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**ORIGINAL ARTICLE**

# Correlation Between Knowledge and Use of Information and Communication Technologies in Medical Sciences

## Correlación conocimiento-uso de las tecnologías de la información y las comunicaciones en ciencias médicas

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**ABSTRACT**

**Background:** The integration of information and communication technologies (ICT) in medical education responds to the need for adaptation to new virtual teaching-learning environments, where teachers' mastery of these tools directly impacts the quality of the educational process.

**Objective:** To determine the correlation between knowledge and use of information and communication technologies among faculty at the Municipal Health Site in Fomento municipality.

**Methods:** A cross-sectional descriptive study was conducted with the faculty of the Municipal Health Site in Fomento, Sancti Spíritus, between January and March 2025. Methods from the theoretical level (analysis-synthesis, inductive-deductive, historical-logical, systems approach); empirical (questionnaire); and mathematical-statistical (descriptive analysis, measurement scales, Cronbach's alpha coefficient) were used.

**Results:** Most teachers were between 50 and 64 years old (38.3%) and held the teaching category of Assistant Professor (51.6%). While 70.0% possessed basic theoretical knowledge about ICT, 80.0% made low use of them in teaching practice.

**Conclusions:** It was determined that theoretical mastery contrasts with notable limitations in its practical application, which negatively impacts the quality of the teaching-learning process.

**MeSH:** information technology; faculty; professional development; professional competence; education, medical.

**RESUMEN**

**Fundamento:** la integración de las tecnologías de la información y las comunicaciones en la educación médica responde a la necesidad de adaptación a nuevos entornos educativos virtuales, donde el dominio de estas herramientas por los profesores incide directamente en la calidad del proceso enseñanza aprendizaje.

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**Objetivo:** determinar la correlación entre conocimiento y uso de las tecnologías de la información y las comunicaciones en los profesores del claustro de la Sede Municipal de Salud en el municipio Fomento.

**Métodos:** se realizó un estudio descriptivo transversal en el claustro de la Sede Municipal de Salud en el municipio Fomento en Sancti Spíritus entre enero-marzo 2025. Se utilizaron métodos del nivel teórico (análisis-síntesis, inductivo-deductivo, histórico-lógico, enfoque de sistema); empíricos (cuestionario); y matemáticos estadísticos (análisis descriptivo, escalas de medición, coeficiente alfa de Cronbach).

**Resultados:** la mayoría de los profesores tenían entre 50 y 64 años (38,3 %) y ostentaban la categoría docente de profesor asistente (51,6 %). El 70,0 % de estos poseían conocimientos teóricos básicos sobre las tecnologías de la información y las comunicaciones; no obstante, el 80,0 % hacían un bajo uso de ellas en la práctica docente.

**Conclusiones:** se determinó que el dominio teórico contrasta con notables limitaciones en su aplicación práctica, lo cual repercute de manera negativa en la calidad del proceso enseñanza aprendizaje.

**DeCS:** tecnología de la información; docentes; superación profesional; competencia profesional; educación médica.

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# INTRODUCTION

The incorporation of information and communication technologies (ICT) in Cuban medical universities arises to respond to the need to introduce students and teachers to virtual teaching-learning environments (VTLE). The use of these platforms transforms the acquisition, processing, and preservation of health information.[1] Furthermore, the use of ICT in medical teaching has a positive impact on efficiency, quality, and pedagogical

innovation, facilitates access to knowledge, allows for the creation of new didactic models, and introduces innovative, interactive, and participatory teaching methods.[2]

In the context of societal informatization, improving the educational process constitutes a challenge for higher medical education, which requires fostering conditions for the comprehensive training of students as an expression of the new paradigms of the contemporary university.[3]

In Cuba, despite the existence of a well-structured educational system, according to Sanjuán Gómez *et al*.,[4] virtuality develops in a complex context marked by economic and technological limitations due to the financial blockade imposed on the country. Pérez *et al*.[5] emphasize that despite current socioeconomic conditions, this phenomenon helps identify and solve problems of integration between teaching, healthcare, and research. Berenguer Gouarnaluses *et al*.[6] also highlight the importance of graduating qualified professionals with solid informational skills and competencies for a greater contribution to social development.

