BEME
Systematic
Review
Protocol

TITLE, ABSTRACT, AND AUTHORS

Title of Review
Teaching visual diagnosis in medical education: a scoping review

Abstract

Background
Despite substantial literature on visual expertise, little is known about the teaching practices involved during the process of visual expertise development. Addressing this knowledge gap is the first step to facilitate the modification and development of instructional strategies to improve visual diagnosis instruction.

Aim
To characterize the breadth of educational practices for teaching visual diagnosis in medical education.

Methods
A scoping review will be performed to map the existing literature and characterize the instructional methods, assessment strategies, and educational outcomes in studies of visual diagnosis teaching in medical education.

Importance
The characterization of the educational practices for teaching visual diagnosis in medical education can serve as a template to inform the design of better methods and tools for teaching visual diagnosis in medical education.

Keywords: visual diagnosis, visual expertise, medical education, teaching, instruction, learning, training

Word count: 125 words

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**Dr. Thammasitboon is a BEME Review Committee member and has provided oversight during the protocol development and will continue to facilitate the team decision-making throughout the iterative refinement of the screening, data charting form and process, as well as data analysis.*

BACKGROUND TO THE TOPIC

Visual diagnosis is a cornerstone of multiple disciplines in medical education, such as radiology, pathology, and dermatology. There is an extensive body of work in the medical education literature on the characteristics and interactions between cognitive and visual skills involved in the development of visual expertise (Norman et al., 1992; Gegenfurtner & van Merriënboer, 2017). However, little is known about the instructional practices involved in teaching visual diagnosis (Gegenfurtner et al., 2017; Jaarsma et al., 2018; Kok et al., 2017). Addressing this knowledge gap on visual diagnosis teaching could inform improved instructional strategies in visual diagnosis as a foundational step to support visual expertise development.

There is variable description in the literature of teaching methods for visual diagnosis. Anecdotally, medical training programs use a combination of didactic lectures, self-study materials, case libraries, and predominantly experiential clinical learning through apprenticeship. There is a gap in knowledge related to structured approaches or theory-informed methods to teach learners to approach visual diagnostic information. A better understanding of various teaching methods and underlying educational theories or principles used to teach visual diagnosis could support the development of better instructional strategies.

Our goal with this scoping review is to explore the teaching of visual diagnosis focusing on the diagnostic processes that involve visual information as the central source of data (e.g., images in radiology or slides in pathology). Visual diagnosis can encompass many types of visual information so we will conduct a broad exploration to comprehensively describe the landscape of instruction across different visual information sources.

We anticipate that there will be a wide range of terminology to describe “visual diagnosis” across the literature, likely from a lack of a uniform definition and the use of variable terms. This review will help narrow the gap in terminology by describing the extent of the terms and definitions across studies. The dissemination of terminology can facilitate a shared understanding of the language used to describe visual diagnosis and visual diagnosis teaching. Having a common language is an important step to focus future research, outline and explore the gaps in the literature, and serve as a focal point for future evidence synthesis efforts.

Visual diagnosis is inherently different from usual clinical diagnostic reasoning (Norman et al., 1992); visual diagnosis represents a set of unique skills and thus requires specific and tailored instructional methods. This scoping review will provide a critical first step to address the knowledge gap in medical education research on visual diagnosis teaching. We will categorize the terminology, explore the instructional processes, and provide a landscape of the types of studies, methods, tools, and theoretical frameworks involved in visual diagnosis teaching. Providing this initial landscape will help guide and focus future studies. The findings of this scoping review can also further inform research on specific visual diagnosis teaching practices and facilitate the design and implementation of instructional processes aiming to establish best practices in visual diagnosis teaching.

REVIEW QUESTION(S)/OBJECTIVES, TYPE OF REVIEW, AND KEYWORDS

Type of Review

We will conduct a scoping review given the potentially heterogeneous nature of the literature on visual diagnosis instruction, as well as diverse terminology used in various disciplines. A scoping review would allow for outlining the range of the existing literature in visual diagnosis teaching in medical education, and the findings may also inform educational development and guide future research inquiry in this area (Arksey and O’Malley, 2005; Levac et al., 2010).

Objectives

1. Examine the breadth of existing literature on visual diagnosis teaching in medical education.

2. Identify areas related to visual diagnosis teaching that potentially warrant a full systematic review.
3. Identify gaps in the literature on visual diagnosis teaching for future research and educational intervention development.

