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# Exploring links between visuospatial ability and anatomy learning in education: A bibliometric analysis and scientific mapping

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## Abstract

The field of medical education faces a significant challenge in teaching human anatomy, a fundamental aspect of medical science that is often perceived as complex and demanding. Understanding the shapes and anatomical structure locations is crucial for students to master the intricacies of anatomy. Visuospatial ability, which involves comprehending three-dimensional structures and their spatial relationships, plays a pivotal role in anatomy learning. The aim of this study was to examine keywords, territories/countries, the number of publications, institutions, authors, and associated journals related to visuospatial ability in anatomy learning through extensive bibliometric analysis. Data were gathered from the Scopus database, and VOSviewer was employed to conduct a bibliometric analysis. Approximately 552 eligible articles were examined in their entirety. The findings indicated that the most significant research growth occurred in 2012, with the United States of America emerging as the leading country in the field. Furthermore, Anatomical Science Education was recognized as the most esteemed journal in this field, with Wilson, T.D. being credited as the most influential author. The bibliometric data also demonstrated various approaches to improve visuospatial capacity in anatomy learning, such as utilizing virtual reality or other computer-assisted learning modalities and their integration into medical education practice. In conclusion, these findings highlight the critical role of visuospatial ability in facilitating the acquisition of anatomical knowledge and offer direction for future research in this area.

**Keywords**: Visuospatial ability, anatomy learning, bibliometric analysis, scientific mapping, education

## Introduction

As one of the most essential subjects in medical science, anatomy is frequently perceived as difficult by students because of its complex and detailed characteristics. Visual information plays a critical role in comprehending the shape and anatomical position components, making visuospatial aptitude an essential factor in student efforts to understand anatomy [1]. Visuospatial ability, a concept to understand three-dimensional structures, locations, and object manipulations, is crucial for attaining a full grasp of anatomy [2]. Within the context of constantly progressing technology, the importance of visuospatial cognition in anatomy learning is growing, especially when multimedia modalities are incorporated [2,3]. The application of multimedia technologies such as virtual reality (VR) and augmented reality (AR) has fundamentally





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transformed the examination of human anatomy. This technology provides adaptable and immersive platforms for the presentation and exploration of anatomical structures, particularly in situations where physical models may be restricted or expensive maintenance costs [4,5].

Despite ongoing efforts to enhance anatomy education, there are still gaps in understanding the correlation between these educational interventions and their impact on visuospatial abilities [6,7]. Further research is essential to evaluate the effectiveness of interventions aimed at improving visuospatial skills to enhance the overall understanding of anatomy. This research should provide valuable insights for future directions of educational strategies, focusing on the enhancement of visuospatial abilities to optimize anatomy learning outcomes particularly [3].

Bibliometric analysis is a well-established method that utilizes statistical and mathematical techniques to evaluate various knowledge sources quantitatively and qualitatively, including journal articles [8]. This approach plays a crucial role in discerning active research areas, potential collaborators, famous topics, engaging trends, and research directions in the future. This method aids in recognizing influential authors, institutions, countries, journals, highly cited papers, and prevalent research themes, which are essential for understanding the current research landscape, pinpointing gaps, recognizing opportunities, and guiding future research endeavors [9]. Moreover, bibliometric analysis allows for tracking trends over time, enabling researchers to stay abreast of the newest developments in their fields [8,9]. By employing bibliometric analysis, researchers can evaluate the effect and productivity of studies in fields such as anatomy learning and visuospatial ability. Visual techniques were performed to generate a knowledge map of this field, providing insights into important terms, territories/countries, publication counts, institutions, authors, and journals in the context of investigating visuospatial ability in learning anatomy.

By leveraging bibliometric techniques, researchers can obtain valuable insights into the current research state and potential research directions with key contributors in a particular field, facilitating informed decision-making and fostering future advancements in knowledge. The findings from this analysis were instrumental in highlighting potential research areas for further exploration. The aim of this study was to identify emerging research trends regarding anatomy learning and visuospatial ability from the existing literature by analyzing keywords or co-occurrence, countries/territories, publication numbers, institutions, authors, and journals, which are essential as it highlights promising directions for future research, innovations, and utilization within the biomedical field.

## Methods

Bibliometric data were retrieved from the Scopus database, which is acknowledged for its extensive compilation of curated abstracts and citations, thus serving as a primary bibliometric data repository. Data from the Scopus database were collected and integrated into the ultimate data analysis procedure in Vosviewer. Inclusion criteria comprised research papers published from 1998 to 2023, the period during which a number of publications regarding this topic were consecutively produced each year as of December 6, 2023. Closed-access and non-English journals were excluded from the analysis.

### Data analysis

The entire publication dataset was transferred to the VOSviewer version 1.6.18, a tool used to perform bibliometric analysis and create visual displays. In this investigation, VOSviewer was utilized to examine co-occurrence patterns visually. The rings depicted the nations' dispersion and the keywords provided by the authors. The proximity of the circles denoted the degree of correlation between phrases, with greater distances implying weaker associations. The visualization employed a diverse palette of colors to depict various clusters of terms distinctly. The size of the circles corresponded directly to the word frequency. Moreover, line thickness precisely depicted the intensity of the links between words. Larger Circle diameters signified higher phrase frequencies [9].

Data was collected from Scopus's database using the results menu analysis. This allowed for insights into the growth trajectories of research, prolific authorship, national publication trends, prevalent publication genres, and highly cited journals. The article data was exported in CSV

format using VOSviewer, allowing for the visualization and analysis of trends. This facilitated the creation of a keyword map by identifying shared networks. The approach and results of the data retrieval and analysis are illustrated in **Figure 1**.

