

Review

How Learning Styles Characterize Medical Students, Surgical Residents, Medical Staff, and General Surgery Teachers While Learning Surgery: Scoping Review

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Abstract

Background: Learning style is a biologically and developmentally imposed configuration of personal characteristics that makes the same teaching method effective for some and ineffective for others. Studies support a relationship between learning style and career choice, resulting in learning style patterns observed in distinct types of residency programs, which can also be applied to general surgery, from medical school to the latest stages of training. The methodologies, populations, and contexts of the few studies pertinent to the matter are very different from one another, and a scoping review on this theme will unequivocally enhance and organize what is already known.

Objective: The goal of this study is to identify and map out data from studies that report on learning styles in medical students, surgical residents, medical staff, and surgical teachers.

Methods: The search strategy was performed on September 25, 2023, by a librarian and digital search strategy expert, through the descriptors “learning, style” and “surgery.” The databases consulted were Embase, SCOPUS, Web of Science, and PubMed through descriptors and their synonyms, according to MeSH (Medical Subject Headings). Of the 213 articles found, 135 articles remained after the exclusion of duplicates. The remaining 78 articles were analyzed by 3 of the researchers independently. A total of 27 articles were selected, and 2 articles were excluded because the full article was not found.

Results: A total of 25 articles were included in the review. A total of 96% (n=24) of the articles used cognitive theories as their theoretical basis. Regarding learning style instruments, 36% (n=9) articles used the visual, aural, read, and kinesthetic learning method instrument, and 40% (n=10) articles chose Kolb’s learning style inventory. The papers concentrate especially on the 2010s, and most of them are from North America (16/25, 64%) or Europe (6/25, 24%). The smallest study had 15 participants and the biggest had 1549 participants. The included studies primarily focused on surgical residents (21/25, 84%), with fewer targeting faculty and staff (9/25, 36%). The primary objectives of the studies were to investigate the relationship between learning styles and performance (15/25, 60%), gender differences (7/25, 28%), changes over time (4/25, 16%), and motivation (3/25, 12%).

Conclusions: This scoping review reveals a limited and geographically concentrated body of research on learning styles in surgery education, primarily focusing on surgical residents and using Kolb's learning style inventory and visual, aural, read, and kinesthetic learning method instruments. Considerable gaps exist regarding geographical diversity and the study of medical staff and faculty. These findings underscore the need for future research with a broader scope to better inform educational strategies in surgery.

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Keywords: learning styles; general surgery; medical staff; surgical residents; students; medical faculty; medical school; cognitive theories; scoping review; PRISMA

Introduction

The concept of learning styles was first developed as a result of the interest in individual differences through the learning process, at the beginning of the 1960s [1]. According to Dunn, everyone has a peculiar learning style, like a signature. In this regard, tailoring teaching to different learning styles may help and improve results in education.

Several theories and inventories were created to assess and determine one's learning style, including the following: Kolb's model, Felder and Silverman's model, and Gregorc's model, especially in health care education. A debate about whether learning styles are fixed or flexible exists to this day, and to what extent the context can influence and determine them [2].

However, it is important to acknowledge the growing body of evidence that challenges the effectiveness and validity of learning styles theories. While these theories suggest that tailoring instruction to individual learning preferences can enhance learning outcomes, empirical studies have shown limited support for this approach [3]. Specifically, research indicates that many students do not study in ways that align with their self-reported learning styles, and that matching instruction to these styles does not necessarily improve performance [4].

For example, David Kolb describes learning as a process where knowledge is transformed through experience, and that acknowledgment is the combination of appropriation and transformation of experience. His theory is a holistic model called "experiential learning" and emphasizes experience in its core, differing from other theories [5]. Kolb's scheme hypothesizes that the learner has a concrete experience, upon which he reflects. Through reflection, it is possible to formulate abstract concepts and make appropriate generalizations, then consolidate the understanding by testing the implications of the knowledge in new situations. This then provides a concrete experience, and the cycle continues. Learners with different learning preferences will have different strengths and weaknesses in the quadrants of the (Kolb) cycle [6]. Based on that, he created the learning style inventory (LSI) to determine and assess individually the different learning styles, divided into converging, diverging, assimilating, and accommodating [7].

