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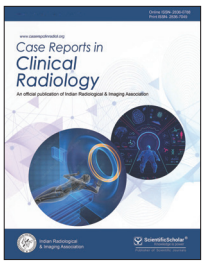

Editorial

Competency-based radiology education: How to strengthen critical thinking and empowerment in tomorrow's radiologists

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Radiology is a medical specialty that uses imaging techniques such as ultrasound, computed tomography, and magnetic resonance imaging for diagnostic and interventional purposes. Over the past decades, radiology has evolved significantly, becoming an essential pillar of modern medicine. Today, imaging plays a crucial role in patient management, as it supports both clinical decision-making and surgical practice. It allows physicians to detect diseases early, monitor their progression, and evaluate the effectiveness of treatments. As a result, radiology is deeply integrated into almost every medical discipline.

Because radiology is such a broad, complex, and rapidly evolving specialty, it represents a considerable challenge from an educational perspective. The vast amount of knowledge required, combined with continuous technological advancements – including the advent of artificial intelligence (AI), makes traditional teaching methods alone insufficient. For this reason, medical education in radiology is increasingly shifting toward more innovative approaches. One of the most promising models is competency-based education, which has already been successfully implemented in several medical fields and appears to produce positive outcomes in radiology as well. This approach focuses not only on theoretical knowledge but also on the development of practical skills, clinical reasoning, and professional attitudes – with particular attention to field subspecialization.[1]

A key element of competency-based education is the adoption of active learning strategies.[2] Rather than relying solely on passive learning through lectures, students are encouraged to engage with the material actively. Various strategies can be employed to achieve this goal, foremost among them the use of clinical case studies. Presenting real or realistic cases to students allows them to apply theoretical knowledge in practical contexts, thereby reinforcing learning and bridging the gap between theory and practice. This method also helps students understand how imaging findings influence clinical decisions in real-life scenarios.

However, the use of case-based learning requires significant effort in terms of preparation and organization. Educators must carefully select and design cases that are both educationally valuable and appropriate to the students' level of training. In addition, this approach necessitates the use of specialized technological tools, such as picture archiving and communication systems and digital imaging and communications in medicine viewers. These tools allow students to interact with imaging studies in a manner similar to that of practicing radiologists, thereby enhancing the realism and effectiveness of the learning experience.[3]

Another fundamental objective of radiology education is the development of critical and creative thinking. These cognitive skills are essential for problem-solving and for reaching accurate diagnostic conclusions. Radiologists are often required to analyze complex imaging findings, integrate clinical information, and consider multiple differential diagnoses. Teaching students how to think critically enables them to approach diagnostic challenges systematically and confidently. Creative thinking, on the other hand, helps students explore alternative solutions and adapt to unexpected situations.[4]

An important aspect of critical thinking in radiology is the ability to choose the most appropriate imaging technique for each clinical situation. The goal is to achieve maximum diagnostic effectiveness while minimizing potential risks, particularly radiation exposure. This consideration is especially important in pediatric and young patients, who are more sensitive to ionizing radiation. Teaching students to balance diagnostic accuracy with patient safety fosters responsible and ethical medical practice. Furthermore, the preferences and priorities of both patients and physicians regarding different diagnostic options play a central role in the decision-making process and should be incorporated into educational discussions.

In contemporary radiology education, traditional teaching resources are complemented by a wide range of digital tools.[5,6] These include textbooks, scientific articles, online modules, and prerecorded lectures. Compared to the traditional didactic approach, which typically requires many hours of classroom teaching and supplementary readings, e-learning offers greater flexibility. Students can learn at their own pace, review complex topics multiple times, and tailor their study schedules to their individual needs.

Another valuable educational resource is the use of online simulators. These platforms provide students with an exceptional opportunity to develop essential skills across various areas of radiology. For example, ultrasound simulators allow students to practice scanning techniques in a controlled and risk-free environment. Furthermore, they can be used to introduce students to interventional radiology procedures, helping them understand the technical and cognitive aspects involved.

AI represents one of the most innovative and rapidly developing tools in radiology. Although AI is still undergoing extensive research and refinement, it already plays a well-defined role in scientific studies and is beginning to support diagnostic practice. AI-based systems can assist radiologists by improving diagnostic accuracy, detecting subtle abnormalities, and reducing interpretation times. From an educational standpoint, introducing students to AI applications in radiology prepares them for future clinical practice and encourages them to critically evaluate the strengths and limitations of these technologies.

At our center, particular emphasis is placed on collaborative and research-oriented learning. Students are divided into small groups and actively involved in research projects focused on emerging imaging topics. This approach promotes teamwork, communication skills, and independent thinking. In addition, students have access to webinars and scientific conferences, which allow them to stay updated on the latest advances in radiology and interventional techniques.

Furthermore, students are encouraged to publish research articles and present their work at the most important national and international scientific meetings. These activities stimulate critical thinking, enhance scientific writing skills, and increase students' confidence in presenting their ideas. Participation in research also helps students better understand evidence-based medicine and the importance of continuous innovation in radiology.

The goal of radiology education is to train competent and adaptable medical professionals who are capable of meeting the demands of modern healthcare. In diagnostic medicine, it is essential to prepare physicians who can compete at an international level and respond effectively to technological and clinical challenges. To achieve this objective, all available tools offered by scientific and technological progress must be utilized, ranging from simple clinical case discussions to advanced AI applications.

Competency-based education is becoming increasingly prominent in radiology because it reduces the gap between theory and practice and enables students to achieve early autonomy in their medical careers. By identifying and addressing its limitations, this educational model can further enhance learning outcomes and contribute to the formation of skilled, ethical, and forward-thinking radiologists.

REFERENCES

1. Bentley H, Diep Quoc Vo C, Zaki-Metias K, Nikpanah M. Competency-based medical education in radiology graduate medical education: Overview and future perspectives. Radiographics 2023;43:e220197.
2. Cohen MD, Gunderman RB, Frank MS, Williamson KB. Challenges facing radiology educators. J Am Coll Radiol 2005;2:681-7; discussion 688-9.
3. Otero HJ, Weissman BN, Rybicki FJ. System-based practice: Proposal for a comprehensive curriculum. Acad Radiol 2008;15:119-26.
4. Khan A, Afzal S, Samnani S, Sirat Maheen Anwar S, Hussain Z. Entrustable professional activities for radiology residents: A case-based assessment framework. BMC Med Educ 2025;25:1624.
5. Nguyen VQ, Watson SM, Nguyen LF, Tinsley S, Walters SA, Colorado B. Development and use of observable practice activities in graduate medical education: A 10-year experience:

Invited commentary. Am J Phys Med Rehabil 2025;104:e174-7.
6. Rai S, Tamilselvan A, Ganesh R. Competency-based medical education in radiology in Indian medical schools: A narrative review. Indographics 2025;4:22-30.

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