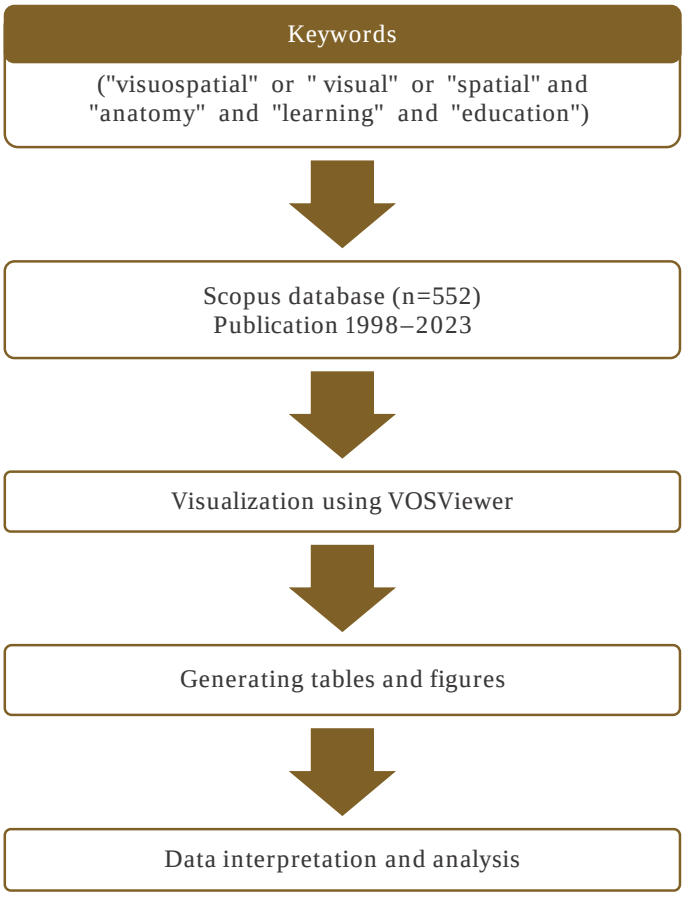


Figure 1. Search strategy and data processing method (flow diagram).

## Results

### Historical background

The initial exploration of visuospatial ability and anatomy learning dates back to a 1973 article titled "Radiology in a new medical school" [10]. While this article represents an early milestone in the study of these concepts, it was excluded from the bibliometric analysis due to non-compliance with inclusion criteria. Nonetheless, this historical piece marks the nascent stages of research into the intricate relationship between visuospatial abilities and anatomy learning. The article sheds light on the early endeavors to understand the complexities of visuospatial cognition in the context of anatomical studies, laying the foundation for subsequent research in this domain.

### Analysis of global publication trends

The number of research papers on visuospatial ability and anatomy learning exhibited significant fluctuations between 1998 and 2023, as depicted in **Figure 2**. The number of publications annually showed both upward and declining trends, with the most significant increases observed during the periods of 2016–2017 (57.69%), 2022–2023 (60.61%), and 2018–2019 (64.29%). This variation indicated an increasing worldwide interest in visuospatial aptitude, specifically regarding the acquisition of anatomical knowledge.

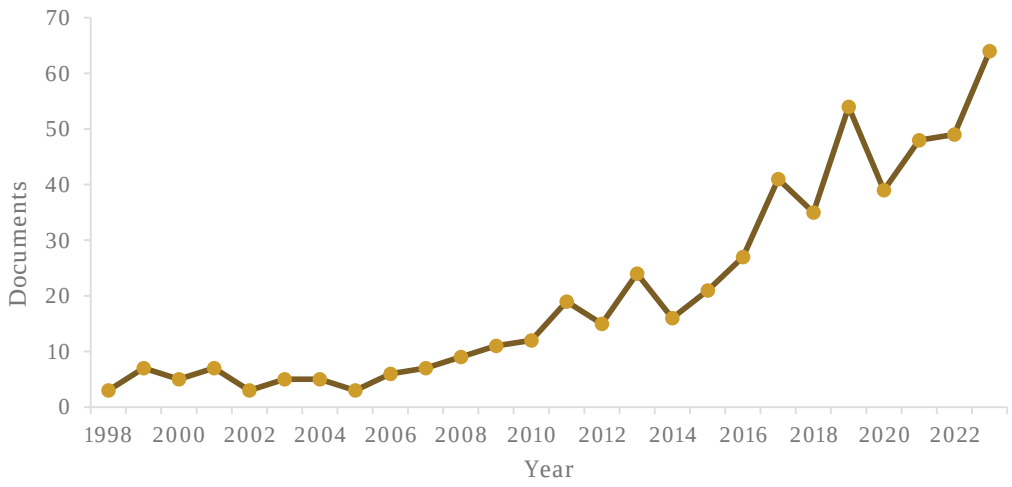


Figure 2. Trends in research.

## Core analysis of the journals

Top peer-reviewed publications published with a high number of works in anatomy learning and visuospatial ability fields over the past 24 years are presented in **Figure 3**. The three highest-ranked journals were Anatomical Sciences Education (with an H index of 71 and Scimago Journal Rank (SJR) of 1.57 in 2023), Clinical Anatomy (with an H index of 88 and SJR of 0.72 in 2023), and Medical Science Educator (with an H index of 24 and SJR of 0.56 in 2023). Evidence supports the status of these journals as preeminent research publications on a global scale.