In medical education, it is particularly important to remember the heterogeneity of students. Some programs count on learners who have already completed a university degree; in others, the students come straight from secondary school, and many face a mixture of both. The broader concept of medical education includes postgraduate students and continuing professional development, too. Each of them will have variable individual constraints, experiences, and preferences [8].

The diversity in educational backgrounds, cultural influences, ethnic origins, and gender identities among contemporary surgical trainees presents unique challenges and opportunities for educators. While it is often assumed that these diverse backgrounds necessitate a personalized approach to learning, it is crucial to recognize that individual learning preferences may not always align with optimal learning strategies [9].

Instead, effective surgical education should focus on evidence-based instructional methods that cater to a wide range of learners, while also promoting critical thinking, adaptability, and lifelong learning skills.

Perry [10] noted that students change their learning approach as they progress through their college years. Students often begin with a "duality" approach, with a clear view between right and wrong, towards "multiplicity," where they recognize that context is important, and that there are various valuable sources of knowledge and experience.

Knowledge is the main domain of medical education, but the outcome depends strongly on other domains such as attitude, lifelong learning, empathy, communication, ethics, and professionalism. The clinical environment is challenging for both the student and the teacher, without mentioning the patient, who is at the center of the action. In this bigger context, it is vital to use different learning theories to promote effective learning [8].

Contemporary surgical trainees come from diverse educational, cultural, ethnic, and gender backgrounds [11], and are pressured to develop skills not only in the role as a medical expert, but also as a professional, scholar, health advocate, manager, collaborator, and communicator [12].

Educating surgeons is an ancient tradition that has existed since the development of surgery [13], and for centuries, surgical residency curricula have been guided primarily

by tradition. The apprenticeship model has been one of the essential components of surgical training. It generally involves 3 steps: assisting at operations, performing operations with expert assistance, and operating without assistance.

Modern surgical education has been revolutionized by exponents such as Halsted: the historical model of apprenticeship was transformed into the current organized system that we call Residency [11].

The present day, however, requires the realization of more complex procedures, performed more regularly and in safer manners, demanding even more prepared professionals [14].

Studies report on a relationship between learning style and medical career choice, resulting in learning style patterns observed in distinct types of residency programs, which can also be applied to general surgery. Based on Kolb's LSI, students classified as accommodating and diverging frequently chose surgery as their career choice, whereas converging chose internal medicine, and assimilating chose academic medicine [15].

However, despite the theme's relevance, a preliminary search in the MEDLINE, Cochrane Database of Systematic Reviews, and Joanna Briggs Institute's evidence synthesis revealed no scoping review. Moreover, the methodologies, populations, and contexts of the few studies pertinent to the matter are very different from one another, and a scoping review on this theme would unequivocally enhance and organize what is already known.

Therefore, the aim of this scoping review is to identify, map, and synthesize the existing literature on learning styles in medical students, surgical residents, medical staff, and surgical teachers within the field of surgery. This review seeks to provide a comprehensive overview of the current state of knowledge, identify gaps in the literature, and inform future research and educational practices in surgical training.

Methods

Overview

The scoping review proposed here was carried out according to Arksey and O'Malley's [16] structure, using the first five stages: (1) identify the research question; (2) identify relevant studies; (3) select studies; (4) map out the data; and (5) collate, summarize, and report the results. Since this is preliminary research, it is likely that more studies on the theme will be finalized. Although the sixth stage of Arksey and O'Malley's [16] structure (consulting) will not be completed in this review, its results can inform this stage in a future study. The structure is congruent with The Joanna Briggs Institute's scoping review methodology. The protocol for this scoping review was duly developed in accordance with relevant reporting guidelines and has been publicly registered [17].

Inclusion Criteria

After a discussion involving the researchers, the eligibility criteria were defined.

Participants

Studies were made with medical students, surgical residents, medical staff in general surgery, and the general surgery's medical faculty. It was not obligatory to contain all the population's extracts. Studies were included if they involved at least one of these population groups; it was not required for a study to include all listed groups.

Concept

The included studies approached "learning styles" of the target population, regardless of the chosen instrument to define them.

Context

The eligible studies were those related to teaching surgery to the population in question, in any country.

Types of Sources

The following types of sources were included in the review: studies with qualitative and quantitative approaches, primary studies, systematic reviews, meta-analyses and meta-synthesis, books, and guidelines, published in indexed sources.

