ISBN: 978-65-83849-09-0

Aurum EDITORA

CHAPTER 11

THE ART OF TEACHING IN TECHNICAL AND TECHNOLOGIST COURSES IN RADIOLOGY: STRATEGIES, CHALLENGES, AND TRAINING COMPETENT PROFESSIONALS

https://doi.org/10.63330/aurumpub.013-011

Rosangela Thomé da Silva[1]

ABSTRACT

Technical education in Radiology constitutes the central theme of this work, given its relevance for training professionals capable of acting with technical, ethical, and interpersonal competence in the healthcare sector. The main objective was to analyze the art of teaching in technical Radiology courses, identifying pedagogical strategies used, challenges faced, and perspectives for training competent professionals prepared to meet the demands of the market and society. The methodology adopted was bibliographic and qualitative in nature, developed from the analysis of books, scientific articles, and academic documents that addressed technical education in health, the specificities of teaching in Radiology, and the elements necessary to consolidate an effective teaching-learning process. The results obtained showed that training in Radiology required an articulation between theory and clinical practice, associated with active methodologies such as simulation, case studies, use of digital technologies, and practical laboratories. It was found that pedagogical practice demanded a teaching role focused on mediation and the construction of meaningful experiences, overcoming traditional teaching models centered solely on content transmission. Furthermore, it was verified that the training of competent professionals involved the balanced development of technical skills for performing exams, ethical competencies related to professional responsibility, and interpersonal skills aimed at patient communication and care. Among the highlighted challenges were limitations in infrastructure in some educational institutions, scarcity of updated equipment, difficulties in students' adaptation to complex techniques, and the need for constant teacher updating in the face of technological innovations. The analysis allowed us to conclude that the art of teaching in technical Radiology courses was a dynamic, interdisciplinary, and humanized process, in which the integration between theory and practice played a central role in consolidating learning. The research also indicated that investing in teacher training, technological resources, and innovative methodologies was essential to qualify pedagogical practice, meet scientific and social transformations, and, above all, contribute to improving healthcare delivery.

Keywords: Technical education; Radiology; Teaching-learning; Professional competencies; Teacher training.

[1] Master in Biomedical Engineering - UnB
E-mail: rosangelaengbio@gmail.com

INTRODUCTION

The training of professionals in the healthcare field requires not only technical knowledge but also a pedagogical process capable of articulating theory, practice, and professional ethics. Within this scenario, technical education in Radiology occupies a highly relevant space, as it prepares professionals who perform essential functions in diagnostic imaging services, directly contributing to the quality of healthcare delivery. The art of teaching in this field goes beyond the mere transmission of content: it is an educational process that seeks to integrate pedagogical resources, active methodologies, technologies, and clinical practices to train competent, ethical technicians prepared to face contemporary challenges in the sector (Padoveze, 2012; Oliveira & Silva, 2018).

Radiology, since the discovery of X-rays by Wilhelm Conrad Röentgen in 1895, has undergone profound transformations, incorporating different diagnostic and therapeutic modalities such as computed tomography, magnetic resonance imaging, ultrasonography, and nuclear medicine (Langland et al., 2018). In this context, technical education must keep pace with technological innovations and meet the demands of an increasingly demanding market. Technical Radiology courses should balance scientific foundations, such as anatomy and applied physics, with laboratory practices and supervised internships that allow students to experience real work situations (Albuquerque & Carmo, 2019). Thus, understanding the specificities of this teaching and reflecting on the best pedagogical strategies becomes essential for building quality education.

This study aims to analyze the art of teaching in technical Radiology courses, discussing fundamental concepts, pedagogical strategies, professional training, and challenges faced in this process. As a hypothesis, it is considered that the use of active methodologies, combined with educational technologies and the integration of theory and clinical practice, significantly contributes to the training of competent professionals capable of meeting the technical, ethical, and human demands of the profession. The justification for choosing this topic lies in the social and educational relevance of Radiology, since the quality of technical training directly impacts patient care, safety in the use of ionizing radiation, and the effectiveness of healthcare services (Sloniak et al., 2017; Santos, 2021).

Methodologically, the work was developed through a bibliographic review of authors who discuss both the technical field of Radiology and the pedagogical practices applied to vocational education. In this way, the aim was to articulate concepts from the literature on technical education, health teaching, and the specificities of diagnostic radiology to understand the paths and challenges of teaching practice in this field.