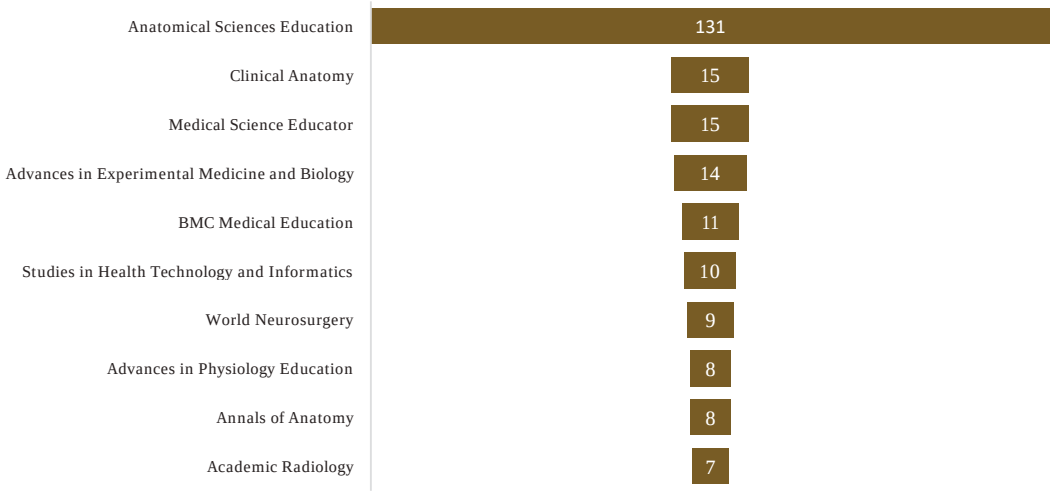


Figure 3. Top ten journals with the most publications in visuospatial ability and anatomy learning.

## Most productive authors and publications

The top ten contributors who have made the most significant contributions to publications about visuospatial ability and anatomy learning published in Scopus journals are presented in **Figure 4**. Wilson TD. has authored around thirteen publications, establishing themselves as the most prolific authors on the list. Keenan ID., Seo JH., and Vorstenbosch MATM. each produced seven publications, while Pine M. authored five papers. Bernardo A., Border S., Cook M., De Ribaupierre S., and Fung K. each had four additional articles. Each author has made significant contributions to the fields of visuospatial ability and anatomy learning by producing numerous papers. Furthermore, **Table 1** concisely summarizes the top 10 publications with the highest citation counts.

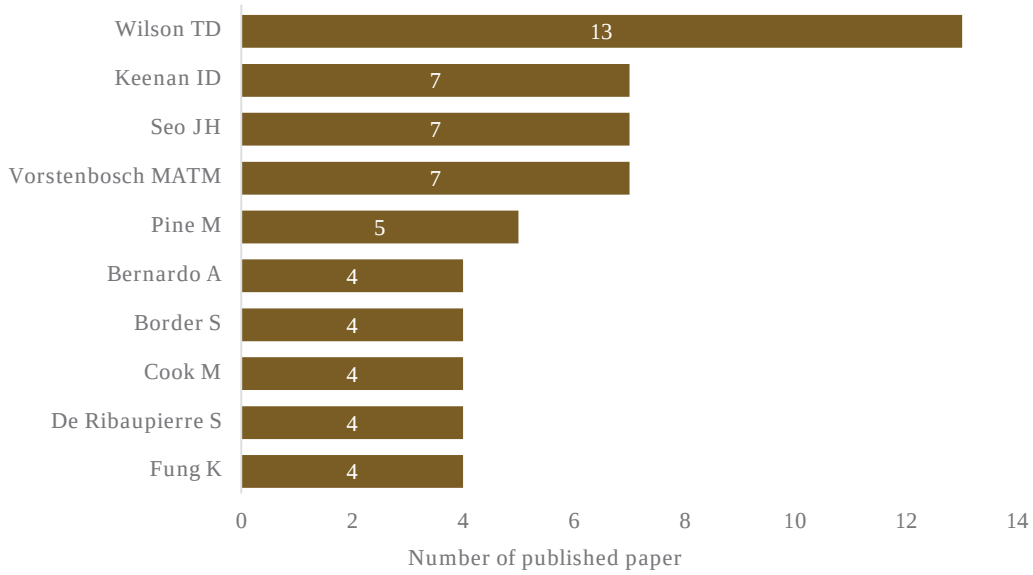


Figure 4. Top contributing authors' research in visuospatial ability and anatomy learning collectively.

Table 1. Most valuable publications by citation counts

| Rank | Authors | Title | Journal | Cited by |
|---|---|---|---|---|
| 1 | Preece D *et al.* [11] | "Let's get physical": Advantage of a physical model over 3D computer model and textbook in learning imaging anatomy | Anatomical Science Education | 270 |
| 2 | Garg AX *et al.* [12] | How medical student learns spatial anatomy | The Lancet | 266 |
| 3 | Bernardo A [13] | Virtual reality and simulations in neurosurgical trainings | World Neurosurgery | 211 |
| 4 | Jang S *et al.* [14] | Directly manipulation is better than passive viewing for learning anatomy in a three-dimensional virtual reality environment | Computers & Education | 201 |
| 5 | Yammine K *et al.* [15] | Meta-analysis of the educational effectiveness of three-dimensional visualization technologies in teaching anatomy | Anatomical Science Education | 191 |
| 6 | Maresky HS *et al.* [16] | Virtual reality and cardiac anatomy: Exploring immersive three-dimensional cardiac imaging, a pilot study in undergraduate medical anatomy education | Clinical Anatomy | 158 |
| 7 | Khot Z *et al.* [17] | The relative effectiveness of computer-based and traditional resources for education in anatomy | Anatomical Science Education | 155 |
| 8 | Guillot A *et al.* [18] | Relationship between spatial abilities, mental rotation, and functional anatomy learning | Advances in Health Sciences Education: Theory and Practice | 155 |
| 9 | Levinson AJ *et al.* [1] | Virtual reality and brain anatomy: A randomised trial of e-learning instructional designs | Medical Education | 153 |
| 10 | Hegarty M *et al.* [19] | How spatial abilities enhance, and are enhanced by dental education | Learning and Individual Differences | 144 |

## Top ten countries of authors based on number of publications

The top ten countries ranked by publications number in the subject of visuospatial ability and anatomy learning are pointed out in **Figure 5**. The United States of America had the highest

number of publications on visuospatial ability and anatomy learning, with 179 articles (35.06%). The United Kingdom and Canada followed with 59 articles (11.30%), Germany with 34 articles (6.51%), Australia with 26 articles (4.98%), India with 24 articles (4.6%), the Netherlands with 22 articles (4.21%), France and Spain with 16 articles each (3.07%), and China with 15 articles (2.87%). Indonesia was ranked 17th with eight publications, accounting for 1.53% of the total.

