

The Effectiveness of Visual-Based Learning Strategies in Improving Clinical Reasoning of Medical Professional Students: Literature Review

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Background: Medical education aims to produce physicians with strong clinical competencies, including clinical reasoning skills. Visual-based learning strategies, such as images, videos, virtual simulations, and virtual patients, are considered effective in enhancing these skills through more concrete, contextual, and interactive learning experiences. However, the effectiveness of different visual learning methods in improving clinical reasoning abilities among medical students remains an area that requires further investigation. **Methods:** This study employed a literature review design using a systematic search approach based on the PICOS framework. Relevant articles were identified through Google Scholar, PubMed, Garuda, and ScienceDirect databases using keywords related to visual learning, clinical reasoning, and medical students. The review included studies published between 2021 and 2025 that examined the effectiveness of visual-based learning strategies among medical profession students. Data were analyzed using descriptive and narrative synthesis methods. **Results:** The findings indicate that visual-based learning strategies are generally effective in enhancing clinical reasoning skills among medical students. Interactive approaches, particularly virtual simulations and virtual patient-based learning, demonstrate greater effectiveness compared to passive visual methods such as educational videos. In addition to improving clinical reasoning, visual-based learning strategies also contribute to the development of clinical observation skills, critical thinking, communication abilities, and empathy toward patients. **Conclusion:** Visual-based learning strategies are effective in improving clinical reasoning skills among medical profession students, especially when integrated with active and interactive learning approaches. The effectiveness of these strategies is influenced by the type of visual media used and the instructional design implemented. Therefore, the integration of interactive visual learning methods is recommended to support the development of clinical competencies in medical education.

Keywords: Visual-based learning; Clinical reasoning; Medical profession students; Medical education; Virtual simulation.

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1. Introduction

Medical education is a complex learning process aimed at producing physicians with optimal clinical competencies, including strong clinical reasoning skills [1]. Clinical reasoning is a fundamental skill that enables medical students to integrate their knowledge, analyze clinical information, and make appropriate therapeutic decisions in patient care [2]. Unlike most previous research that focuses more on diagnostic reasoning, studies on clinical reasoning oriented towards therapeutic decision-making still require more in-depth attention because it is closely related to the academic achievement and professional commitment of medical students [3].

Clinical education is an important part of medical professional education, implemented in healthcare settings through the guidance of clinical instructors and healthcare professionals [4]. Through direct clinical

experience, students have the opportunity to integrate theoretical knowledge learned with the practical skills needed in patient care [5]. In addition, clinical education plays a role in developing clinical reasoning skills through the application of knowledge and decision-making processes to various real-life cases encountered during clinical practice [6].

The success of the clinical learning process is greatly influenced by the learning strategies used by educators [7]. Learning strategies are a series of approaches and methods designed to help students understand material effectively and efficiently [8]. Implementing the right strategy is important considering that each student has different learning characteristics, both in the speed of understanding information, attention span, and ability to remember learning material [9].

One of the learning strategies increasingly used in medical education is visual-based learning [10]. Visual media has the ability to transform abstract concepts into more concrete representations, making it easier for students to understand complex information [11]. The use of images, diagrams, graphs, videos, virtual simulations, and virtual patients allows students to build connections between new knowledge and prior knowledge more effectively [12].

In the context of clinical reasoning focused on therapeutic decision-making, visual-based learning can help students conduct a more comprehensive assessment of a patient's condition, consider various relevant clinical factors, and improve adherence to safe prescribing principles [13]. Furthermore, this strategy is also considered capable of supporting the implementation of patient-centered care principles in the clinical decision-making process [14].

However, the effectiveness of various visual-based learning strategies in improving clinical reasoning skills in medical students requires further study. The various visual media used in medical education have different characteristics and levels of interactivity, potentially impacting learning outcomes differently. Therefore, a systematic literature review is needed to identify the effectiveness of various visual-based learning strategies and determine the most optimal method for improving clinical reasoning skills in medical students.