Research Strategy

The search strategy was performed on September 25, 2023, by a librarian and digital search strategy expert, through the descriptors "learning, style" and "surgery." There was no time frame restriction in the search. For the combination of descriptors, the Boolean operators "AND" and "OR" were considered. Words were reduced to their root to embrace variations in writing and broaden the search scope.

Databases consulted were Embase, SCOPUS, Web of Science, and PubMed through descriptors and their synonyms—according to the Medical Subject Headings—to every strategy item. These databases were selected because they are comprehensive and have a broad coverage of health publications. The databases' search resulted in a table made using a Microsoft Excel spreadsheet. In accordance with PRISMA-P (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols) guidelines, the detailed search strategy used for one database (eg, PubMed) is provided in [Multimedia Appendices 1](#) and [2](#) including specific search terms, Boolean operators, and any applied limits, to ensure reproducibility.

Data Selection and Extraction

The articles were evaluated by 3 independent researchers after discussions about inclusion and exclusion criteria. To align the eligibility criteria among the researchers, the titles and abstracts of 25 random articles were analyzed by 3 of the researchers. Disagreements regarding the inclusion or exclusion of the articles were discussed until a consensus was reached. There was a 100% agreement concerning the

inclusion and exclusion of the articles. After the articles' selection, a form was used to extract data from the articles' full analysis, both quantitatively and qualitatively.

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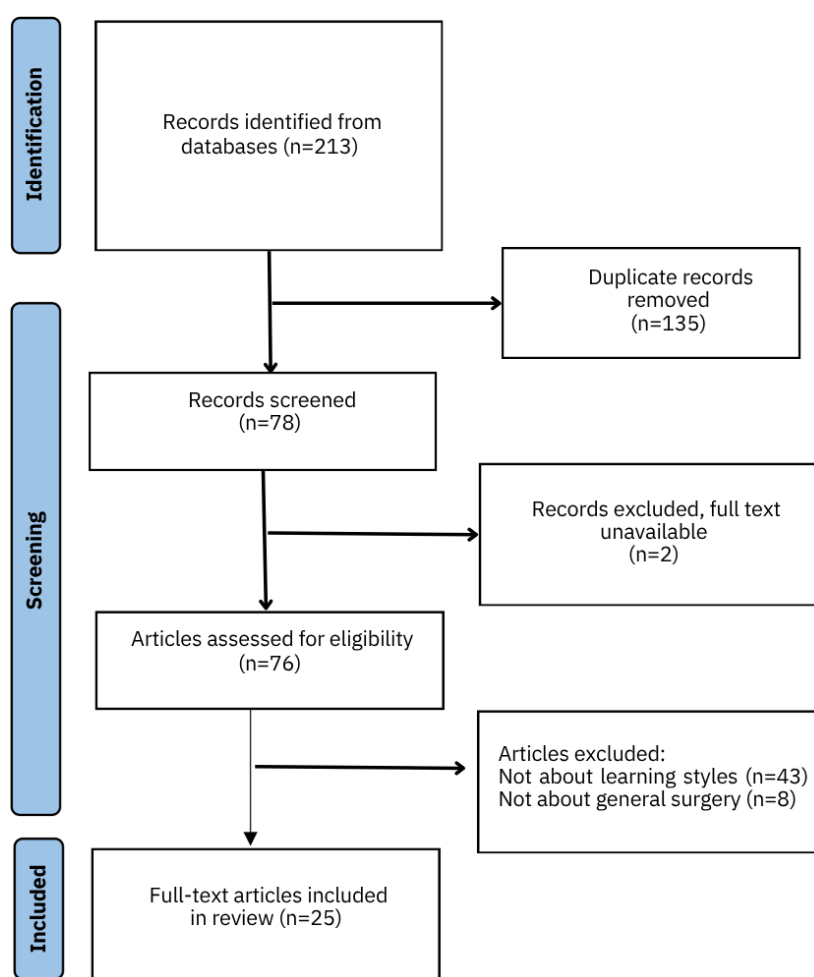
of the researchers independently, from which 27 articles were selected, and 2 articles were excluded because the full article was not found. A PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews; [Checklist 1](#)) flow diagram was produced ([Figure 1](#)). Thus, the analysis included a total of 25 articles.

Results

Overview

Of the 213 articles found, 135 remained after the exclusion of duplicates. The remaining 78 articles were analyzed by 3

Figure 1. PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews) flow diagram of learning styles in general surgery.



