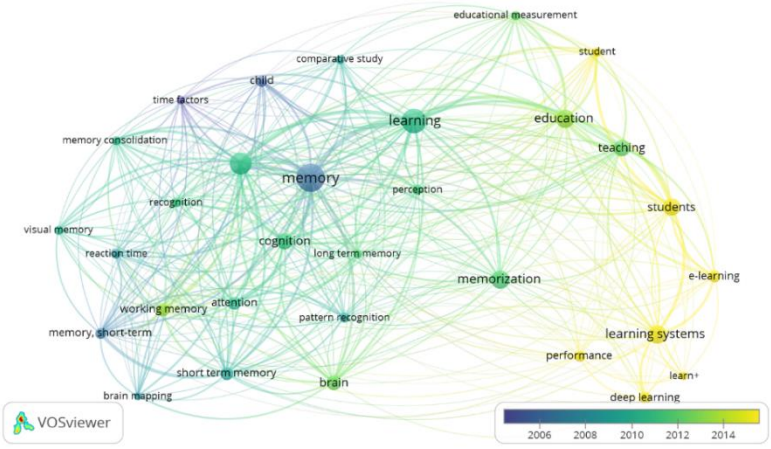
Figure 9. Network Analysis

Figure 8, “Network Visualization,” shows a VOSviewer-created network map of important phrases and their relationships in the academic literature. Different colors are used in the graphic to indicate groups of related phrases. Underneath the term "memory," there is a red cluster with terms like "cognition," “working memory,” “short-term memory,” “visual memory,” and “memory consolidation.” The close relationships between these concepts suggest a robust focus on different facets of memory and cognition in the study.

The words “education,” “educational measurement,” “comparative study,” “student,” and “teaching” are all included in the blue cluster, which is devoted to the concept of "learning." The link between learning processes and educational approaches is depicted in this cluster.

The words “students,” “e-learning,” “performance,” “deep learning,” and “learning systems” are highlighted in the green cluster together with terms that are associated with "memorization" and “learning systems.” This suggests studies that connect systemic and technological approaches to memory and learning.

These clusters’ interconnection serves as an example of how multidisciplinary memory, learning, and education research is. The graphic offers a thorough summary of the relationships between various terminology and ideas in the literature, emphasizing regions with a lot of research activity and possibilities for interdisciplinary collaboration.



Co-Occurrence Overlay

Figure 10. Overlay Analysis

A network map of important phrases and their relationships within the scholarly literature is shown in Figure 9, labeled “Overlay Visualization,” which uses a time-based color gradient to show the average publication year of the papers linked to each keyword. The visualization, which was made using VOSviewer, uses a range of colors—from blue to yellow—to depict the evolution throughout time, with yellow denoting more recent articles and blue signifying earlier ones.

The word "memory" is highlighted in the center and has a gradient color scheme that ranges from blue to green, indicating ongoing study interest from earlier to more recent periods. Similar color gradients surround terms like "cognition," "working memory," and "short-term memory," suggesting that these concepts are still being researched. Green to yellow terms that pertain to “learning” and “education,” such as “teaching,” “students,” and “educational measurement,” indicate a growing area of study interest in recent years. The majority of terms like “e-learning,” “learning systems,” and

"deep learning" are also yellow, which reflects their recent literature-based rise and growing prominence.

The way that terms are connected and the color gradient shows how research topics have changed over time, revealing how some areas—like "e-learning" and "deep learning" have become more popular recently while other areas—like "memory" and "cognition"—have remained stable favorites. This graphic does a good job of illustrating how academic research is dynamic and how its concentration changes over time.