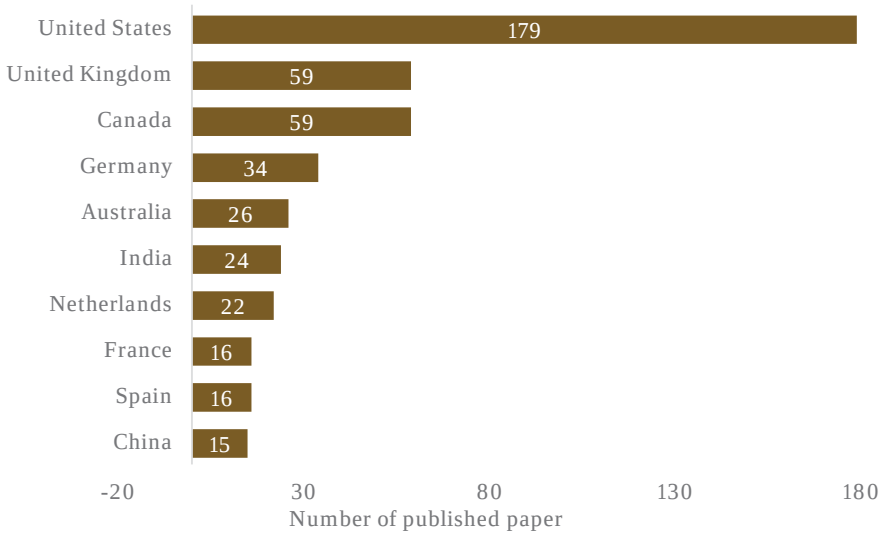


Figure 5. Top countries of authors based on the number of publications.

## Types of publication in the field of visuospatial ability and anatomy learning

The majority of the publications, accounting for 75.5%, were journal articles, with 395 documents. Conference papers comprised 13.2% of the publications, with a total of 68 documents (**Figure 6**). Subsequently, 29 papers (5.4%) were in the review category, and 20 documents (3.9%) were categorized as book chapters. Additional types of publication encompass conference reviews, notes, books, and editorials, in that order.

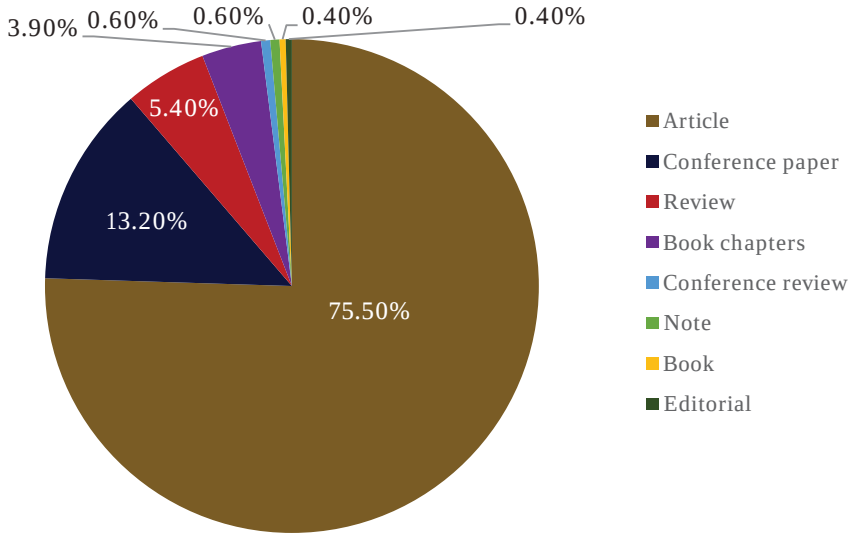


Figure 6. Types of publication.

## Visualization of networks

The overlay visualization illustrates the progression of research topics from 1998 to 2023, offering a thorough perspective on their evolution throughout time. Each link can track the shifting focus and patterns in research within this discipline by adopting a historical viewpoint, reflecting the progression of knowledge and scientific priorities across time. Overlay visualization is a method

for presenting bibliometric networks by using different colors to represent changes over time. Items are colored according to their scores or custom colors. For scored items, the default color scheme ranges from blue for the lowest scores, green for mid-range scores, and yellow for the highest, as illustrated in **Figure 7**. A network visualization that illustrates the linkages across analyzed locations, which are organized into five distinct clusters, is presented in **Figure 8**. Each cluster had multiple keywords that exhibited a significant level of agreement in the map structure.