Review Questions

1. What are the terms used to define visual diagnosis and visual diagnosis teaching in medical education?
2. What are the study characteristics of visual diagnosis teaching in medical education?
3. What are the instructional methods used in visual diagnosis teaching in medical education?
4.What are the educational outcome measures used in studies of visual diagnosis teaching in medical education?

The above objectives are based on Arksey and O'Malley's description of purposes for conducting scoping studies (Arksey and O'Malley, 2005).

Keywords: visual diagnosis, visual expertise, medical education, teaching, instruction, learning, training

STUDY SELECTION CRITERIA

Consistent with the guidelines for conducting a scoping review, we pursued a broad approach to the inclusion and exclusion criteria and the search strategy (Arksey and O'Malley, 2005).

	Inclusion Criteria	Exclusion Criteria
Date Range	No restrictions	No date range limitations
Literature Type	No restrictions on literature type or publication source	Literature not in English or Spanish (given that the review authors are only proficient in English and Spanish)
Study Methodology	No restrictions	
Study Design	No restrictions	
Study Method	No restrictions	
Setting	Medical education	Setting outside of medical education (e.g., veterinary, nursing, dentistry)
Participants/Population	Learners in medical education (at any level) with identified training need to develop visual diagnostic skills	Non- medical education learners Learners not undergoing training in visual diagnostic skills
Instructional Methods	The article includes instructional methods for the explicit purpose of visual diagnosis teaching	No instructional methods described Machine learning or artificial intelligence for visual diagnosis is described but not used for instruction Visual tools used for teaching medical concepts that are not directly related to diagnostic processes or not used for visual diagnosis teaching

Educational Outcome	The article describes educational outcome measure(s)	No description of an educational outcome measures

SEARCH SOURCES AND STRATEGIES

We will conduct and document the search strategy and article selection process in accordance with the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) extension for Scoping Reviews (Tricco et al., 2018).

Search Strategy Development: The primary search strategy was developed by a research librarian, Gregory Laynor, MLS, PhD. The search terms were developed iteratively and refined through initial pilot searches and discussions among GL, AF, and ST (the final pilot search is described below).

The primary search strategy is based on the following PubMed search, using title/abstract keywords and MeSH terms:

((audiovisual aids [mesh]) OR (competency-based education [mesh]) OR (computer-assisted instruction [mesh]) OR (curricul* [title/abstract]) OR (curriculum [mesh]) OR (education [mesh subheading]) OR (education, distance/methods [mesh]) OR (education, medical, continuing/methods [mesh]) OR (education, medical, graduate/methods [mesh]) OR (education, medical, undergraduate/methods [mesh]) OR (education, medical/methods [mesh]) OR (education/methods [mesh]) OR (instruct* [title/abstract]) OR (interprofessional education/methods [mesh]) OR (learn* [title/abstract]) OR (learning [mesh]) OR (lesson* [title/abstract]) OR (module* [title/abstract]) OR (pedagog* [title/abstract]) OR (problem-based learning [mesh]) OR (self-directed learning as topic [mesh]) OR (simulation training [mesh]) OR (simulation* [title/abstract]) OR (social learning [mesh]) OR (spatial learning [mesh]) OR (teach* [title/abstract]) OR (teaching [mesh]) OR (training* [title/abstract]) OR (tutor* [title/abstract])) AND ((diagnos* [title/abstract]) OR (diagnosis [mesh subheading]) OR (diagnosis [mesh]) OR (heuristic* [title/abstract]) OR (heuristics [mesh]) OR ("image interpretation" [title/abstract]) OR (pattern recognition, visual [mesh]) OR ("visual interpretation" [title/abstract]) OR ("visual pattern recognition" [title/abstract]) OR ("visual problem solving" [title/abstract])) AND ((anatomic landmarks/diagnosis [mesh]) OR (cardiac imaging techniques [mesh]) OR ("computed tomography" [title/abstract]) OR (dermatology [title/abstract]) OR (dermatology/diagnosis [mesh]) OR ("diagnostic imag*" [title/abstract]) OR (diagnostic imaging [mesh subheading]) OR (diagnostic imaging [mesh]) OR (ECG [title/abstract]) OR (echocardiograph* [title/abstract]) OR (echocardiography [mesh]) OR (EEG [title/abstract]) OR (EKG [title/abstract]) OR (electrocardiograph* [title/abstract]) OR (electrocardiography [mesh]) OR (electroencephalogra* [title/abstract]) OR (electroencephalography [mesh]) OR (fluoroscop* [title/abstract]) OR (fluoroscopy [mesh]) OR (fMRI [title/abstract]) OR (image [title/abstract]) OR (image interpretation, computer-assisted [mesh]) OR (images [title/abstract]) OR (imaging [title/abstract) OR (magnetic resonance imaging [mesh]) OR ("magnetic resonance imaging" [title/abstract]) OR (microscopy [mesh]) OR (microscopy [title/abstract]) OR (molecular imaging [mesh]) OR (MRI [title/abstract]) OR (multimodal imaging [mesh]) OR (neuroimaging [title/abstract]) OR (neuroimaging/diagnosis [mesh]) OR (observation [mesh]) OR (optical imaging [mesh]) OR (pathology [mesh]) OR (pathology [title/abstract]) OR ("physical appearance" [title/abstract]) OR (physical appearance, body [mesh]) OR ("physical sign*" [title/abstract]) OR (positron-emission tomography [mesh]) OR ("positron-emission tomography" [title/abstract]) OR (radiograph* [title/abstract]) OR (radiographic image interpretation, computer-assisted [mesh]) OR (radiography/diagnosis [mesh]) OR (radiolog* [title/abstract]) OR (radiology [mesh]) OR (radionuclide imaging [mesh]) OR (rash* [title/abstract]) OR (scan* [title/abstract]) OR ("skin manifestation*" [title/abstract]) OR (skin manifestations/diagnosis [mesh]) OR ("skin sign*" [title/abstract]) OR (slide* [title/abstract]) OR (stain* [title/abstract]) OR (staining and labeling [mesh]) OR (tissue array analysis [mesh]) OR (tomography [title/abstract]) OR (tomography, emission-computed, single-photon [mesh]) OR (tomography, x-ray computed [mesh]) OR (tomography[mesh]) OR (ultrasonography [mesh]) OR (ultrasonography [title/abstract]) OR ("visual