Regarding the functions of the teacher as a key figure in the training of the general practitioner and a fundamental element in the Cuban public health system, Salgado Reyes[2] highlights the responsibility of making adequate and efficient use of ICT during classes with online alternatives including educational portals, virtual classrooms, courses, audiovisuals, and multimedia. However, as Sanjuán Gómez *et al*.[4] warn about the quality of teaching in virtual environments, this educational transformation is only possible if the faculty possesses a positive attitude and the necessary knowledge to rationally utilize available technological resources and institutions guarantee the necessary technological infrastructure.

Despite technological advances and growing investment in educational infrastructure, challenges persist in effectively integrating these tools into academic disciplines worldwide.[3] In the specific setting of the Municipal Health Site in Fomento municipality, belonging to the University of Medical Sciences of Sancti Spíritus, deficiencies have been identified in the faculty to enhance the use of ICT in the teaching-learning process.

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Consequently, the objective of this research is to determine the correlation between knowledge and use of information and communication technologies among the faculty of the Municipal Health Site in Fomento municipality.

# METHODS

A cross-sectional descriptive study was conducted with faculty of the Municipal Health Site in Fomento municipality affiliated with the University of Medical Sciences of Sancti Spíritus during the period January-March 2025. The population consisted of all teachers who granted consent to participate in the study: 74 (n=74). A simple random sampling was performed where 60 (n=60) who met the proposed selection criteria were selected:

- Inclusion criteria: teachers directly involved in teaching and willing to participate in the study.
- Exclusion criteria: teachers without teaching load in the last six months, or who for any reason were unwilling to participate in the study.

The following theoretical methods were used:

- Analysis-synthesis: applied to decompose the study variables (age, teaching category, knowledge and uses of ICT) into analyzable elements, then integrating the results into a comprehensive view of the educational phenomenon. Questionnaire responses were synthesized to establish patterns of ICT knowledge and use.
- Inductive-deductive: to formulate hypotheses about the relationship between teaching category and ICT mastery.
- Historical-logical: considered the historical evolution of ICT incorporation in medical education to contextualize the study results.
- Systems approach: addressed the educational phenomenon as an integral system, considering the interaction between sociodemographic, pedagogical, and technological variables. The role of teachers as key components of the university teaching system was evaluated.

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Empirical method: a structured questionnaire administered to teachers to evaluate ICT knowledge and uses, validated by experts.

The following variables were studied:

- Age in age groups: 20 to 34, 35 to 49, 50 to 64, 65 or more years.
- Teaching category: instructor, assistant professor, or associate professor.
- Level of knowledge about ICT: evaluated through 10 dichotomous questions where each correct answer was awarded 1 point and incorrect answers 0 points. It was considered low when a total score less than 5 points was obtained, medium between 5 and 7 points, and high if 8 or more points were reached.
- Uses of ICT in teaching: evaluated with 10 items on a 5-option Likert scale with frequency: 1: never, 2: rarely, 3: sometimes, 4: frequently, 5: always. The total score ranged from 10 to 50 points. Levels were classified as: Low: less than 35 points (25th percentile of the pilot distribution). Medium: from 35 to 44 points (percentiles 26-74). High: greater than or equal to 45 points (75th percentile).

The questionnaire was validated by 5 experts (3 methodologies and 2 specialists in educational ICT). It was administered by a team of trained researchers in person and anonymously to minimize social desirability bias. It was previously applied as a pilot test to 10 teachers not included in the final sample, which showed high reliability ($\alpha = 0.85$ for knowledge and $\alpha = 0.78$ for ICT uses), evaluated using Cronbach's alpha coefficient. The data collected were tabulated and analyzed with SPSS v.28 statistical software. Descriptive analyses were performed to obtain frequencies and measures of central tendency in relation to the obtained responses.

Mathematical-statistical methods:

- Descriptive analysis: frequencies and measures of central tendency were calculated to evaluate the distribution of variables of interest.

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- Measurement scales: dichotomous scores were applied for the level of ICT knowledge; a 5-option Likert scale was used for its use.
- Cronbach's alpha coefficient: questionnaire reliability was evaluated with values of α = 0.85 for knowledge and α = 0.78 for ICT use.

Ethical aspects: the research respected the postulates of ethics and always had a scientific purpose. The characteristics of the research and its harmlessness were explained, and participants signed the informed consent form. Approval was obtained from the ethics committee and the municipal scientific council.