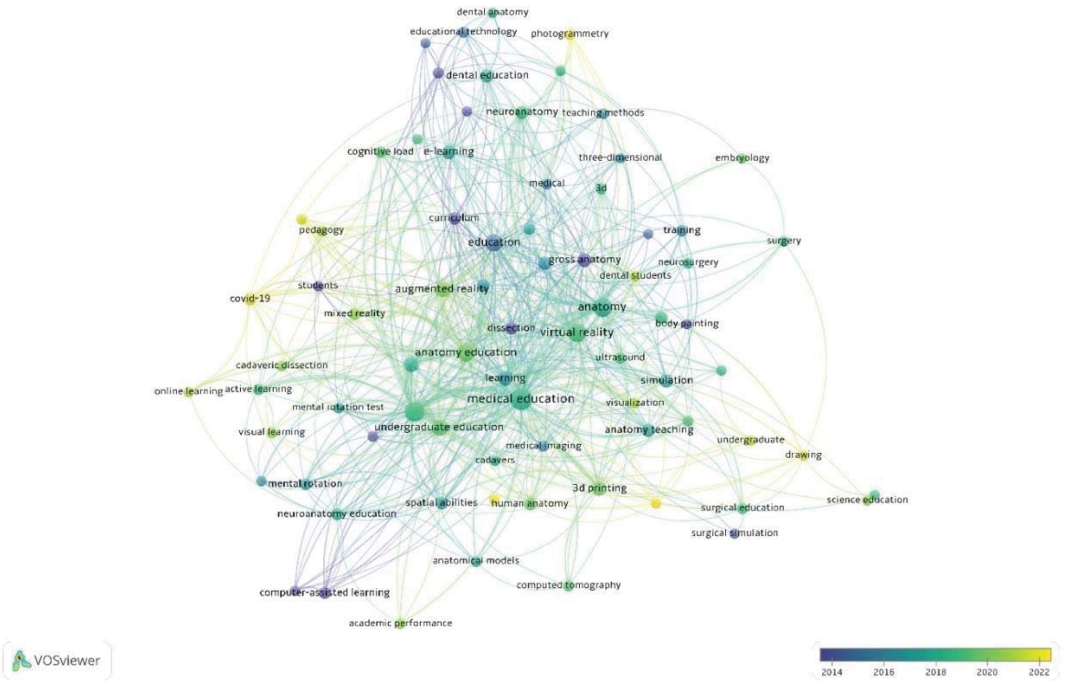


Figure 7. Overlay visualization of visuospatial ability for anatomy learning publication co-occurrence map using VOSviewer.

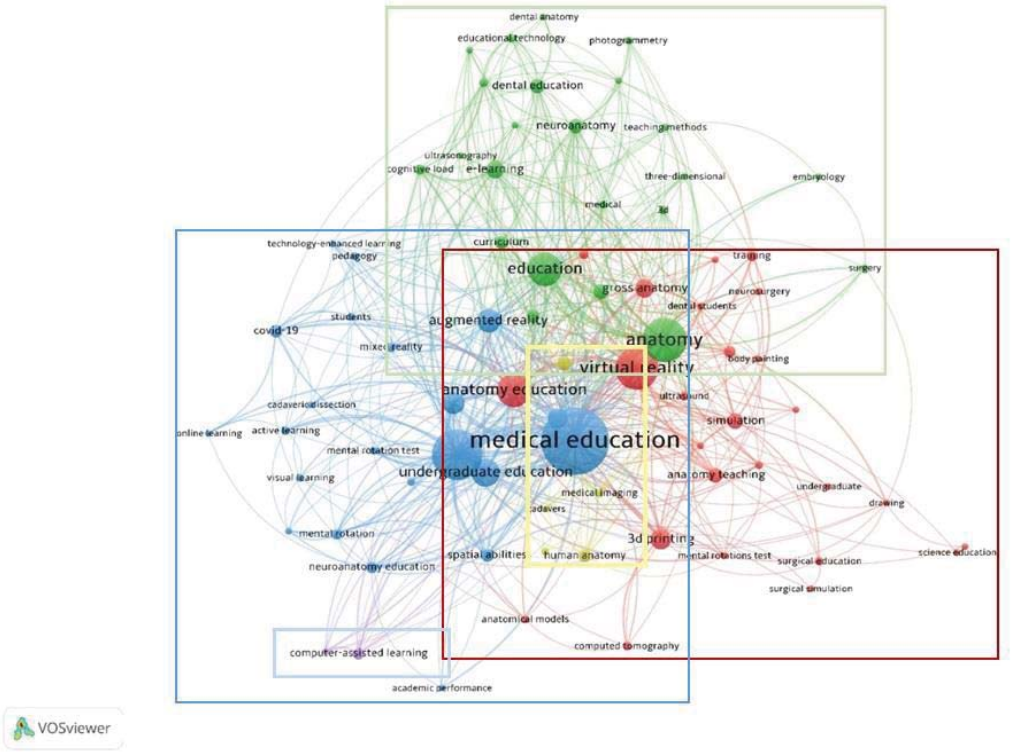


Figure 8. Co-occurrence of network visualization in the visuospatial ability for anatomy learning publication co-occurrence map using VOSviewer.

Each cluster has distinct high keyword frequency occurrences that indicate the research topics that have been previously investigated. The top three clusters with the highest frequency of occurrence in their respective words were identified. The initial first cluster comprised the occurrence of the following phrases: virtual reality (65), anatomy education (47), and 3D printing (23), whereas the second cluster was characterized by anatomy (68), education (47), and e-learning (19) as the most notable shared term. The third cluster consisted of medical education (126), gross anatomy instruction (83), and undergraduate education (38). Comprehensive information on the outcome of the cluster analysis is provided in **Table 2**.

