



## Teaching-learning of the radiological clinic and professional skills of the graduate in Medical Imaging and Radiophysics

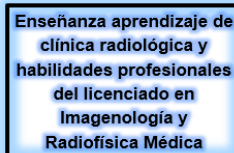
### Enseñanza aprendizaje de clínica radiológica y habilidades profesionales del licenciado en Imagenología y Radiofísica Médica

### Enseignement-apprentissage de la clinique radiologique et les compétences professionnelles du diplômé en Imagerie et Radiophysique Médicale

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#### ABSTRACT

**Introduction:** The challenges of Higher Education in the 21st century in Cuba outline the need for a new educational process based on the principles of excellence, quality, and relevance in the preparation of professionals with knowledge, skills, and abilities that give answers to the scientific-technological advances, characterized by integrating education into medical care processes.

**Objective:** To expose the development of professional skills from the teaching-learning process of the Radiological Clinic to the future Graduate. **Methods:** From the theoretical

level: historical-logical, analysis and synthesis, inductive-deductive, systematization, and documentary analysis. **Results:** In professional training, higher education, and in particular medical education hard work for the educational and training work is systematic, comprehensive, and inclusive with specific professional skills for a mastery performance. For the educational work, the essence of the problem from the curricular dimension lies in evaluating how the Radiological Clinic subject contributes to the educational purposes that, in its integration, develop new qualities foreseen in the objectives. Undoubtedly, teaching aids are necessary, including the basic textbook, since it groups knowledge and teaches skills that guarantee comprehensive modes of action in the search for better practical skills, knowledge, and necessary attitudes in the development of professional activity. **Conclusions:** The teaching-learning process of the Radiological Clinic is aimed at

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the development of the cognitive activity, mastery of content, fulfillment of objectives and development of skills oriented towards professional performance.

**Keywords:** teaching-learning process, professional skills, radiological clinic, visual memory.

## RESUMEN

**Introducción:** los retos de la Educación Superior en el siglo XXI en Cuba, esbozan la necesidad de un nuevo proceso educativo, fundamentado en los principios de excelencia, calidad y pertinencia en la preparación de profesionales con conocimientos, habilidades y capacidades que den respuestas a los avances científicos-tecnológicos, caracterizado por integrar la educación a los procesos de atención médica. **Objetivo:** exponer el desarrollo de habilidades profesionales a partir del proceso de enseñanza aprendizaje de Clínica Radiológica del futuro Licenciado. **Métodos:** del nivel teórico: histórico-lógico, análisis y síntesis, inductivo-deductivo, sistematización y análisis documental. **Resultados:** en la formación del profesional, la educación superior y en particular la educación médica, desarrollan una ardua labor para que el trabajo educativo y formativo sea sistemático, integral e inclusivo con presencia de habilidades profesionales específicas que brinden una actuación con maestría. Para la labor educativa, la esencia del problema desde la dimensión curricular radica en evaluar cómo la asignatura Clínica Radiológica contribuye a los propósitos educativos que en su integración desarrollan nuevas cualidades previstas en los objetivos. Sin dudas los medios de enseñanza son necesarios, entre ellos el libro de texto básico, ya que agrupa conocimientos y enseña habilidades que garantizan modos de actuación integral en la búsqueda de mejores capacidades prácticas, el saber y las actitudes necesarias en el desarrollo de la actividad profesional. **Conclusiones:** el proceso enseñanza-aprendizaje de Clínica Radiológica está encaminado al desarrollo de la actividad cognoscitiva, dominio de los contenidos, cumplimiento de los objetivos y desarrollo de habilidades orientadas al desempeño profesional.