Based on this description, it is important to conduct a literature review on the effectiveness of visual-based learning strategies in improving clinical reasoning in medical students. The results of this study are expected to contribute to the development of more effective, innovative learning methods that are in line with the demands of modern medical education. Therefore, the researcher is interested in conducting a study entitled "The Effectiveness of Visual-Based Learning Strategies in Improving Clinical Reasoning in Medical Students: A Literature Review."

2. Literature Review and Problem Statement

Professional Education for Doctors and Clinical Reasoning

Medical professional education aims to produce graduates with clinical competence, professionalism, and sound decision-making skills in healthcare. One of the key competencies medical students must possess is clinical reasoning. Clinical reasoning is the thought process used by healthcare professionals to gather information, analyze clinical data, make diagnoses, determine therapies, and evaluate the outcomes of patient care. This ability is fundamental to medical practice because it directly relates to the quality of care and patient safety. The development of clinical reasoning is achieved not only through mastery of theory but also through learning experiences that enable students to integrate knowledge with real-life clinical situations. Therefore, medical educational institutions need to implement learning strategies that effectively and sustainably support clinical thinking.

Visual-Based Learning Strategies in Medical Education

Visual-based learning strategies are learning approaches that utilize various visual media to help students understand information more easily and meaningfully. The media used can include images, graphs, diagrams, learning videos, animations, virtual simulations, and even virtual patients. The use of visual media allows complex and abstract concepts to become more concrete, thus facilitating the understanding process. In medical education, visual-based learning is increasingly developing with the advancement of digital technology. Various visual media are used to illustrate clinical conditions, medical procedures, disease mechanisms, and clinical decision-making processes. In addition to improving conceptual understanding, this strategy also creates a more interactive learning experience so that students can actively participate in the learning process.

Effectiveness of Visual-Based Learning on Clinical Reasoning

Several studies have shown that visual-based learning has the potential to improve medical students' clinical reasoning skills. Visual media can help students connect theory to clinical practice through more realistic case representations. Furthermore, methods such as virtual simulations and virtual patients allow students to practice clinical decision-making in a safe environment without risk to real patients. Visual-based learning is also known to improve clinical observation, critical thinking, problem-solving, communication, and empathy for patients. However, the effectiveness of each type of visual media varies. Interactive media tend to produce better results than passive media. Therefore, a more comprehensive study is needed to determine the most effective form of visual learning in improving medical students' clinical reasoning skills.

Problem Statement

Clinical reasoning is a crucial competency for medical students to support sound clinical decision-making. Various visual-based learning strategies have been implemented in medical education to enhance this ability. However, available research shows variations in effectiveness across visual media types. To date, there is limited information regarding the most effective visual-based learning strategies for improving clinical reasoning in medical students. Furthermore, there are few studies specifically comparing various forms of visual media, such as instructional videos, virtual simulations, and virtual patients, in the context of developing clinical reasoning skills. Therefore, a literature review is needed to analyze the effectiveness of visual-based learning strategies in improving clinical reasoning in medical students and to identify methods that provide optimal learning outcomes.

3. Method

This study employed a literature review method, a research method conducted through the search, collection, and analysis of various literature and previous research findings relevant to the research topic. This method aims to identify, evaluate, and synthesize published scientific findings to gain a comprehensive understanding of the effectiveness of visual-based learning strategies in improving clinical reasoning in medical students. The study results are analyzed descriptively and presented systematically to generate conclusions that can serve as a basis for further research and medical education practice.