Table 2. Result of cluster analysis

| Clusters | Top keywords | Other keywords |
|---|---|---|
| Red-26 items | Virtual reality (65), anatomy education (47), and 3D Printing (23) | Gross anatomy (20), simulation (16), anatomy teaching (14), medical students (10), training (9), assessment (8), computed tomography (7), surgical education (7), ultrasound (7), anatomical models (6), cadaver dissection (6), neurosurgery (6), body painting (5), cognitive load theory (5), dental students (5), drawing (5), evaluation (5), mental rotations test (5), science education (5), surgical simulation (5), undergraduate (5), visual literacy (5), and visualization (5) |
| Green-24 items | Anatomy (68), education (47), and e-learning (19) | Teaching (15), dental education (14), neuroanatomy (14), curriculum (12), undergraduate medical education (12), cognitive load (9), 3d (7), computer-assisted instruction (7), educational technology (7), medical (6), photogrammetry (6), teaching methods (6), 3d visualization (5), computer simulation (5), dental anatomy (5), embryology (5), multimedia (5), surgery (5), three-dimensional (5), and ultrasonography (5) |
| Blue-22 items | Medical education (126), gross anatomy education (83), and undergraduate education (36) | Augmented reality (28), spatial ability (26), learning (22), covid-19 (12), spatial abilities (12), neuroanatomy education (10), mental rotation (9), mixed reality (8), active learning (7), cognition (6), mental rotation test (6), pedagogy (6), students (6), visual learning (6), academic performance (5), cadaveric dissection (5), functional anatomy (5), online learning (5), and technology-enhanced learning (5) |
| Yellow-5 items | Dissection (13), human anatomy (11), and medical imaging (7) | Anatomical education (6) and cadavers (5) |
| Violet-2 items | Computer-assisted learning (10) and animation (5) | - |

The number in bracket represents the occurrence of each keyword

## Discussion

Visuospatial ability is a critical factor in anatomy learning within medical education. Research has demonstrated a reciprocal advantage in learning anatomy and enhancing spatial ability, indicating that challenging spatial aspects of anatomical knowledge can positively influence students' learning outcomes [20]. Anatomy learning is a fundamental aspect of medical education, requiring students to grasp the intricate spatial relationships within the human body. Visuospatial ability, which involves understanding and manipulating three-dimensional structures, is crucial for effective anatomy learning. It plays a significant role in tasks such as interpreting medical images, comprehending spatial relationships, and performing procedures that require precise hand-eye coordination [21]. The utilization of virtual reality (VR) and three-dimensional (3D) model tools is particularly beneficial for low spatial ability students, improving their post-session knowledge levels comparable to those with high spatial ability [22].

Incorporating multimedia modalities and advanced technologies like VR, AR, and 3D-printing has transformed the study of human anatomy, providing immersive platforms for visualizing anatomical structures interactively. Innovative tools such as virtual dissection and

three-dimensional models have been developed to offer interactive and immersive learning experiences [23]. Extensive research consistently emphasizes the importance of visuospatial skills in comprehending the complexities of anatomy. Individuals with high visuospatial abilities typically excel in grasping spatial concepts in anatomy, leading to enhanced academic performance [4]. Additionally, providing students with the ability to rotate and view anatomical structures from different angles freely has been found to impact the performance of students with different visuospatial abilities in anatomy tests [4,33]. Understanding the connection between visuospatial abilities and anatomy learning is essential for optimizing educational approaches and improving student outcomes.

Within the field of medical education, the conventional method of cadaveric dissection is changing to include more advanced technologies like 3D models and digital imaging for human anatomy study [24]. Furthermore, AR applications and online dissection courses have become increasingly widespread, particularly in response to challenges such as the Coronavirus disease-19 (COVID-19) epidemic. These challenges have required the adoption of creative teaching methods to improve students' visuospatial abilities [25,26]. Furthermore, studies have underscored the correlation of spatial abilities with anatomy learning, suggesting that enhancing spatial ability skills can significantly contribute to practical anatomy learning and should be integrated into anatomy education [3,27,29].

Additionally, the integration of innovative technologies like augmented reality and interactive 3D models has been explored to enhance neuroanatomy learning, demonstrating their effectiveness in enhancing knowledge acquisition and student satisfaction [26]. By acknowledging the significance of visuospatial abilities in medical education and incorporating tailored interventions and technologies, educators can optimize student's learning processes and competency development in anatomy and medical practice.

The development of visuospatial ability is crucial for tasks demanding precise spatial cognition and motor coordination in medical practices, such as ultrasound-guided procedures and surgical interventions. Novices' learning procedures, like real-time ultrasound-guided needle manipulation, may be influenced by their inherent visuospatial ability, affecting their spatial cognition and motor coordination [28]. Interventions targeting the enhancement of visuospatial abilities have been shown to positively impact learning outcomes in visuospatial science domains, indicating the potential for improving educational achievements through focused training [29].

To enhance anatomy education, the integration of computer-assisted learning (CAL) has become an integral component of modern anatomy education, offering innovative approaches to enhance student's understanding of complex anatomical structures, such as interactive multimedia and virtual reality applications. These technologies have revolutionized the teaching of anatomy by providing students with dynamic and engaging learning experiences [30,31]. They facilitate the visualization of anatomical structures and cater to different learning styles, benefiting students with varying visuospatial abilities [32,1]. Studies have shown a positive correlation between high visuospatial ability and improved performance on practical anatomy examinations, underscoring the importance of these skills in acquiring anatomical knowledge [4]. Educators are advised to adopt flexible curriculum delivery and assessment strategies to accommodate students with varying levels of spatial ability, ensuring equitable learning experiences [33].

The main limitation of this bibliometric investigation is the reliance on a solitary database. Therefore, certain articles regarding visuospatial ability and anatomy learning have not been included. Scopus was selected as the preferred medical database due to its wide variety of information and advanced search analysis features. Performing concurrent searches in multiple databases may slightly enhance the outcomes of the literature. Although there are limitations, the results offer vital insights into the important contributions to research on learning about visuospatial-related anatomy. This study also provides a framework for future investigations.

## Conclusion

A total of 552 academic papers were acquired from the Scopus database. Some key findings showed the most substantial growth in publications from 2018 to 2019, and anatomical sciences education was recognized as the most esteemed journal within the field. Furthermore, Wilson

TD. produced the most significant research contributions, and the United States was the most productive country. The utilization of virtual reality and 3D printing models in anatomy education aims to enhance students' visuospatial abilities and improve their theoretical knowledge and practical skills. Additionally, the assessment of student satisfaction with these techniques suggests that further investigation into these topics is warranted. The bibliometric findings can provide a foundation for future prospective studies, specifically targeting important areas that are impacted by visuospatial abilities, such as virtual reality and anatomy instruction. This will enhance the progress of anatomy education and facilitate its wider use. Further research in this area is essential to bridge existing gaps and improve strategies for enhancing visuospatial abilities in anatomy education.