Learning Theory and Learning Style Instrument

Regarding the theoretical basis, 96% (n=24) of the included articles used cognitive theories as a theoretical basis. Regarding the choice of learning style instrument: 36% (n=9) used the visual, aural, read, and kinesthetic learning method (VARK) instrument, and 40% (n=10) chose Kolb's LSI. One study opted for the Multiple Intelligences Developmental Assessment Scales [18] instrument; another used the Meyer-Briggs type indicator [19]. One study used the students'

learning preferences questionnaire [20], and 2 others chose the 24 self-reported LSI questionnaire [21,22]. One study was conducted as a review, so it explained various learning styles approaches [23].

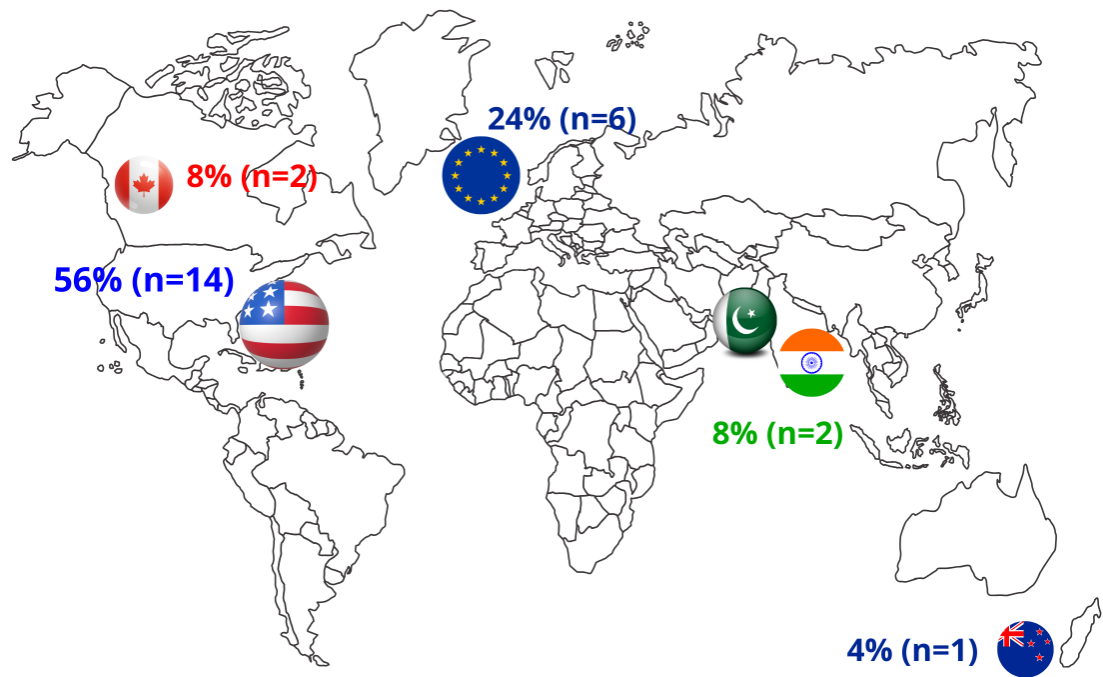
Mapping Studies Around the World

A majority of the studies were conducted in North America or Europe. Specifically, 14 studies were developed in the United States and 2 studies were from Canada, accounting for 64% (n=16) of the studies with a northern American population. A total of 24% (n=6) of the studies took place in Europe,

4 studies in the United Kingdom, one study in Spain [24], and one study in the Netherlands [23]. Only one study was conducted in Oceania (New Zealand) [18], and the other 2 studies were from Asia (2/25, 8%), one from Pakistan [20]

and the other from India [21]. No studies (0/25, 0%) were found regarding learning styles and surgery in Latin America or Africa. Figure 2 summarizes these findings.

Figure 2. Map of previous studies conducted around the globe regarding learning styles and surgery.



Interest in Learning Styles Across Time

Learning styles were not a common subject until the 1960s. Table 1 shows the number of articles on the theme in each

decade. The year 2010 was the most interesting in the subject, with 15 published papers.

Table 1. Number of articles about learning styles in surgery through the decades.