# RESULTS AND DISCUSSION

According to the data presented in Table 1, most teachers were in the age range of 50-64 years (38.3 % of the sample), followed by younger groups -between 20-34 years (26.7 %) and 35-49 years (26.7 %)-. Teachers with the teaching category of Assistant Professor predominated (51.6 %), only 16.6 % were Associate Professors.

**Table 1.** Distribution of teachers according to age groups and teaching category. Municipal Health Site in Fomento municipality, Sancti Spíritus. January-March 2025

| Age groups | Teaching categories | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Instructor | | Assistant Professor | | Associate Professor | | Total | |
| | No. | % | No. | % | No. | % | No. | % |
| 20 to 34 years | 10 | 52,6 | 6 | 19,4 | 0 | 0,0 | 16 | 26,7 |
| 35 to 49 years | 7 | 36,9 | 8 | 25,8 | 1 | 10,0 | 16 | 26,7 |
| 50 to 64 years | 2 | 10,5 | 15 | 48,4 | 6 | 60,0 | 25 | 38,3 |
| 65 years and over | 0 | 0,0 | 2 | 6,4 | 3 | 30,0 | 5 | 8,3 |
| Total | 19 | 31,6 | 31 | 51,6 | 10 | 16,6 | 60 | 100 |

Source: questionnaire. n=60

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Table 2, regarding teachers' knowledge about ICT, shows that 93.3 % of them knew the meaning of the acronym ICT and 91.7 % understood the acronym AI (artificial intelligence). However, only 16.7 % knew the appropriate platform for conducting remote medical consultations and 15.0 % mastered personal data protection regulations. Furthermore, knowledge about tools for managing online learning was 61.7 %; and 86.7 % of respondents knew about useful digital resources for searching biomedical literature.

**Table 2.** Distribution of teachers according to knowledge about ICT. Municipal Health Site in Fomento municipality, Sancti Spíritus. January-March 2025

| Question Content | Answers | | | |
|---|---|---|---|---|
| | Correct Answers | | Incorrect Answers | |
| | No. | % | No. | % |
| Meaning of the acronym ICT | 56 | 93,3 | 4 | 6,7 |
| Tool to manage online learning | 37 | 61,7 | 23 | 38,3 |
| Platform that allows conducting remote medical consultations | 10 | 16,7 | 50 | 83,3 |
| Regulation that protects patient personal data in digital environments | 9 | 15,0 | 51 | 85,5 |
| Useful digital resource for searching biomedical literature | 52 | 86,7 | 8 | 13,3 |
| Cloud service for secure file storage | 22 | 36,7 | 38 | 63,3 |
| Meaning of the acronym AI | 48 | 80,0 | 12 | 20,0 |
| Platform that allows creating evaluation questionnaires | 51 | 85,0 | 9 | 15,0 |
| Meaning of the acronym AI | 55 | 91,7 | 5 | 8,3 |
| Platform that allows creating evaluation questionnaires | 28 | 46,7 | 32 | 53,3 |

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Source: questionnaire. n=60

According to the results shown in Table 3 on ICT use by teachers, 43.3 % frequently used digital educational resources, and 48.3 % employed digital tools in educational strategies. Furthermore, 56.6 % never used simulation environments in teaching practice, 55.0 % used the virtual classroom occasionally, and 40.0 % did not use academic social networks for educational purposes. The majority (58.3 %) reported not having sufficient institutional resources to implement ICT in teaching. However, 50.0 % frequently used online training as a form of professional development.

**Table 3.** Distribution of teachers according to their use of ICT. Municipal Health Site in Fomento municipality, Sancti Spíritus. January-March 2025

| Questions | Answers | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Never | | Rarely | | Sometimes | | Frequently | | Always | |
| | No. | % | No. | % | No. | % | No. | % | No. | % |
| Do you apply digital educational resources in teaching? | 1 | 1,7 | 13 | 21,7 | 26 | 43,3 | 12 | 20,0 | 8 | 13,3 |
| Do you use digital tools in educational strategies? | 3 | 5,0 | 10 | 16,7 | 29 | 48,3 | 8 | 13,3 | 10 | 16,7 |
| Do you use simulation environments in teaching practice? | 34 | 56,6 | 15 | 25,0 | 10 | 16,7 | 1 | 1,7 | 0 | 0,0 |
| Do you take advantage of online training as a form of professional development? | 3 | 5,0 | 16 | 26,7 | 30 | 50,0 | 9 | 15,0 | 2 | 3,3 |
| Do you use digital tools to facilitate interaction and communication with students? | 2 | 3,3 | 18 | 30,0 | 24 | 40,0 | 10 | 16,7 | 6 | 10,0 |
| Do you use | 24 | 40,0 | 18 | 30,0 | 5 | 8,3 | 10 | 16,7 | 3 | 5,0 |