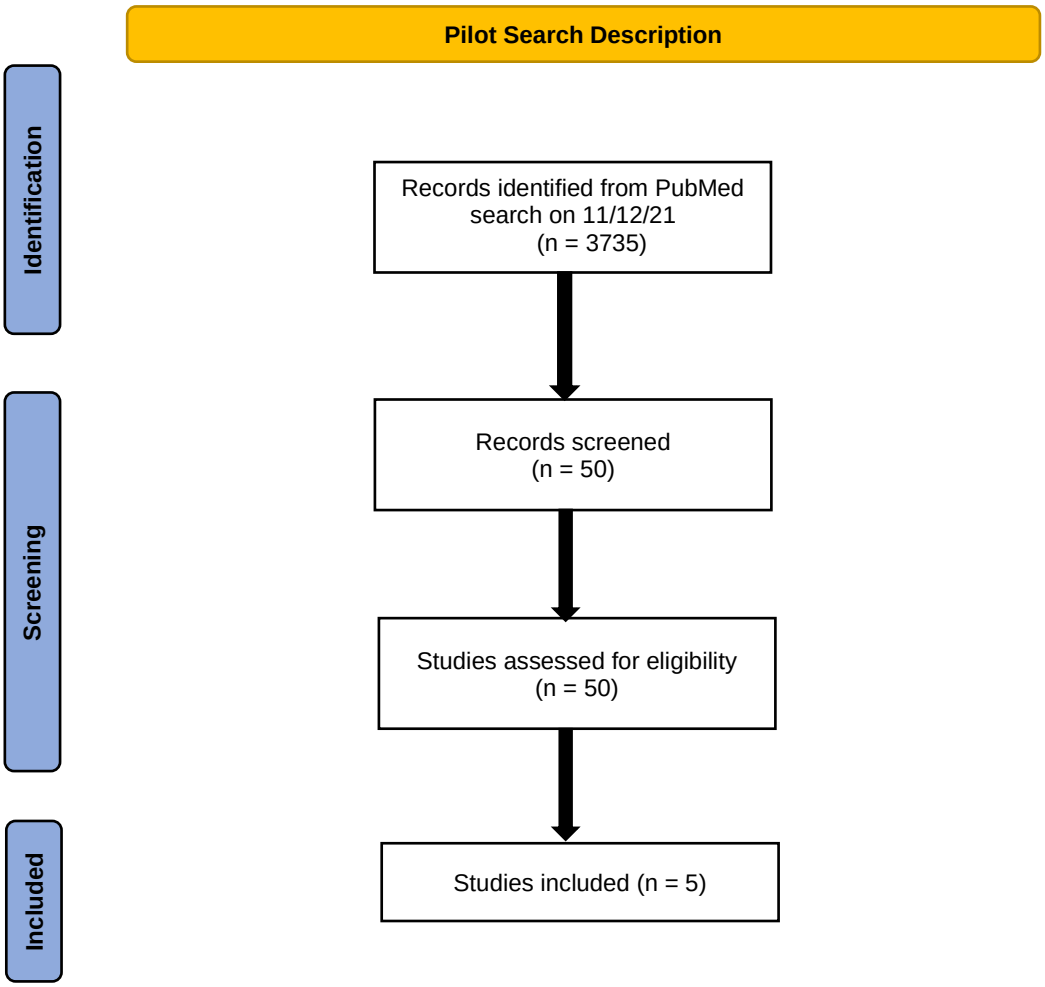
information" [title/abstract]) OR ("visible signs" [title/abstract]) OR (visualization* [title/abstract]) OR (whole body imaging [mesh]) OR (x-ray* [title/abstract])) AND ((education, medical [mesh]) OR (education, medical, continuing [mesh]) OR (education, medical, graduate [mesh]) OR (education, medical, undergraduate [mesh]) OR (internship and residency [mesh]) OR ("medical education" [title/abstract]) OR (“medical school*” [title/abstract]) OR (schools, medical [mesh])) AND ((“apprentice*” [title/abstract]) OR (“intern*” [title/abstract]) OR (“novice*” [title/abstract]) OR (“learner*” [title/abstract]) OR (“resident” [title/abstract]) OR (“student*” [title/abstract]) OR (students, medical [mesh]) OR (“trainee*” [title/abstract])) AND ((english[filter]) OR (spanish[filter]))