The structure of the work is organized as follows: initially, a conceptualization of Radiology is presented, highlighting its historical evolution and current role in healthcare. Next, technical education in Radiology is discussed, focusing on its specificities, student profile, and labor market requirements.

Subsequently, pedagogical strategies applied to this teaching are addressed, such as active methodologies, simulations, case studies, and multimedia resources. Following this, the training of competent professionals is analyzed, emphasizing the technical, ethical, and interpersonal competencies required, as well as the integration between theory and clinical practice. Finally, the challenges faced by this type of education are discussed, including infrastructure issues, student adaptation to complex techniques, and the need for continuous teacher training.

DEVELOPMENT

CONCEPTUALIZING RADIOLOGY

Radiology is a healthcare field dedicated to obtaining images of the human body for diagnostic, therapeutic, and clinical follow-up purposes, using ionizing radiation and other advanced imaging technologies. It is a specialty that combines knowledge of anatomy, physics, biology, and technology, enabling professionals to visualize internal structures, identify pathological changes, and contribute to precise medical decision-making (Albuquerque & Carmo, 2019).

The concept of Radiology has evolved significantly since the discovery of X-rays by Wilhelm Conrad Röentgen in 1895, when the use of radiation for diagnostic purposes represented a major scientific innovation. Today, Radiology encompasses different modalities, such as conventional radiography, computed tomography, magnetic resonance imaging, ultrasonography, and nuclear medicine, each with specific physical principles, clinical indications, and protocols (Langland et al., 2018). This technological diversity requires radiology professionals not only to have theoretical knowledge but also practical skills to operate complex equipment, interpret images, and apply radiological safety measures, ensuring the protection of both patients and professionals.

Beyond its diagnostic role, Radiology plays a therapeutic role in image-guided interventional procedures, such as biopsies, drainages, and minimally invasive treatments, expanding its importance within hospital and outpatient contexts (Sloniak et al., 2017). Therefore, Radiology is not limited to the mere production of images but integrates a set of technical, scientific, and ethical practices aimed at promoting health, preventing diseases, and ensuring quality clinical care.

Another relevant aspect is the impact of Radiology on the evolution of modern medicine. The development of increasingly sophisticated techniques has contributed to early diagnoses, reduced the need for invasive procedures, and increased precision in surgical and therapeutic planning. This technological advancement has also brought new challenges, such as the need for constant professional updating in the face of rapid innovations and strict compliance with biosafety standards to minimize risks associated with radiation exposure (Sloniak et al., 2017).

Furthermore, Radiology has established itself as an interdisciplinary field, interacting with various medical specialties and decisively contributing to comprehensive healthcare. In this sense, its practice requires not only technical mastery but also ethical sensitivity and communication skills to work in a multidisciplinary team and provide humanized care to patients (Sloniak et al., 2017). Thus, conceptualizing Radiology means understanding its hybrid nature: a science that combines cutting-edge technology and human responsibility, being indispensable for diagnosis, treatment, and improving quality of life.

TECHNICAL EDUCATION IN RADIOLOGY

Technical education in Radiology is characterized as a form of vocational training aimed at preparing professionals to work effectively in diagnostic imaging services. Unlike higher education, technical training has specific features that require an intensive practical approach combined with essential theoretical foundations for safe and ethical professional practice. According to Padoveze (2012), the primary goal of technical education is to provide rapid and efficient training, promoting practical skills that meet the immediate demands of the labor market without neglecting the understanding of the scientific principles underlying the activities performed.

In the context of Radiology, technical training involves a variety of competencies, including mastery of imaging equipment, knowledge of anatomy, physics applied to radiology, biosafety, and professional ethics. The specificity of this teaching is reflected, for example, in the need for practical simulations and supervised internships, which are fundamental for building professional competence. According to Oliveira and Silva (2018), technical Radiology courses must balance theory and practice, ensuring that students understand not only the operation of X-ray machines, computed tomography, and magnetic resonance imaging but also patient care and compliance with regulatory standards.