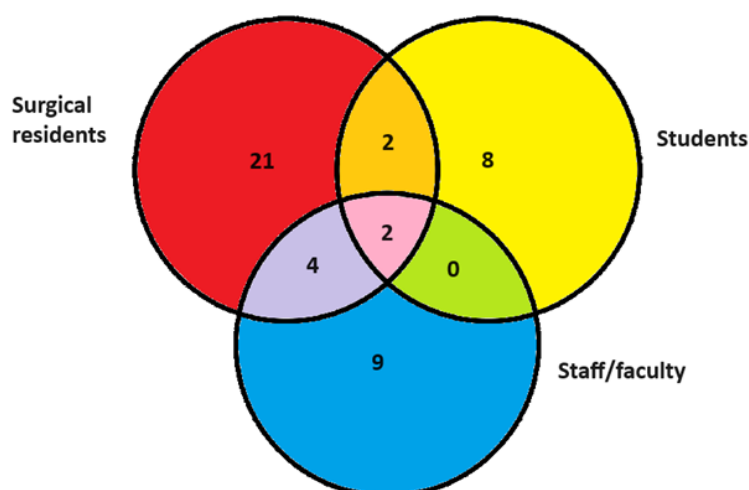
Year	Articles, n
1970	1
2000	4
2010	15
2020	4

Characteristics

Most articles had a transversal design, accounting for 88% (n=22) of the total. One study (1/25, 4%) was a review, and 3 others (3/25, 12%) were cohorts. The number of participants was, on average, 114. The smallest study had 15 participants [25] and the biggest, 1549 participants [19].

The articles included students, surgical residents, and surgical staff/faculty. Figure 3 shows the number of articles with each of these populations. Specifically, 84% (n=21) of the papers included general surgery residents, while 36% (n=9) targeted faculty and staff.

The goals of these studies differed a bit. A total of 60% (n=15) of participants were interested in the relation between learning styles and performance, such as laparoscopic or robotic skills, academic achievement, and so on. Another 28% (n=7) of participants also looked over gender gaps and differences among female and male participants. Four studies (4/25, 16%) took an interest in changes in learning styles over time. Three studies (3/25, 12%) also evaluated motivation.

Figure 3. Number of articles with each population.

Discussion

Principal Findings

This scoping review identified 25 studies published between the 1960s and 2023 that explored learning styles in the context of surgery education. The majority of these studies were published in the 2010s and were predominantly conducted in North America and Europe. The most frequently used instruments to assess learning styles were Kolb's LSI and the VARK questionnaire. The included studies primarily focused on surgical residents, investigating the relationship between learning styles and various outcomes such as performance, gender differences, changes over time, and motivation.

There are several ways to face adult education. For example, there are multiple theories that can be superposed along with multiple ways of evaluating them according to the chosen theory. In health care, there are several specificities that make the educational process more complex, since there are a lot of abilities and competencies to be developed in a short period of time. On top of it, medical science evolution becomes faster every day, adding challenges to education and the preparation of professionals.

Surgery is commonly known as a delicate place for developing skills and training in high-risk procedures. When teaching surgery, it is important to account for medical students, residents, and continuous improvement for teachers and medical staff. These pieces of surgical educational chess are very different from each other, each one with special needs and goals. To understand how these population extracts capture and keep knowledge is vital to effective learning [26].

As highlighted in the results, Kolb's LSI and the VARK instrument were the most commonly used tools in the reviewed literature. Kolb's LSI, based on experiential learning theory, categorizes learners into 4 styles (diverging, assimilating, converging, and accommodating) based on their preferences for concrete experience, reflective observation, abstract conceptualization, and active experimentation

[4,5]. The VARK questionnaire, on the other hand, focuses on sensory preferences for information intake and output, classifying learners as visual, auditory, read/write, or kinesthetic [16]. While both instruments aim to identify individual learning preferences, they stem from different theoretical frameworks and assess distinct aspects of the learning process. Kolb's model is more focused on how individuals process information through a cycle of experience and reflection, whereas VARK is centered on the modality through which information is best received and conveyed. The prevalence of these instruments in the literature may be attributed to their relative ease of administration and interpretation. However, it is important to note that the psychometric properties and theoretical underpinnings of some learning style instruments, including Kolb's LSI, have faced criticism in the broader educational psychology literature, raising questions about their validity and the implications of findings based solely on these tools [27-29]. Future research should consider these limitations and potentially explore alternative or complementary approaches to understanding individual differences in surgical learning.