### Ethics approval

Not required.

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### Competing interests

All the authors declare that there are no conflicts of interest.

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This study received no external funding.

### Underlying data

Derived data supporting the findings of this study are available from the corresponding author on request.

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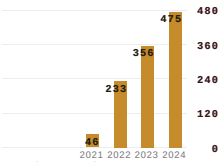


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## ORIGINAL ARTICLE

**Early activation of macrophage-2 with IL-4 in stromal vascular fraction increases VEGF levels and adipocyte count and maintains volume of fat graft in Wistar rats (Rattus norvegicus)**

*Rachel Vania, I GPH. Sanjaya, Agus RRH. Hamid, Shita D. Sudarsa, I GASM. Dewi, I W. Niryana, Elysanti D. Martadiani*

DOI: 10.52225/narra.v4i3.1080

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**Global prevalence and potential factors influencing willingness for renal transplantation in end-stage renal disease patients: A systematic review and meta-analysis**

*Fredo Tamara, Jonny K. Fajar, Agung Susanto, Yesica T. Enggriani, Maria IS. Beluan, Reychell Mirino, Lia D. Farida, Diana V. Hastutya, Dewi A. Puspitasari, Yama S. Putri, Jefri P. Susanto, Volodymyr Dzhyvak*

DOI: 10.52225/narra.v4i3.964

PDF

**Effectiveness of combined physical exercise and cognitive training in older adults with cognitive impairment: A systematic review and meta-analysis**

*Dwi NK. Wati, Heng Y. Lin, Jing J. Wang*

DOI: 10.52225/narra.v4i3.1040

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**Effects of decursinol angelate on viability and apoptosis in PC-3 prostate cancer cells: In vitro study**

*Zakaria A. Rahman, Furqan Hidayatullah, Putu KD. Pratama, Dimas P. Andhika, Lukman Hakim*

DOI: 10.52225/narra.v4i3.948

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**Antioxidant and immunomodulatory activities of ethanol extracts from Syzygium cumini L. Skeels and Pogostemon cablin Benth**

*Meutia Faradilla, Irda Fidrianny, Maria I. Iwo*

DOI: 10.52225/narra.v4i3.918

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**A network pharmacology approach to elucidate the anti-inflammatory and antioxidant effects of bitter leaf (Vernonia amygdalina Del.)**

*Illah Sailah, Trina E. Tallei, Linda Safitri, Yulianida Tamala, Ernie Halimatushadyah, Dewi Ekatanti, Nur B. Maulydia, Ismail Celik*

DOI: 10.52225/narra.v4i3.1016

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**Association between vitamin D levels with IL-6 and IL-10 in umbilical cord blood of infants**

*Muhammad N. Massi, Bahrul Fikri, Azwin M. Putera, Sofa D. Alfian, Nadira R. Ridha, Sri H. Putri, Ummi Chaera, Israini W. Iskandar, Naoki Shimojo*

DOI: 10.52225/narra.v4i3.889

PDF

**Predictors for 30-day mortality in hepatocellular carcinoma patients undergoing liver resection**

*Erik Prabowo, Neni Susilaningsih, Catharina Suharti, Hery D. Purnomo, Ignatius Riwanto, Ahmad F. Fuadi, Ardiyana Ar, Beatrice LA. Bulandari, Kevin C. Tjandra, Danendra RK. Respati, Derren DCH. Rampengan*

DOI: 10.52225/narra.v4i3.1001

PDF

**Inhibition of B-cell activating factor activity using active compounds from**

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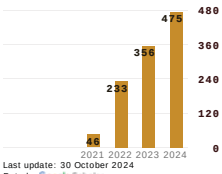


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**Physalis angulata in the mechanism of nephrotic syndrome improvement: A computational approach**

*Astrid K. Kardani, Loeki E. Fitri, Nur Samsu , Krisni Subandiyah , Agustina T. Endharti, Dian Nugrahenny, Syahputra Wibowo*

DOI: 10.52225/narra.v4i3.859

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**Effects of cholecalciferol supplementation on depressive symptoms, C-peptide, serotonin, and neurotrophin-3 in type 2 diabetes mellitus: A double-blind, randomized, placebo-controlled trial**

*Rudi Putranto, Siti Setiati, Martina W. Nasrun, Fiastuti Witjaksono, Suzanna Immanuel, Imam Subekti, Kuntjoro Harimurti, Agus Siswanto, Hamzah Shatri, Suhendro Suwarto, Marcelino A. Megantara*

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**Finding the new potential research on diabetic kidney disease and hemodialysis in healthcare insurance databases: A bibliometric analysis**

*Lily Kresnowati, Suhartono Suhartono, Zahroh Shaluhiyah, Bagoes Widjanarko*

DOI: 10.52225/narra.v4i3.827

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**Aerobic exercise improves spatial memory in a rat model of meningitis**

*Lailatuz Zaidah, Soetrisno Soetrisno, Bambang Purwanto, Agus Kristiyanto, Brian Wasita, Vitri Widyaningsih*

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**Exploring links between visuospatial ability and anatomy learning in education: A bibliometric analysis and scientific mapping**

*Muhammad Z. Rahmani, Agussalim Bukhari, Nanang Wiyono, Khaeriah Amru, Baharuddin Baharuddin, Asty A. Nurhadi*

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**Role of mothers in preventing tuberculosis in children: A scoping review**