The profile of Radiology students, in turn, presents distinctive characteristics. Generally, these are individuals motivated by a technical-scientific career, interested in working in hospitals, clinics, or diagnostic laboratories. The literature indicates that these students need to develop cognitive, psychomotor, and socio-emotional skills, including attention to detail, critical analysis ability, and ethical conduct toward patients (Gonçalves, 2020). Furthermore, the labor market imposes increasing demands: professionals must master new technologies, stay updated on clinical protocols, and demonstrate flexibility to work in different contexts, such as conventional radiology, computed tomography, magnetic resonance imaging, and interventional procedures (Padoveze, 2012).

PEDAGOGY AND TEACHING STRATEGIES

Pedagogy applied to technical Radiology education must consider the particularities of this training, which requires not only theoretical knowledge but also complex practical skills and technical precision. In this context, the adoption of active teaching methods has proven essential to promote meaningful learning and professional competence among students. Active learning, for example, involves strategies in which students become protagonists of the educational process, participating in discussions, solving problems, and making decisions in simulated situations, which favors the construction of knowledge in a contextualized and applied manner (Freire, 2014).

The use of simulations and practical laboratories is another fundamental pedagogical resource. These methodologies allow students to reproduce radiological procedures in a controlled environment, learning to handle equipment, correctly position patients, and apply safety standards without health risks. Studies indicate that simulated practice significantly contributes to knowledge retention and the development of technical confidence, preparing students for real work situations (Gonçalves & Oliveira, 2020).

Furthermore, the study of clinical cases enables critical analysis of complex situations, stimulating decision-making skills and the application of theoretical concepts in practical contexts, which is particularly relevant in areas such as interventional radiology and advanced diagnostic imaging (Melo, 2019).

The use of educational technologies and multimedia resources complements these strategies, expanding learning possibilities and making the process more dynamic and interactive. Digital platforms, educational videos, simulation software, and virtual reality resources allow students to visualize anatomical structures, understand radiological processes, and practice procedures in different scenarios, even outside the physical laboratory (Santos, 2021). These tools not only facilitate access to complex content but also promote student autonomy, enabling them to review concepts and perform training independently, contributing to the consolidation of technical competencies necessary for professional practice.

TRAINING COMPETENT PROFESSIONALS

The training of competent professionals in Radiology goes far beyond acquiring theoretical knowledge about anatomy, equipment physics, and imaging techniques. It is an integral educational process aimed at developing technical, ethical, and interpersonal competencies that are essential for safe and qualified performance in healthcare settings. According to Oliveira and Silva (2018), professional competence in Radiology involves not only the ability to operate diagnostic imaging equipment but also the skill to interpret results accurately, apply correct clinical protocols, ensure patient safety, and comply with ethical and legal standards governing radiological practice.

Technical competencies form the foundation of professional performance and include, among other aspects, proficiency in conventional radiology exams, computed tomography, magnetic resonance imaging, and interventional radiology.

Additionally, it is essential for professionals to master biosafety procedures, such as the correct use of radiological protection and contamination prevention, ensuring the health of patients and colleagues (Gonçalves, 2020). However, technical mastery alone is not enough; radiological practice also requires interpersonal skills, such as effective communication with patients, families, and multidisciplinary teams, empathy, and the ability to handle stressful situations and clinical emergencies. These skills are fundamental not only for ensuring quality care but also for humanizing healthcare delivery (Padoveze, 2012).

Professional ethics, in turn, is a central component in the training of radiology professionals. Ethical practitioners respect patient privacy and confidentiality, act responsibly when handling sensitive exams, and strictly follow principles established by professional councils and international radiology standards. Integrating ethics into technical education allows students to develop not only practical competence but also critical awareness and a sense of social responsibility—attributes indispensable in modern healthcare (Freire, 2014).

Another crucial aspect of training competent professionals is the integration of theory and clinical practice. Technical learning should occur in environments that simulate real situations, enabling students to apply theoretical concepts in practical procedures under qualified supervision. Studies show that this integration strengthens content understanding, increases student confidence, and reduces errors in real work environments (Melo, 2019). Supervised internships, practical laboratories, and the use of simulation technologies, such as software and virtual anatomical models, are pedagogical tools that foster this connection between theory and practice, preparing students to handle everyday challenges in the profession.