**Palabras claves:** proceso de enseñanza-aprendizaje, habilidades profesionales, clínica radiológica, memoria visual.

## RÉSUMÉ

**Introduction:** les défis de l'enseignement supérieur au XXI<sup>e</sup> siècle à Cuba, soulignent la nécessité d'un nouveau processus éducatif, basé sur les principes d'excellence, de qualité et de pertinence dans la préparation de professionnels dotés de connaissances, de compétences et d'aptitudes qui répondent aux exigences scientifiques -les progrès technologiques, caractérisés par l'intégration de l'éducation dans les processus de soins médicaux. **Objectif:** exposer le développement des compétences professionnelles issues du processus d'enseignement-apprentissage de la Clinique Radiologique du futur Diplômé. **Méthodes:** du niveau théorique: historique-logique, analyse et synthèse, inductif-déductif, systématisation et analyse documentaire. **Résultats:** dans la formation professionnelle, l'enseignement supérieur et en particulier l'enseignement médical, ils effectuent un travail acharné pour que le travail d'éducation et de formation soit systématique, complet et inclusif

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avec la présence de compétences professionnelles spécifiques qui assurent une performance avec maîtrise. Pour le travail pédagogique, l'essence du problème de la dimension curriculaire réside dans l'évaluation de la contribution du sujet de Clinique Radiologique aux finalités pédagogiques qui, dans son intégration, développent de nouvelles qualités prévues dans les objectifs. Sans aucun doute, les supports pédagogiques sont nécessaires, y compris le manuel de base, car il regroupe des connaissances et enseigne des compétences qui garantissent des modes d'action complets dans la recherche de meilleures compétences pratiques, connaissances et attitudes nécessaires au développement de l'activité professionnelle. **Conclusion:** le processus d'enseignement-apprentissage de Clinique Radiologique vise le développement de l'activité cognitive, la maîtrise du contenu, la réalisation des objectifs et le développement des compétences orientées vers la performance professionnelle.

**Mots clés:** processus d'enseignement-apprentissage, compétences professionnelles, clinique radiologique, mémoire visuelle.

## INTRODUCTION

Since the beginning of modern medicine, the doctor has had the need to corroborate the clinical diagnosis with the use of different types of complementary tests. A fact that has been facilitated since the end of the last century with scientific-technological development, by exerting great influence on Medical Sciences; because it humanizes and makes both diagnostic and therapeutic procedures less invasive, with new modalities, more exact and with greater possibilities,<sup>1</sup> by allowing the improvement of the quality of life of the population. This translates into an increase in health indicators; but to maintain them, prepared professionals are needed, capable of assimilating and assuming new technologies.

José Martí, a great Cuban thinker, envisioned in the 19th century the need to achieve quality training processes at the level of existing scientific development so that student graduates with the necessary knowledge to facilitate their professional growth. It is essential to have curricular designs that take into account development trends with the priority of including in the different disciplines the necessary knowledge so that the student upon graduation does not find that his preparation is below the actual development.<sup>2</sup>

In the 21st century in Cuba, Higher Education has a new educational process based on the principles of excellence, quality, and relevance in the preparation of professionals with cognitive, procedural, and attitudinal capacities in correspondence with scientific and technological development that respond to the health needs of the population. The training must guarantee knowledge, skills, habits, and capacities through viable and flexible study plans and programs with current times; that provide tools for professional performance that guarantee quality within the teaching-learning process. Education is integrated into the processes of medical assistance in the services.

The triumph of the Revolution in Cuba marks an important change in the training of technical health personnel that was empirical. In 1960 began an organized way of study plans and programs. In 1989, in the interest of increasing the quality of human resources and as a consequence of the

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technological development achieved, the training of Graduates in Health Technology began experimentally in five profiles at the Higher Institute of Medical Sciences of Havana "Victoria de Girón". With the objective of giving a social response and raising the quality of professional action in solving basic and general problems within the profile of each technical specialty.<sup>3</sup>

In 2003, with the programs of the Revolution in the Battle of Ideas, the Health Technology Degree began with a new pedagogical model: three training cycles (basic, technical, and professional) that covered all the technical specialties and included twenty-one profiles.