Databases: The primary PubMed search will be translated by GL into additional searches of these databases: Scopus, Cochrane Library, CINAHL (Ebsco), ERIC (Ovid), PsycInfo (Ovid). Searches will be conducted from the inception of the databases to the time of the search.

Citation Management: Citations will be exported from the databases into EndNote for de-duplication. After de-duplication, citations will be imported into Covidence for title and abstract screening.

Additional Search Sources: In addition to the journal database searching, a grey literature search will be conducted by searching Open Dissertations (Ebsco), Open Access Dissertations & Theses (Proquest), and MedEdPublish. These databases will be searched from the inception of the databases to the time of the search.

Pilot Search Description: Based on the primary PubMed search outlined above, there were **3,735** results (as of 11/12/2021). A pilot screening of 50 articles was done, and five articles met the inclusion criteria:



Below are three examples of articles meeting the inclusion criteria:

1. Cho WC, Gill P, Aung PP, Gu J, Nagarajan P, Ivan D, Curry JL, Prieto VG, Torres-Cabala CA. The utility of digital pathology in improving the diagnostic skills of pathology trainees in commonly encountered pigmented cutaneous lesions during the COVID-19 pandemic: A single academic institution experience. Ann Diagn Pathol. 2021 Oct;54:151807.

2. Schrepel C, Amick AE, Sayed M, Chipman AK. Ischemic ECG Pattern Recognition to Facilitate Interpretation While Task Switching: A Parallel Curriculum. MedEdPORTAL. 2021 Sep 7;17:11182.

3. Viteri Jusué A, Tamargo Alonso A, Bilbao González A, Palomares T. Learning How to Order Imaging Tests and Make Subsequent Clinical Decisions: a Randomized Study of the Effectiveness of a Virtual Learning Environment for Medical Students. Med Sci Educ. 2021 Jan 11;31(2):469-477.

SCREENING ARTICLES AND EXTRACTING DATA

Screening Process

The research team will use Covidence for article screening and data extraction.

The article screening will be done by two dyads. Each dyad will review half of the articles at each stage of the screening process: the four reviewers (AF, JR, AP, and UV) will independently screen titles and abstracts based on the inclusion and exclusion criteria. The reviewers will indicate reasons for exclusion. A fifth reviewer (DP) will resolve any discrepancies in the screening decisions.

The two reviewer dyads will then independently screen their respective set of full text of articles included from the title/abstract screening, indicating reasons for exclusion. A fifth reviewer (DP) will resolve any discrepancies in the screening decisions. The research team will discuss any remaining discrepancies or uncertainties about a study's eligibility for inclusion, and a consensus will be reached.

As part of the iterative process of reaching consensus during the screening process, the five reviewers will do an initial joint screening of the first 50 articles. We will additionally track the subsequent process of discrepancy resolution during independent screening.

We will track the interrater reliability of the dyads using Cohen's kappa statistic.