The study field of learning styles and surgery is wide and still poorly explored. It is only possible to imagine the benefits that would emerge with the amplification of this understanding in teaching and learning surgery in the next decades.

Principal Results

Historically, there are not many studies on learning style in surgery, as pointed out by this scoping review. The papers concentrate especially on the year 2010, and most of them are in North America or Europe. Thanks to important cultural, financial, and political contexts, it is evident that more information on the participants from the rest of the world is needed.

The main instruments used in the papers were Kolb's LSI and the VARK instrument, both derived from cognitive theories. The ease of handling the instruments was probably an impact factor in their choice, on top of their proven effectiveness and reproducibility.

A total of 84% (n=21) of papers had general surgery residents as the target, while only 36% (n=9) targeted faculty and staff. The improvement of teaching goes by deep knowledge of teachers and their methods [30]. So, prospective surgeons should not be the only goal of surgical educational research. The ratio is to disarticulate the former master-learner vision, understanding that everyone involved in the learning process is a potential and continuous learner [16,24].

The main purpose of the papers was to relate learning styles and performance, motivation, gender, and changes over time.

The articles aiming for performance did it in a lot of diverse ways. One way to assess performance is to evaluate the scoring in admission tests, and research has concluded, many times, that a nonspecific learning style is being favored in those types of admissions [25-29]. Others took interest in psychomotor skills, measured by specific metrics [14,19,20,30]. There were also the ones that focused on academic achievement throughout college [31] or residency program [11,21], by overlooking the number of procedures [32], for example.

In surgery, gender is a substantial subject because the surgical environment is, in general, very masculine. There is still today a discrepancy between women in the early career (residents) and late career (teachers) [33-38], and differences in payment, rates of sexual harassment, rates of sexual abuse, rates of psychological abuse, and so on. The proportion of women in surgery, although it has been increasing in the past few decades [17,20,28,31,32,39]

Motivation is key to good learning, and many learning theories rely on it [40,41]. Without motivation, the learner lacks stimuli and fatally decreases their learning. There is no

robust evidence in the literature to support the relationship between learning styles and degree of motivation [16,42-44].

Limitations

The main limitation of this scoping review is the fact that only English articles were searched, which diminishes the cultural range due to the language barrier, especially if we consider that surgical residency has very different types of models and resources around the world.

Comparison With Prior Work

No scoping review on learning styles in surgery was ever done.

Conclusions

This scoping review identified a limited number of studies exploring learning styles in surgery education, with the majority concentrated in the 2010s and predominantly conducted in North America and Europe. The review found that Kolb's LSI and the VARK instrument were the most frequently used tools, and that research has primarily focused on surgical residents, investigating relationships between learning styles and performance, gender, changes over time, and motivation. The scarcity of studies from other regions, particularly Latin America and Africa, and the limited focus on medical staff and faculty highlight considerable gaps in the current literature. Based on these findings, understanding the characteristics of the existing research landscape is key to informing future studies. Further research is needed to broaden the geographical scope, explore diverse populations within surgical education, and investigate the practical implications of learning style research for enhancing teaching and learning strategies in surgery.

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Authors' Contributions

GGs and JCA contributed to the conceptualization of the study. Data curation was performed by GGS, MARF, CDSC, and BCG. FSF was responsible for formal analysis. GGS, LVCN, and JCA conducted the investigation and developed the methodology. Project administration was carried out by DVO, FF, PSF, ARAL, VMSB, HCC, and JCA. Validation and visualization were undertaken by SRPVT, JDSM, MQS, WDM, NAASRC, ERS, HLGC, ALL, ABQ, and SMML. The manuscript was written, reviewed, and edited by GGS and JCA.

Conflicts of Interest

None declared.

Multimedia Appendix 1

Detailed search strategy.

[\[DOCX File \(Microsoft Word File\), 22 KB-Multimedia Appendix 1\]](#)

Multimedia Appendix 2

Search strategy used for one database (PubMed).

[\[DOCX File \(Microsoft Word File\), 15 KB-Multimedia Appendix 2\]](#)

Checklist 1

PRISMA-ScR checklist.

[\[DOCX File \(Microsoft Word File\), 87 KB-Checklist 1\]](#)**References**

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Abbreviations

LSI: learning style inventory

MeSH: Medical Subject Headings

PRISMA-P: Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols

PRISMA-ScR: Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews

VARK: visual, aural, read, and kinesthetic learning method

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