Thus, the training of Radiology professionals should be understood as a complex process that combines technical knowledge, interpersonal skills, and ethical principles, ensuring that students become competent, responsible professionals capable of adapting to the constant innovations in the healthcare sector. Developing these competencies requires active methodologies, continuous pedagogical support, and learning environments that encourage critical reflection, safe practice, and humanized care, thereby consolidating the quality of technical training and excellence in professional performance.

CHALLENGES IN TECHNICAL RADIOLOGY EDUCATION

Technical education in Radiology faces several challenges that directly impact the quality of professional training and the effectiveness of pedagogical practice. Among the main obstacles are

infrastructure limitations and the scarcity of appropriate materials or equipment for learning. Many technical courses operate with
laboratories that do not keep pace with technological innovations in healthcare, making it difficult for students to interact with modern equipment and current market practices (Gonçalves, 2020). This reality highlights the need for institutional investments and educational policies that ensure well-equipped laboratories, access to simulation software, and sufficient teaching resources for practical learning, enabling students to develop technical skills safely and efficiently.

In addition to structural issues, another significant challenge is students' adaptation to complex techniques and clinical procedures that require precision and technical rigor. Radiology, by its very nature, demands refined psychomotor skills, critical interpretation of images, and strict application of safety protocols, which can pose barriers for students at the beginning of their training or those who struggle to reconcile theory and practice (Oliveira & Silva, 2018). In this context, the use of active methodologies such as simulations, case studies, and supervised practical laboratories is essential to facilitate learning, reduce student anxiety, and promote the gradual acquisition of competencies, consolidating the confidence and technical autonomy necessary for professional practice.

The role of the teacher in this scenario is equally challenging. The Radiology instructor must not only master technical and scientific content but also develop pedagogical skills to mediate learning, provide constant feedback, and adapt teaching strategies to individual student needs. Furthermore, teachers are required to engage in continuous professional development, staying updated on technological advances, new teaching methodologies, and regulatory changes in healthcare (Padoveze, 2012). This ongoing updating is fundamental for educators to effectively integrate theory and practice, promoting excellence in technical training and preparing competent, ethical professionals who can adapt to labor market demands.

Therefore, the challenges in technical Radiology education involve structural, pedagogical, and human aspects that require integrated solutions. Investments in infrastructure and teaching resources, active teaching methodologies, individualized
student support, and continuous teacher training are essential strategies to overcome these difficulties, ensuring the quality of technical education and the development of professionals capable of working safely, ethically, and competently in the context of modern radiology.

CONCLUSION

The conclusion of this study allows us to reflect on the centrality of pedagogical practice in technical Radiology education and its relevance for training professionals who work directly in health promotion and diagnostic imaging. Throughout the research, it was found that the art of teaching in this

area goes far beyond content transmission: it is a complex process that involves the development of technical, ethical, and interpersonal competencies, as well as the integration of theory and clinical practice. This combination is essential to prepare technicians capable of dealing with the growing technological and human demands of the profession, ensuring not only diagnostic quality but also patient care and safety (Padoveze, 2012; Oliveira & Silva, 2018).

It was observed that technical Radiology courses face multiple challenges. Among them, infrastructure limitations, scarcity of modern materials, and the need for constant updating in the face of technological innovations stand out (Gonçalves, 2020). Furthermore, the difficulties students encounter in adapting to complex techniques and the requirement for technical rigor highlight the importance of active methodologies and pedagogical resources that bring practice closer to professional reality (Melo, 2019). This scenario emphasizes the role of the teacher, who, in addition to mastering technical content, must act as a mediator, using innovative teaching strategies and engaging in continuous professional development (Freire, 2014).

Another aspect highlighted is the relevance of pedagogical methodologies that make teaching more dynamic and effective, such as active learning, simulations, case studies, and the use of digital and multimedia technologies. These strategies, in addition to promoting greater student autonomy, enable the construction of meaningful learning, in which theory is directly linked to practice (Santos, 2021). Thus, it is clear that technical Radiology education requires flexible pedagogy that addresses both scientific demands and the human aspects of the profession.

In light of these reflections, it can be affirmed that training competent professionals in Radiology depends on the articulation of three fundamental pillars: technical solidity, ethical commitment, and interpersonal interaction skills. Only when these elements are worked on together is it possible to consolidate a professional profile that meets market demands and, above all, patient needs (Sloniak et al., 2017). The future of technical Radiology education, therefore, is intrinsically linked to the quality of pedagogical practices adopted, investment in infrastructure, and the appreciation of teacher training.