In 2010, a new structure was designed on the basis of study plans, Plan D, which began the career of Medical Imaging and Radiophysics integrated into the same profile based on the training of professionals with a broad profile, prepared to work in the field of technological processes in health. The governing discipline Integrated Technical Fundamentals is organized into 14 subjects and includes Radiological Clinic, which is the fourth subject. It is taught in the first semester of the third year, the result of the integration of medical clinic, conventional radiology I, II, and special radiology I, II; in previous curricular designs they were independent subjects.<sup>4</sup>

In 2020, a new curricular design arises, Plan E, with the aim of achieving better quality and integration in the areas of knowledge in accordance with technological scientific development and its reflection on professional performance. This design maintains Integrated Technical Foundations as the governing discipline with Radiological Clinic; but now more up-to-date, made up of nine units where it groups aspects of clinical medicine and radiological semiology integrated by systems, as well as special radiology procedures.<sup>5</sup>

This integration facilitates a better treatment of the content in the teaching-learning process, and a better articulation and organization of theory with practice for the student, by mediating the mobilization of their knowledge in the development of professional training. With the aim of making them work in an articulated and harmonious way, in order to provide tools for professional performance and comprehensive humanist training that allow academic leadership in the exercise of the profession.<sup>5</sup>

The Ministry of Public Health has outlined strategies and policies aimed at strengthening undergraduate and postgraduate education in human resources since the development of professional skills is considered one of the main quality indicators. This makes the task of learning possible, promoting knowledge and know-how; so that university education plays a fundamental role in the effective preparation to learn the different knowledge of professional training and throughout life.<sup>4,5</sup>

In Cuba, Medical Education has a social responsibility, aimed at satisfying health demands. What is necessary is to encourage a series of qualities that should characterize the professional's personality such as convictions, attitudes, moral and character traits, ideals and aesthetic tastes, respect, responsibility, and punctuality, as well as other modes of conduct.<sup>6</sup> These are professionals committed to meeting health needs with solid scientific-technical preparation, where active teaching models encourage the student to be the object and subject of their own learning with the capacity

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for self-preparation directed towards the acquisition and permanent improvement of knowledge for a higher deployment in professional activity.<sup>7</sup>

This capacity will allow them to learn and develop knowledge, habits, abilities, and skills,<sup>7</sup> that allow the future professional to solve problems in radiological practice. During the teaching-learning process of the Radiological Clinic, the necessary tools are provided for the development of conscious, reflective thinking, with the ability to work independently for the development of high professional skills. Therefore, the main objective of this work is to analyze the development of professional skills from the teaching-learning process of the Radiological Clinic of the student of Medical Imaging and Radiophysics.

## METHODS

The logic of the research was framed in the qualitative paradigm, starting from a dialectical materialist approach; and in particular, investigations of the theoretical and empirical level were used.

**Historical - Logical:** for the analysis of the historical development of the teaching-learning process and its reflection in the professional skills of the Graduate in Medical Imaging and Radiophysics.

**Analysis and synthesis:** for the partial study of the development of the teaching-learning process in the Degree in Medical Imaging and Radiophysics.

**Inductive - Deductive:** to study the characteristics of the teaching-learning process in the Degree in Medical Imaging and Radiophysics.

**Systematization:** for the analysis of the theoretical referents and antecedents of the teaching-learning process of the Radiological Clinic subject, in the development of the professional skills of the Graduate in Medical Imaging and Radiophysics.

**Documentary Analysis:** for the assessment of the information collected on the teaching-learning process of the Radiological Clinic subject in the Degree in Medical Imaging and Radiophysics.