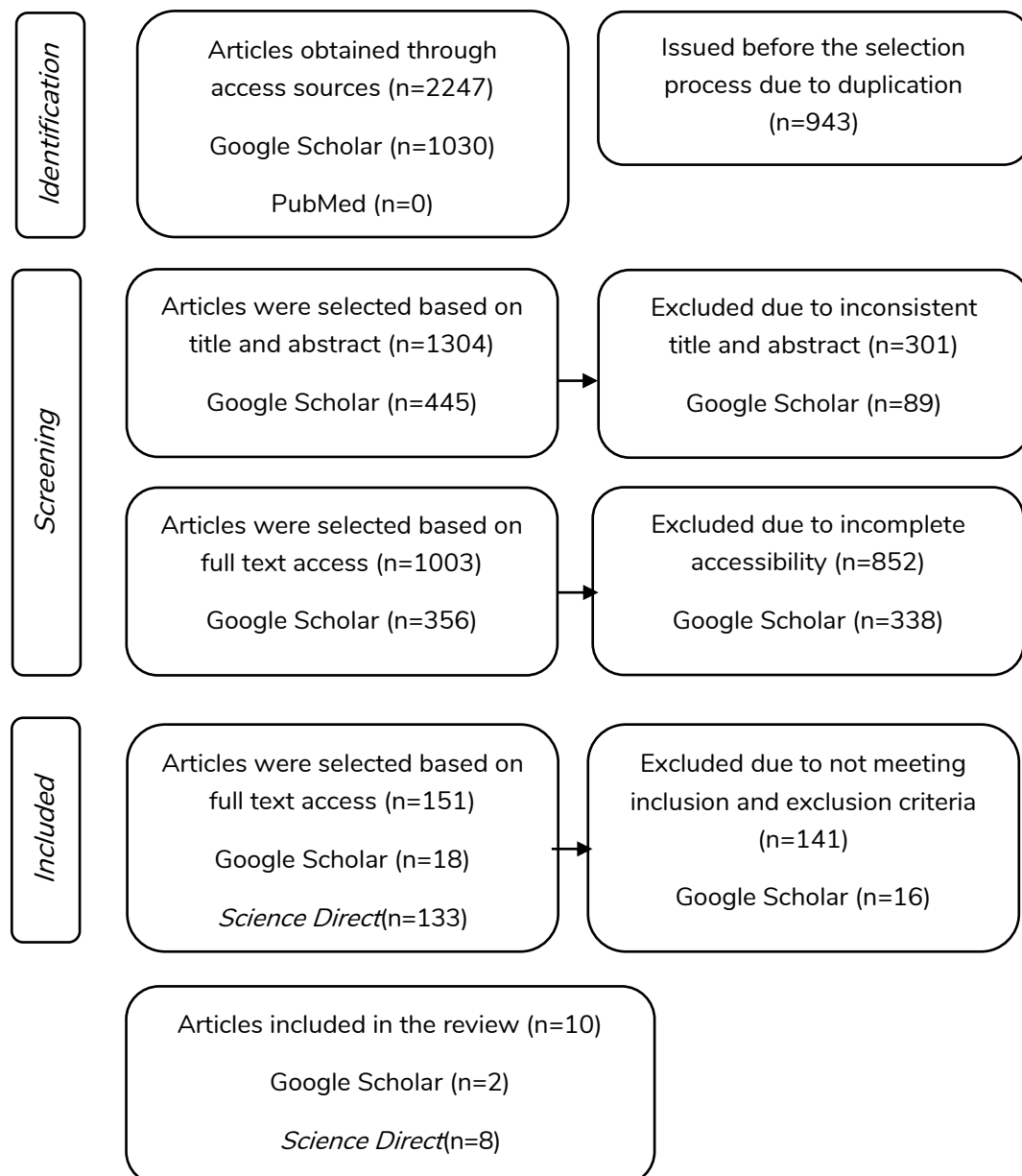


Figure 1.PRISMA Flow Research Article: The Effectiveness of Visual-Based Learning Strategies in Improving Clinical Reasoning in Medical Students

The literature search process yielded 2,247 articles obtained from Google Scholar (n=1,030) and ScienceDirect (n=1,217). During the identification stage, 943 articles were eliminated due to being duplicates, leaving 1,304 articles for the screening process based on title and abstract. Of these, 301 articles were excluded for not matching the research focus, resulting in 1,003 articles for the eligibility assessment stage. Next, a full-text availability check was conducted, and 852 articles were excluded for being unavailable or inaccessible. A total of 151 articles that met the full-text access requirements were then evaluated based on the established inclusion and exclusion criteria, consisting of 18 articles from Google Scholar and 133 articles from ScienceDirect. The evaluation results showed that 141 articles did not meet the research criteria and were therefore excluded from the selection process. Thus, 10 articles were deemed to meet all criteria and were selected for analysis in this literature review, consisting of 2 articles from Google Scholar and 8 articles from ScienceDirect.