Thus, the art of teaching in technical Radiology courses should be understood as a continuous formative process capable of transforming health education and contributing to strengthening diagnostic imaging services. It is a constant challenge but also an opportunity to innovate, humanize, and qualify pedagogical practice, ensuring that technical training remains aligned with scientific and social transformations of contemporary times. Ultimately, investing in the quality of this education means investing in improving healthcare delivery and valuing professionals who play an indispensable role in human care.

In this sense, Radiology should be understood not only as a technological field but as an area of practice that demands sensitivity, social responsibility, and commitment to life. Strengthening

pedagogical foundations in technical education constitutes a promising path to ensure that the future of Radiology is marked not only by diagnostic precision but also by the human and ethical excellence of its professionals.

REFERENCES

1 Albuquerque, R., & Carmo, L. (2019). Introdução à radiologia: princípios e aplicações [Introduction to radiology: Principles and applications]. Manole.

2 Alencar, C. de A. C. (2022). Procedimentos radiológicos de alta complexidade: comparação entre setores público e privado [High-complexity radiological procedures: A comparison between public and private sectors] (Undergraduate thesis, Escola Bahiana de Medicina e Saúde Pública). Retrieved from https://repositorio.bahiana.edu.br:8443/jspui/handle/bahiana/6900
. Accessed September 29, 2025.

3 Conselho Nacional de Secretários de Saúde (CONASS). (2007). Assistência de média e alta complexidade no SUS [Medium and high complexity care in the SUS]. Retrieved from https://bvsms.saude.gov.br/bvs/publicacoes/colec_progestores_livro9.pdf
. Accessed September 29, 2025.

4 Freire, P. (2014). Pedagogia da autonomia: saberes necessários à prática educativa [Pedagogy of autonomy: Necessary knowledge for educational practice] (55th ed.). Paz e Terra.

5 Gonçalves, A. M. (2020). Formação técnica em radiologia: competências e desafios [Technical training in radiology: Competences and challenges]. Revista Brasileira de Educação Profissional e Tecnológica, 10(2), 45–59.

6 Gonçalves, A. M., & Oliveira, R. (2020). Estratégias de ensino em cursos técnicos de radiologia: práticas e desafios [Teaching strategies in technical radiology courses: Practices and challenges]. Revista Brasileira de Educação Profissional e Tecnológica, 11(1), 32–46.

7 Langland, O. E., Langlais, R. P., & Souza, R. (2018). Radiologia: fundamentos e técnicas [Radiology: Fundamentals and techniques]. Guanabara Koogan.

8 Melo, F. C. (2019a). Estágio supervisionado e integração teoria-prática em cursos técnicos de saúde [Supervised internship and theory–practice integration in technical health courses]. Revista de Ensino Técnico em Saúde, 5(2), 15–27.

9 Melo, F. C. (2019b). Estudo de casos como metodologia de aprendizagem em cursos técnicos de saúde [Case study as a learning methodology in technical health courses]. Revista de Ensino Técnico em Saúde, 5(2), 15–27.

10 Oliveira, R., & Silva, T. (2018). Educação técnica em saúde: desafios e perspectivas na formação de profissionais em radiologia [Technical education in health: Challenges and perspectives in the training of radiology professionals]. Cadernos de Saúde Pública, 34(3), 1–12.

11 Padoveze, C. L. (2012). Gestão da educação profissional técnica e tecnológica [Management of technical and technological professional education]. Atlas.

12 Santos, T. A. (2021). Tecnologias educacionais e formação técnica em radiologia: contribuições para a aprendizagem prática [Educational technologies and technical training in radiology: Contributions to practical learning]. Cadernos de Educação em Saúde, 14(3), 88–101.

13 Sloniak, A., et al. (2017). Radiologia diagnóstica: fundamentos, prática e ética profissional [Diagnostic radiology: Fundamentals, practice, and professional ethics]. Artmed.

14 Tavano, F., & Oliveira, M. (2020). Técnicas radiológicas e segurança do paciente [Radiological techniques and patient safety]. Santos.