Co-Occurrence Density

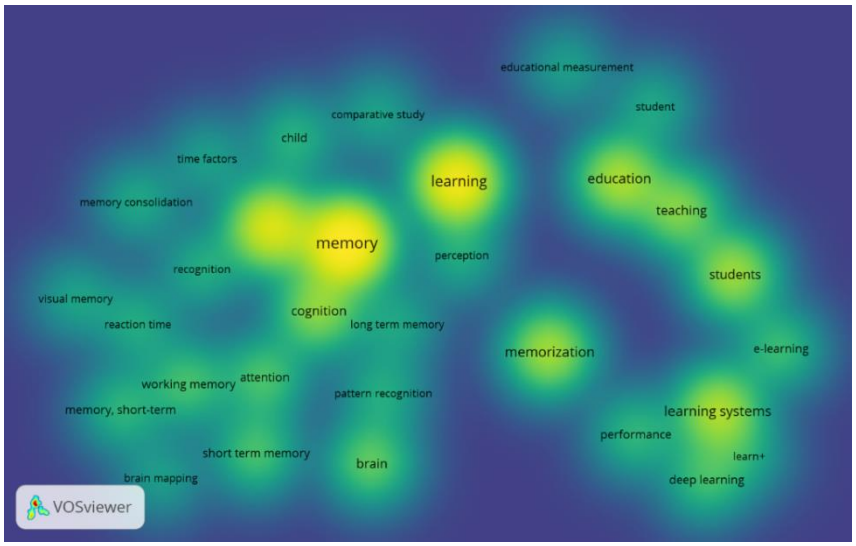


Figure 11. Density Analysis

The frequency and distribution of terms used in the abstracts of academic publications are displayed in Figure 10, "Density of the Most Used in Abstract Terms," a heatmap made with VOSviewer. The color's intensity, with blue denoting less frequency and yellow representing higher frequency, corresponds to the density of term usage. The word "memory" is highlighted in a bright yellow area, indicating how frequently abstractions utilize it. Although they are not as strongly highlighted, surrounding concepts like "cognition," "working memory," and "memory consolidation" are nonetheless noteworthy despite being used less frequently(Mahmudulhassan et al., 2023).

Alongside related terms like "education," "teaching," and "students," which are also prominent, the keyword "learning" is another central focus with a high-density yellow region. The terms "learning systems," "e-learning," and "deep learning" are clustered together with high density, indicating the increasing prominence of these subjects in the literature. Some noteworthy terms that exhibit intermediate density are "attention," "visual memory," "memorization," and "recognition," suggesting their applicability in various research contexts.

The most commonly used phrases in abstracts are graphically represented in this heatmap, which offers valuable insights into the primary themes and areas of focus of the academic research included in the collection. In addition to highlighting areas of active research, including "memory" and "learning," the graphic also demonstrates how similar terms are interconnected throughout the literature.

4. Final considerations

An extensive overview of the research environment on memory, learning, and educational practices from 1897 to 2024 has been made possible by this thorough bibliometric analysis. The study has

documented the development of these research fields, identified important contributors, and demonstrated the complex networks of collaboration and thematic growth within the academic literature by using a strong quantitative methodology.

Important conclusions drawn from the document analysis show that starting in 2010, the field has grown at a consistent yearly pace of 4.57%, with a discernible surge in research effort. The dataset emphasizes the multidisciplinary nature of research in various fields by combining a wide range of sources, such as books, journals, and conference proceedings. The significant number of authors and the extent of international collaboration underscore the global interest and collective effort in advancing knowledge in memory and learning.

Network visualization has helped to clarify the main ideas and new directions in the literature. Terms like "memory," "cognition," "learning," and "education" are commonly used, which suggests ongoing study interest and fundamental significance. In the meantime, the growing emphasis on "e-learning," "learning systems," and "deep learning" is a reflection of how technological developments have affected educational approaches and cognitive research.

The examination of papers with a high citation count highlights the impact of foundational studies that have profoundly influenced these disciplines' discourses. The significant citations that papers by writers like Zhang H., Cheng H-T., and Dehaene S. have received attest to their critical contributions to the advancement of both theoretical and practical understanding.

In summary, this study not only offers a historical overview of the evolution of memory and learning research, but it also identifies current trends and possible future possibilities. To promote cognitive development and improve educational outcomes, researchers, educators, and policymakers can benefit greatly from the insights obtained from this bibliometric analysis. This study establishes the foundation for future research projects and multidisciplinary collaborations that will continue to spur innovation and advancement in these vital sectors by identifying gaps and developing areas of interest.

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Ethical considerations

Not applicable.

Conflict of Interest

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