## ANALYSIS AND DISCUSSION OF RESULTS

### Teaching-learning process in Radiological Clinic

Teaching and learning integrate a single process: the teaching-learning process, which par excellence must be a developer to achieve significant learning. It pursues as its purpose, the formation of sufficient skills for the profession; and constitutes the essential integrating path in the appropriation of knowledge, skills, habits, relationship norms, behaviors, and values bequeathed by humanity. These values are expressed in the teaching content closely linked to the rest of the teaching and extra-teaching activities carried out by the student,<sup>8-9</sup> aimed at achieving the training of professionals with autonomy and sufficient tools in the search for knowledge that facilitates effective learning and continuous throughout his professional life with the ability to apply them actively for the benefit of society.<sup>10</sup>

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Maciel de Olivera<sup>11</sup> in the book Educational Planning: Profiles and Configurations, states that the task of teachers lies in conducting teaching and learning in the field of education, where planning seeks to make it possible in an organized manner and where learning is the *raison d'être* of teaching.

The learning activity needs well-designed and planned strategies, integrated into the educational teaching process with actions aimed at building knowledge for the acquisition and development of habits, skills, and attitudes; where the teacher is the facilitator who guides and directs the process; while the student occupies an active position as he creates his own knowledge, learning to learn.<sup>12</sup>

In a pedagogical sense, the teaching-learning process of the Radiological Clinic aims at exposing knowledge in an organized manner and by levels of complexity adjusted to the study program, whose action is to transmit knowledge in order to stimulate active learning and with it raise the level of instruction and education that builds knowledge and transforms realities. But in order to organize and carry out the sequences of the contents to be worked on, previous knowledge must be taken into account, since learning must be a significant activity for the learner with the corresponding relationship between the new knowledge and that which they already possess.<sup>6</sup>

It is necessary that the teaching-learning process of the Radiological Clinic be a developer, allowing the student to discover their own knowledge with the ability to apply it in practical situations in continuous promotion and ascent in the quality of the different studies carried out. It achieves this by promoting the training of professionals capable of continuing to learn independently throughout their lives, which involves the formation of needs and motivations for learning, a positive attitude towards study, and volitional qualities that sustain this performance.

Teaching and learning in Radiological Clinic is a process that has an interactive and communicative character,<sup>13</sup> it presents fundamental aspects such as bilateral, intentional, planned, regulated, multifaceted, and dialectical character that as a system all its components are concatenated in the achievement of a quality educational process. Its purpose is to educate, teach and instruct.<sup>8</sup> Instructional planning begins by developing the design for the intervention that answers first: What is it intended to teach? Or what do you want the student to learn? This planning groups the acts carried out by the teacher with the intention of providing the student with the possibilities of efficient learning. It presents its own characteristics or components that the teacher must master, such as objectives, contents, methods, teaching means, forms of organization, and evaluation.

**Objectives:** the governing category of the teaching process, guides and directs the activity of the teacher and students by expressing the goals, aspirations, or purposes and the transformations that are intended to be achieved in the personality of each student, responds to the question: why is this taught and learned?

**Content:** it determines what the student must learn to fulfill the objective.<sup>14</sup> The knowledge, skills, and values accumulated by humanity, historically enriched and transmitted as truths. It is specified in the subjects of the study plan, programs, textbooks, and other teaching materials that establish the level of depth in which work will be done in a logical sequence and concatenated with the content that precedes and follows. It is the answer to the question: what to teach – learn?

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**Method:** the way that the teacher follows the educational process to facilitate the teaching of the contents. It is characterized by a successive sequence of actions or a set of logical and conscious procedures that regulates the activity of the teacher and students; aimed at achieving the result in correspondence with the objectives set and type of content. According to the organization of the teaching process, they are classified as active<sup>15</sup> or productive and passive or reproductive. Also according to the nature of the activities they are classified as explanatory-illustrative, reproductive and problematic. It is the answer to the question: how to teach and learn?

**Teaching and learning means:** They constitute the material support of the methods, they are determined by the objectives and content. They enable the achievement of objectives by facilitating the transmission of a greater amount of information in less time in teaching, making the educational teaching process more effective by activating intellectual functions and facilitating the understanding and assimilation of the content that is taught since they increase motivation by the class, increase the concentration of attention and memorization. They answer the question, with what means to teach and with what means to learn?