4. Results and Discussion

Result

Table 1. Analysis of the Effectiveness of Visual-Based Learning Strategies in Improving Clinical Reasoning in Medical Students

No.	Writer	Title	Method	Results	Conclusion
1	Plackett R et al. (2022)	<i>The Effectiveness of Using Virtual Patient Educational Tools to Improve Medical Students' Clinical Reasoning Skills: A Systematic Review</i>	Systematic Review	As many as 58% of studies showed a positive impact on clinical reasoning, especially on the ability to collect data and establish diagnoses.	<i>Virtual patient</i> effective as a learning support media in improving clinical reasoning.
2	Haleem SE et al. (2023)	<i>Medical Students' Perception of Virtual Simulation-Based Learning in Pharmacology</i>	Descriptive (Survey)	The majority of students considered the virtual simulation to be effective, realistic, and helpful in understanding pharmacology material.	Virtual simulation is a useful learning method and is well received by students.
3	Cerqueira AR et al. (2023)	<i>Visual Thinking Strategies in Medical Education: A Systematic Review</i>	Systematic Review	There was an increase in students' observation, critical thinking, and empathy skills.	<i>Visual Thinking Strategies</i> (VTS) is effective in improving clinical competencies based on visual analysis.
4	Choi H et al. (2023)	<i>Nursing Students' Learning Flow, Self-Efficacy and Satisfaction in Virtual Clinical Simulation and Clinical Case Seminar</i>	Descriptive Cross-Sectional	Virtual simulations improved learning flow, but did not show significant improvements in self-efficacy and learning satisfaction.	Virtual simulations aid the learning process, but require adjustments to the level of difficulty and learning design.
5	Galmarini E et al. (2021)	<i>The Effectiveness of Visual-Based Interventions on Health Literacy in Health Care: A Systematic Review and Meta-Analysis</i>	Systematic Review and Meta-Analysis	Visual-based interventions, particularly educational videos, have been shown to be more effective than traditional learning methods.	Visual-based learning is effective in improving understanding of health information.
6	Hanani L et al. (2025)	<i>The Effectiveness of the Clinical Skill Lab Learning Type in the Preclinical Phase in Developing Medical Students' Clinical Skills</i>	Literature Review (Narrative)	<i>Peer Assisted Learning</i> (PAL) is the most effective method. Videos aid visual comprehension, while Self-Directed Learning (SDL) is less effective without supervision.	PAL is the most effective method, while video acts as a supporting medium for students' visual understanding.
7	Bae J et al. (2024)	<i>Learning Outcomes of Education on Visual Thinking Strategies for Healthcare Professionals: A Systematic Review</i>	Systematic Review	VTS improves clinical observation skills, critical thinking, communication, and empathy.	VTS is effective as a learning strategy to improve the clinical competence of healthcare workers.

The Effectiveness of Visual-Based Learning Strategies in Improving Clinical Reasoning of Medical Professional Students: Literature Review. Risa Hude Umar et.al

No.	Writer	Title	Method	Results	Conclusion
8	Abedi F et al. (2021)	<i>Comparison of the Effectiveness of Visual Thinking Strategy Between Persian Miniature and Classical Painting in Learning Medical Humanities from the Perspective of Medical Students</i>	Descriptive Cross-Sectional	VTS improves students' attention, communication, teamwork, and understanding of learning materials.	VTS is effective in improving students' thinking and interaction skills.
9	Humaryanto et al. (2023)	<i>Digital-Based Learning Innovation: Trauma Emergency Triage Simulation</i>	Descriptive	Around 70% of students stated that video media made it easier to understand the material on trauma emergency triage.	Video-based learning is effective in improving students' clinical understanding.
10	Sim J et al. (2022)	<i>Virtual Simulation to Enhance Clinical Reasoning in Nursing: A Systematic Review and Meta-Analysis</i>	Systematic Review and Meta-Analysis	Virtual simulation significantly improves students' clinical reasoning and clinical performance.	Virtual simulation is effective in improving clinical reasoning skills.