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| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| academic social networks for educational purposes? | | | | | | | | | | |
| Do you use the institutional virtual classroom in teaching practice? | 5 | 8,3 | 33 | 55,0 | 16 | 16,7 | 4 | 6,7 | 2 | 3,3 |
| Do you integrate ICT into the design of evaluative activities? | 4 | 6,7 | 16 | 26,7 | 22 | 36,6 | 12 | 20,0 | 6 | 10,0 |
| Do you have sufficient institutional resources to implement ICT in teaching? | 6 | 10,0 | 35 | 58,3 | 7 | 11,7 | 3 | 5,0 | 9 | 15,0 |
| Do you apply Artificial Intelligence for educational purposes? | 3 | 5,0 | 34 | 56,7 | 15 | 25,0 | 6 | 10,0 | 2 | 3,3 |

Source: questionnaire. n=60

Table 4 illustrates the correlation between knowledge and use of ICT in teaching: while 18.3 % possessed a high level and 70.0 % reported having a medium knowledge of these technologies; the majority (80.0 %) made low use of these resources, and none demonstrated a high level of technology use.

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**Table 4.** Correlation between knowledge and use of ICT in teaching. Municipal Health Site in Fomento municipality, Sancti Spíritus. January-March 2025

| Dimensions | Categories | | | | | |
|---|---|---|---|---|---|---|
| | Low | | Medium | | High | |
| | No. | % | No. | % | No. | % |
| Knowledge | 7 | 11,7 | 42 | 70,0 | 11 | 18,3 |
| Uses | 48 | 80,0 | 12 | 20,0 | 0 | 0,0 |

Source: questionnaire. n=60

The results of this study also brought to light the correlation between limitations in knowledge and use of ICT and the variables of age and teaching categories (50-64 years: 15 assistant professors and 6 associate professors; and 65 and over: 3 assistant professors and 2 associate professors). Despite the majority holding higher teaching categories, only 20% of the total sample utilizes the advantages of ICT at a medium level. Leyva Sánchez *et al*.[7] at the Holguín Faculty of Medical Sciences report similarities with the current study regarding faculty characteristics. In the authors' opinion, the variables analyzed could lead to positive values if teaching experience and the high professional level held by the faculty are taken into account.

The findings reveal a significant difference between teachers' theoretical mastery of ICT and their application of it in teaching practice. This dissociation between knowledge and practical skills is not exclusive to the Cuban university context; Acevedo *et al*.[8] in Argentina, discussing the challenges of using emerging technologies in higher medical education, point out similar patterns, where teachers possess elementary notions about educational technology but forego its practical application, which perpetuates a gap between theory and praxis.

The authors of this study maintain that the results may correspond with the identified generational gap, where older teachers show greater resistance to using ICT, often linked to pedagogical preferences or a lack of interest. This is reflected in global trends but acquires particular nuances in Cuba.

Despite a broad majority knowing basic concepts like ICT or AI, difficulties persist in essential competencies for contemporary medical practice, such as the use of telemedicine platforms. In this regard, Zamor Castro *et al*.[9] state that today's knowledge society demands a teaching staff capable of working with ICT, making it necessary to develop informational competencies and create a "digital awareness" to promote the proper use of these tools and their integration into teaching practice.

Another concerning aspect is the widespread lack of knowledge about digital ethics, particularly regarding personal data protection. This gap limits the safe use of tools like electronic health records and could expose professionals to legal risks and violations of medical ethics. On this topic, González Arencibia *et al*.[10] emphasize that privacy, equity, and ethical decision-making are critical aspects that must be studied to guarantee the quality of medical care in the digital era. They also insist on the need to contribute to the training of health professionals equipped with ethical tools that allow them to face the common challenges and dilemmas of daily practice.