**Form of organization:** the way in which the components of the teaching-learning process are arranged and interact with the objectives, they constitute the integrating component of this process. The most frequent forms of organization of teaching are conferences, seminars, practical classes, theoretical-practical classes, meeting classes, workshop classes, teacher consultation, and independent work, among others. It is the answer to the question: how do I organize and integrate the components of the teaching-learning process?

**Evaluation:** the instrument of control and verification of the quality of the educational process when evaluating the results of the work of professors and students in the fulfillment of the objectives. It determines efficiency since it values the knowledge, habits, skills, and ways of acting that the students have acquired during the development of this process when verifying the degree to which the proposed objectives are achieved. It is the answer to the question: has it been possible to teach what was planned? Among the forms of evaluation are: preliminary control, control during the teaching-learning process, and deferred control.<sup>16-17</sup>

The teaching-learning process of Radiological Clinic complies with the fundamental principles of didactics; which expresses the regularities and essential features that characterize this process, as it is important to have well-defined objectives pursued by the teaching activity, using updated teaching methods and procedures to make teaching dynamic, active and problematic in the development of the content of discipline. What is achieved by organizing it from a conception that facilitates a better articulation of theory with practice, where the mobilization of knowledge in the development of professional training is mediated, with the aim of making them work in a more articulated and harmonious way depending on to provide tools for action and humanist training.<sup>18</sup>

Within the educational structure, learning is an important concept that must be facilitated by the presence of didactic means that bring knowledge closer, aimed at a better achievement of the objectives, enhancing the development of skills. In Radiological Clinics, simple and contrasted radiological studies, digitized and/or conventional, and the textbook are frequently used as teaching aids.

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The main forms of organization of the teaching process in this discipline are conferences, seminars, and practical classes; with the purpose that the student systematically receives the level of knowledge for the achievement of practical skills. Therefore, the main role in professional performance implies that the teaching-learning process is directed so that the knowledge and skills of the profession last. It interrelates the knowledge of conventional and special radiology, medical clinic and radiological semiology, for the good development and mastery of professional skills. Its objectives are aimed at developing the ability to explain the generalities of radiology, based on the identification of concepts, medical terminologies, techniques, and equipment most used in the specialty; with the corresponding association, identification, and description of clinical symptoms and radiological signs.

The teaching-learning process in the Radiological Clinic offers a guide that leads the activity and integrates the instructional, educational, and developer; promoting knowledge from the perspective of continuous improvement of pedagogical practice, constituting the essential way for the appropriation of knowledge, skills, habits, relationship norms, behaviors and values bequeathed by humanity.

## Professional skills

Rubinstein, mentioned by Ortiz<sup>19</sup> "...approaches the term ability from a methodological level, and associates it with the conscious mastery of acts that enable man to apply certain methods of action to solve the problems that social practice poses, he admits also the need to train these methods in the context of an educational process."

In the context of initial professional training, there is a close relationship between the teaching-learning process and the development of professional skills, since they are formed by acquiring and integrating knowledge into modes of action and procedures in the form of interventions, executions, and specific actions to a profession being necessary once formed to exercise them to achieve perfection.<sup>20</sup> Professional skills are then defined as the content showing the professional the way of acting in a branch of knowledge and are considered as an interdisciplinary knowledge system that leads to the achievement of a specific purpose, which guarantees success with high quality in the execution of the activity.

Professional skills as a component of the teaching-learning process in a Radiological Clinic constitute its content. Their learning is integrated into the topics taught; with the need to strengthen themselves in practical activities, seminars, and pre-professional practice. For the student to obtain the knowledge and apply it in the mastery of the methods and working techniques that sustain the technological process; in addition to knowing how to establish links in the context, which facilitates solving the problems that may arise in the realization of the different technological imaging procedures.