Discussions

Based on the analysis of ten studies, visual-based learning strategies have generally been shown to be effective in improving clinical reasoning and understanding in medical students and healthcare professionals. Various methods, such as virtual patients, virtual simulations, and instructional videos, have demonstrated a positive impact on these abilities. One study reported that 58% of studies demonstrated improved clinical reasoning, particularly in data collection and diagnosis. Furthermore, virtual simulations were also reported to significantly improve clinical reasoning and clinical performance compared to conventional learning methods. Other findings indicate that the majority of students considered virtual simulations realistic, effective, and helpful in understanding the material, while approximately 70% of students stated that video simulations facilitated understanding of clinical cases, particularly in trauma emergencies [5,6,13,14].

Other visual-based approaches, such as Visual Thinking Strategies (VTS), have also shown positive results. Several studies have reported that VTS can improve students' observational skills, critical thinking, and empathy. These findings align with other studies showing improvements in communication skills, reflective thinking, professional competence, and collaboration and interaction among students. This indicates that visual-based learning impacts not only cognitive aspects but also affective and social aspects of the learning process [7,11,12].

However, not all visual-based learning strategies provide optimal results when used alone. Video-based learning tends to be passive, although effective in improving visual comprehension and information retention. Furthermore, Self-Directed Learning (SDL) is considered less effective without adequate supervision, while Peer-Assisted Learning (PAL) shows higher effectiveness because it encourages active interaction, discussion, and direct feedback. Other findings also indicate that although virtual simulations can improve learning flow, they do not always provide significant improvements in student self-efficacy and learning satisfaction, thus demonstrating the importance of matching learning design to student abilities [8,10].

On the other hand, the results of a systematic review and meta-analysis indicate that visual-based interventions, particularly the use of video, are more effective than traditional learning methods in improving information comprehension. This suggests that visual media has advantages in supporting cognitive processes, particularly in improving memory retention and understanding of complex concepts. However, this effectiveness will be optimal when combined with active learning methods such as case discussions and interactive simulations [9].

Clinical reasoning is a fundamental component of medical education that plays a vital role in clinical decision-making. This process includes the ability to collect and interpret patient data, formulate a diagnosis, and develop and implement an appropriate treatment plan. These skills are crucial for producing accurate, safe, and patient-centered clinical decisions [2].

Overall, the study results indicate that visual-based learning strategies are an effective approach to improving clinical reasoning, especially when implemented interactively and combined with other learning methods. Methods such as virtual simulation, virtual patient, and video-assisted learning (VTS) have been shown to positively impact clinical analysis skills, decision-making, and case understanding. However, passive learning media such as videos need to be integrated with active learning strategies for optimal results. Therefore, the implementation of visual-based learning in medical education needs to be designed comprehensively, taking into account interactivity, feedback, and appropriateness to student ability levels to maximize clinical reasoning development.

5. Conclusion

Based on the results of a review of ten literatures, visual-based learning strategies such as virtual patients, virtual simulations, instructional videos, and Visual Thinking Strategies (VTS) have generally been proven effective in improving medical students' clinical reasoning skills. This improvement is particularly evident in clinical data collection, case analysis, and decision-making in clinical contexts. Furthermore, various findings indicate that visual-based learning media also contribute to improving students' understanding of the material in a more concrete and accessible way.

Furthermore, interactive visual-based learning methods such as virtual simulations and virtual patients demonstrate more optimal results than passive methods such as instructional videos. In addition to improving clinical reasoning, this strategy also contributes to the development of students' observation, critical thinking, communication, and empathy skills. Overall, the effectiveness of visual-based learning is strongly influenced by the learning design, level of interactivity, and active student engagement. Therefore, a combination with active learning methods such as case discussions and peer-assisted learning is recommended to optimize the clinical reasoning skills of medical students.

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