Furthermore, teachers' knowledge about tools for managing online learning and useful digital resources for searching biomedical literature stood out. This contrasts with the findings of Zelada Pérez *et al*.[11] in a study on informational competencies among teachers at the University of Medical Sciences of Havana, where the majority knew and made use of online educational platforms and integrated scientific literature searches into their daily work as educators and researchers. In contrast, Almanza Santana *et al*.,[1] when evaluating this dimension among faculty at the University of Medical Sciences of Matanzas, found a predominance of a low level. These data uncover a significant challenge for medical education in Cuba.

The authors suggest implementing ongoing training programs that strengthen teachers' digital competencies. Likewise, it is crucial to integrate ICT into educational programs by promoting them as pedagogical tools and as means for medical assistance, research, and knowledge management.

In another order, when determining the use teachers made of ICT in teaching practice, it was found to be low; only a small minority was considered medium, and in no cases high. Firstly, this was reflected in the use of digital educational resources in classes. The same occurred in a study conducted by Gamayo *et al*.[12] at the University of Medical Sciences of Holguín, which noted insufficient use of technological teaching aids, as the majority used traditional resources in activities and assigned reproductive tasks without a communicative approach, wasting all that technology could contribute to the teaching-learning process.

Ferrer Díaz *et al*.[13] argue that these aids provide students with the necessary information to achieve the objectives set for the class, enhance interest and motivation, and develop teacher-student interaction.

Analyzing this dilemma from another perspective, the authors of this study declare resistance to change by some teachers as a relevant factor. These teachers perceive digital technologies as recreational tools rather than effective pedagogical resources. This underscores the need to strengthen educational policies and develop strategies that promote digital literacy in educational environments, sensitizing teachers to the benefits of using these resources in learning. This would allow the process to be optimized and current limitations to be reduced.

The development of medical sciences in the contemporary world, and particularly in Cuba, demands continuous training for health professionals, in which online training plays a primary role as a form of professional development. This modality allows teachers to access updated materials regardless of geographical location, fostering autonomy and flexibility, and similarly allows training to be adapted according to schedules and specific needs.[14] García Villarroel *et al*.[15] question whether teachers are adequately prepared to take on this challenge. This creates a contradiction between the rapid development of ICT and the updating of pedagogy in distance education.

The study also found a complete lack of use of simulation environments as educational tools. This may be due to multiple factors. Primarily, their absence is due to their high cost, which

makes acquisition difficult in the Cuban context, particularly in a municipality. Furthermore, a lack of training in this technology limits its use.

Similar results are evidenced in a study by Romero López *et al*.[16] on a didactic proposal for using virtual simulators in the healthcare field, where they found scarce use of this modality. They also maintain that teachers advocate for traditional methodology based on lectures, where integrating these tools is a complex and challenging task.

Finally, the insufficient use of the institutional virtual classroom was noteworthy. On this matter, Díaz Rosa *et al*.[17] affirm that this situation is aggravated by limitations in equipment and connectivity, which hinders access to these platforms. They also argue that teachers show resistance to change, not only due to a lack of skills but also the need to adapt mindset and teaching methodologies to a digital environment. This finding demands comprehensive solutions that combine training and technological investment.

The present research, despite demonstrating methodological reliability, had limitations such as the cross-sectional design, possible self-perception bias in the studied sample, and its conduct in a particular municipality, which could restrict the generalization of the results to other settings.

This study evidence, from a contextualized perspective, the level of use and appropriation of ICT by teachers at the Municipal Health Site in Fomento, which allows for the identification of strengths and limitations in their integration into the teaching process. Its results offer empirical and theoretical bases to guide professional development actions and institutional strategies that foster more innovative, interactive teaching that is adjusted to the current demands of higher medical education.

Scientific contribution

The present research enabled an assessment of the use made of ICT by the faculty of the Municipal Health Site in Fomento Municipality and consequently guides professional development actions and institutional strategies in accordance with the insufficiencies found, to achieve teaching adjusted to the current demands of higher medical education.

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# CONCLUSIONS

In the context of medical education at the Municipal Health Site in Fomento, it was determined that the theoretical mastery of ICT contrasts with critical practical gaps. Despite the professionalization of the faculty and basic knowledge on these topics, the low utilization of these digital tools undermines the quality of the teaching-learning process, which demands an urgent resolution to this problem.

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## Declaration of interests

The authors declare no conflict of interest.

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