In Education, images have a preponderant role because they are a visual communication support that materializes a fragment of the perceiving universe, serving as a vehicle for the transmission of knowledge; they contain messages that are read into previous experiences or knowledge.<sup>21</sup>

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The visual language frequently has difficulties in terms of interpretation; which constitutes a challenge as this is a source of useful information for education.<sup>22</sup> The foregoing indicates the importance of educating with the image and for the image, that is, using it as a support that facilitates the teaching of content and prepares the student for the development of practical skills such as identifying, pointing, and describing; all of this is very useful in medical imaging diagnosis. Visual discrimination helps to identify similarities and differences in shapes and location, paying attention to details and appreciating small differences between objects and images and their characteristics.<sup>23</sup>

When starting from the conception and criteria of didactic or teaching means, it must be kept in mind that in the Radiological Clinic, it is important to educate and develop visual or iconic memory. It is important to remember that memory is the ability of the mind to receive and retain information through the senses and encode, store, and later recall when the clinical situation requires it.

Keep in mind the maxim that says: he who does not know what he is looking for will not find it even if he passes by, because he can look without seeing. In order to see, in addition to learning and knowing, and mastering the content, it is necessary to have good training in the development of visual memory that allows sufficient sensitivity to recognize and identify radiological signs each time they appear.

It is essential to see, to observe with competence and a critical gaze in order to access the specific visual language of the radiological image shown, with the capacity for identification and analysis, interpretation, and description. While in the text of the subject, the concatenation of images and their sequential insertion, support the learning process and endow the contents with meaning and pedagogical structure; making them easier to understand, since well-conceived images play an informative and significant teaching role that facilitates the educational process.

Visual memory is a complex and essential cognitive function in the acquisition of knowledge that allows the learning of logical sequences and the visualization and interpretation of contents expressed in medical images such as radiological signs, and codes that must be translated by students.

The development of visual memory as a constructive and active process is a requirement in Radiological Clinic learning and implies education for the progress of a comprehensive, analytical, and reflective visual reading of radiological images in unity with the text. It is a powerful vehicle for intellectual communication whose fundamental objective is to achieve the harmonious development of professional skills.

In Radiological Clinic, visualization and representation in mental images must interact with each other, so that students achieve a better understanding of the contents and can identify each time it occurs in radiological studies, the different signs that indicate changes or alterations. In addition, visualization is a very useful tool that helps students build their own knowledge to correctly relate symbolic registers, better acquiring the knowledge that they later use in the practical exercise of the profession.

Visual memory has a significant impact on student learning<sup>24</sup> because it facilitates the development of the ability to identify, interpret and describe the images present in teaching media such as sheets, photographs, retro-transparencies, simple and contrasted radiological studies, and in the own

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textbook. With a sample of images and typical descriptions of the radiological signs in relation to the medical clinic of the nosological entity under study.

With the effective use of adequate teaching means, a didactic process is established in which the exchange and transmission of information generates an unprecedented flow of knowledge; where the student improves his sensory and perceptual skills with tools that allow him to identify and detail normal radiographic anatomy and its variants, as well as the radiological signs of entities. All this, to recognize and identify the pathological alterations of the area explored in the image, based on the corresponding detailed description of its characteristics that include the analysis of the regularity or irregularity of its edges, densities, location, definition of its contours and relationship with neighboring structures, size, shape, topographic location; in addition to the ability to associate these radiological signs with the clinical signs of the specific entity, using the appropriate technical language required by the subject.

## CONCLUSIONS

The teaching-learning process at Radiological Clinic is aimed at enhancing cognitive activity, content mastery, and compliance with the objectives set forth in the curricular design; which facilitate the development of visual memory and with it the ability to identify, analyze and interpret, and then describe the alterations seen in radiological studies, for the growth and development of the Graduate in Medical Imaging and Radiophysics in professional performance with a master's degree.

## CONFLICT OF INTEREST

No conflicts of interest are declared.

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