Data Extraction and Charting

After the screening process, articles will be coded in a data extraction table in Covidence. The data extraction categories are aligned with the review questions:

Data Extraction Categories	**Coding Variables**
Author(s)	
Year of Publication	
Publication Source	Journal name (or source name if not a journal)
Specialty	*e.g., radiology*
Study Location	Country (or countries) of study location
Type of Learners	*e.g., medical students, post-graduate trainees*
Theoretical Frameworks	Presence (or absence) of an explicitly reported theoretical framework and type of theoretical framework. If present, we will categorize the theory talk into minimal, moderate, or major (Kumasi et al., 2013)
Terminology	What context-specific term(s) are used to describe the knowledge, skills/competencies, and instruction of visual diagnosis

Study Methodologies	*e.g. ethnography, grounded theory*
Study Designs	*e.g., experimental, quasi-experimental, observational*
Study Methods	*e.g., survey, direct observation, interviews*
Instructional Objectives (intended learning outcomes)	*e.g., instruction aimed at visual perception, instruction aimed at cognitive processing of visual information*
Instructional Methods	*Approaches (e.g. didactic, team-based learning, problem-based learning, flipped classroom, apprenticeship, simulation)* *Enduring educational materials (e.g., prints, online modules, digital materials, flashcards)*
Educational Assessment Tools	*e.g., multiple-choice test, structured observation*
Educational Outcomes	Kirkpatrick's levels of evaluation (Kirkpatrick & Kirkpatrick, 2006)
Summary of Main Results	Narrative summary of main results

Charting the data will be done iteratively. The initial plan is to have four reviewers do the charting (AF, JR, AP, and UV), with additional reviewers for charting to be included, if necessary, depending on the number of studies identified during the screening process.

The reviewers will independently chart the data with an initial review of ten included articles. The reviewers will then confer to evaluate consistency, revise the form, and develop relevant coding variables associated with the different data extraction categories.

To iteratively develop consistent coding practices, the reviewers will also continue to assess the consistency of coding throughout the data charting process at predefined intervals, assessing the need for the addition of new categories or coding variables as the data extraction process progresses. There will be three predefined intervals in the iterative review process: the first one after the 25% article review completion, followed by a review after the 50% article review completion, and a final review after the 75% mark. At these time points, the reviewers will first meet and assess the article coding and subsequently meet with the whole research team to present the data, discuss any disagreements, and answer questions before moving to the next phase. At the intervals between each phase, the reviewers may seek additional input from the research team on the coding scheme.

The identification of the different definitions and terms used to describe visual diagnosis and visual diagnosis instruction during the initial review will also facilitate the iterative refinement of the coding process.

QUALITY APPRAISAL OF STUDIES

As this is a scoping review, we will not perform a structured quality appraisal of identified studies. Not including a formal quality assessment review of the studies follows established guidance on conducting scoping reviews (Arskey and O'Malley, 2005; Levac et al., 2010; Grant and Booth, 2009).

SYNTHESIS OF EVIDENCE AND TRANSFER TO RESEARCH AND PRACTICE

We will conduct a mixed-methods approach to data synthesis given the anticipated heterogeneity in study data (we anticipate finding studies with both quantitative and qualitative data).

Quantitative Reporting

We will compare broad categories across the different included publications and not the specific assessment results within the studies.

Quantitative reporting will be used as appropriate to describe study characteristics (outlined in the data extraction categories) identified during the iterative review of screened studies with potential variables including:

-Graphical display of year of publication (or time interval categories)
-Quantifying the proportion of studies based on the different sources of publication
-Quantifying the proportion of studies based on the specialty of origin
-Quantifying the proportion of studies based on geographical locations
-Quantifying the proportion of studies based on different learner populations
-Quantifying the proportion of studies including a theoretical framework
-Quantifying the use of different methodologies, study designs, and research methods
-Quantifying the use of different instructional objectives
-Quantifying the use of different instructional methods
-Quantifying the use of different assessment tools and educational outcomes

Qualitative Analysis

Using the data extraction categories as a starting point, initial coding variables will be developed after the review of the initial ten studies as described above. The codes will additionally be refined at predefined time points. Additional categories or codes may be added or modified as part of the iterative review process. We will perform a thematic analysis of the coded data. (Braun & Clarke, 2006)

Translation into Practice and Contribution to the Field

This review will characterize the landscape of visual diagnosis teaching practices across medical education. This characterization will complement the existing literature on visual expertise development, which typically concentrates on the acquisition of visual expertise (e.g., through the study of the difference between experts and novices or the assessment of the process of visual diagnosis skill development). This study will instead focus on the instruction of visual diagnosis that underpins the process of visual expertise development.

The findings of this study will inform the development of teaching programs for visual diagnosis teaching and the design of future studies exploring areas of visual diagnosis instruction described through this scoping review.

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