*Nursia Aja, Ravik Karsidi, Sapja Anantanyu, Anik Lestari*

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**Prevalence of major INSTI and HIV-1 drug resistance mutations in pre- and antiretroviral-treated patients in Indonesia**

*Fauzia A. Djojosugito, Arfianti Arfianti, Rudi Wisaksana, Fajri M. Siregar, Nasronudin Nasronudin, Brian E. Rachman, Siti Q. Khairunisa, Agnes R. Indrati*

DOI: 10.52225/narra.v4i3.1022

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**Potential of ant nest extract (Hydnophytum formicarum) for protection of testicular morphometry, epididymal functions, and sperm quality in male rats with alloxan-induced diabetes**

*Roslizawaty Roslizawaty, Mahdi Abrar, Khairan Khairan, Gholib Gholib, Tongku N. Siregar, Syafruddin Syafruddin, Amalia Sutriana, Putri Azzahra, Hanipah Aini*

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**Factors associated with awareness of and undergoing Pap smear tests among Jordanian women**

*Abeer Annab, Lujain Lataifeh, Isam Lataifeh, Diala Al-Rabadi, Osama Alkouri, Yousef S. Khader*

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**Evaluation of phenolic compounds as cross-linkers to improve the qualities of halal gelatin from milkfish scales (Chanos chanos)**

*Nursalam Hamzah, Slamet Ibrahim, Daryono H. Tjahjono*

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**Impacts of Phyllanthus niruri extract on biomarker levels, macrophage count, and lesion area in an endometriotic rat model**

*Eka T. Wulandari, Soetrisno Soetrisno, Bambang Purwanto, Reviono Reviono, Brian Wasita, Abdurrahman Laqif*

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**Burden of rheumatic diseases among people with diabetes: A systematic review and meta-analysis**

*Mahabaleshwar Mamadapur, Abhay M. Gaidhane, Bijaya K. Padhi, Quazi S. Zahiruddin, Rakesh K. Sharma, Sarvesh Rustagi, Prakasini Satapathy, Sathvik B. Sridhar, Javedh Shareef, Sirajunisa Talath, Rajesh K. Yadav , Rachana Mehta*

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**Comparative analysis of synovectomy and total knee replacement in knee joint synovial chondromatosis: A case series**

*Muhammad RA. Primaputra, Vino D. Malau, Filberto Budhy, Pramudito Yudhistira*

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**Challenges in diagnosing and treating Liddle syndrome in resource-limited settings: A case report from Indonesia**

*Nurhasan A. Prabowo, Wachid Putranto, Risalina Myrtha, Tonang D. Ardyanto, Coana S. Gautama, Evi L. Wulandari, Berty D. Hermawati, Desy P. Putri, Artika Ramadhani, Herlina K. Dewi*

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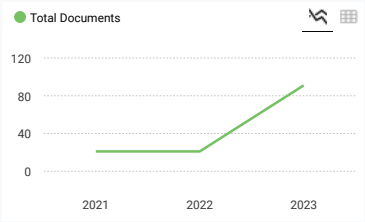


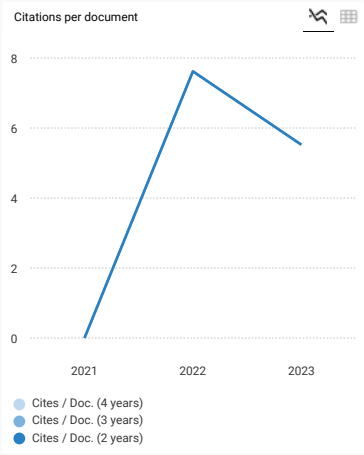


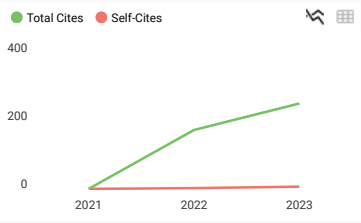


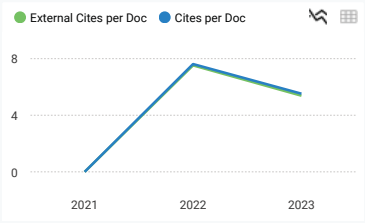


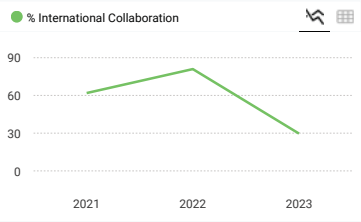


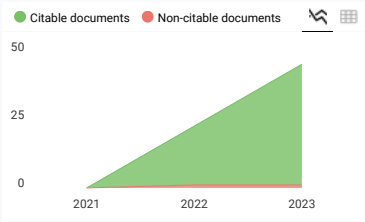


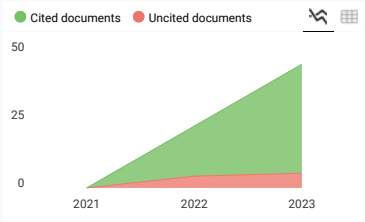


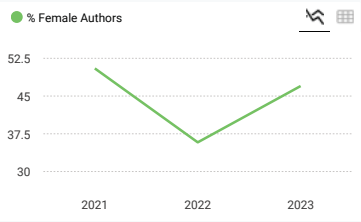


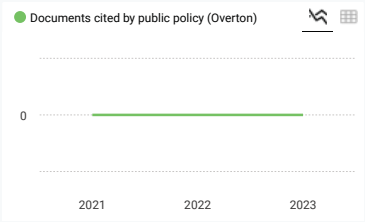


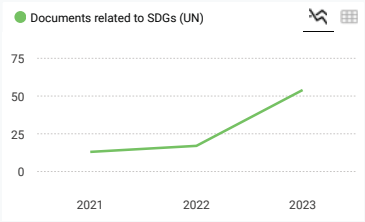



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