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ORIGINAL ARTICLE

Impact of an interactive virtual course on the development of diagnostic skills among medical students in Cuba

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Keywords:
diagnosis; aptitude; medical education; information technology; skills assessment; educational assessment (source: MeSH-NLM).

ABSTRACT

Objective. To evaluate the impact of an interactive virtual course on the development of diagnostic skills in medical students. **Methods.** A prospective, quasi-experimental cohort study was conducted, comprising a control group and an experimental group and involving a total of 160 third-year medical students from the Universidad de Ciencias Médicas de Sancti Spíritus, Cuba. The study employed the interactive virtual course *MedInter* with automated tracking, a survey assessing digital skills, and a diagnostic skills test. **Results.** Both groups reported similar home internet access and high English proficiency. The experimental group improved diagnostic accuracy from 58.4 % to 82.3 %, outperforming the control group. The average time to solve clinical cases decreased from 14.2 to 9.1 minutes in the experimental group. Use of the virtual course was the strongest predictor of diagnostic improvement ($\beta = 0.67$; $p < 0.001$), followed by English proficiency ($\beta = 0.18$; $p = 0.006$). **Conclusion:** The *MedInter* virtual course had a significant positive impact on students' diagnostic skills, enhancing accuracy, efficiency, and performance in complex cases within a technologically limited context.

Impacto de un curso virtual interactivo en el desarrollo de las habilidades diagnósticas en estudiantes de Medicina, Cuba

Palabras clave:
diagnóstico; aptitud; educación médica; tecnologías de la información; evaluación de habilidades; evaluación educacional (fuente: DeCs-BIREME).

RESUMEN

Objetivo. Evaluar el impacto de un curso virtual interactivo en el desarrollo de las habilidades diagnósticas en estudiantes de Medicina. **Métodos.** Estudio cuasiexperimental de cohorte prospectivo, que incorporó un grupo control y un grupo experimental de 160 estudiantes de tercer año de Medicina de la Universidad de Ciencias Médicas de Sancti Spíritus en Cuba. Se empleó un curso virtual interactivo MedInter con registro automatizado, una encuesta enfocada en habilidades digitales y la prueba de las habilidades diagnósticas. **Resultados.** Ambos grupos presentaron similar acceso a Internet en el hogar y alto dominio del inglés. El grupo experimental incrementó la precisión diagnóstica de 58,4 % a 82,3 %, con resultados mayores en el grupo control. El tiempo promedio para resolver casos clínicos se redujo de 14,2 a 9,1 minutos en el grupo experimental. El uso del curso virtual emergió como el predictor más sólido de mejora diagnóstica ($\beta = 0{,}67$; $p < 0{,}001$), seguido del dominio del inglés ($\beta = 0{,}18$; $p = 0{,}006$). **Conclusiones.** El curso virtual MedInter mostró un impacto positivo significativo en las habilidades diagnósticas de los estudiantes, con la mejora de la precisión, eficiencia y resolución en casos complejos en un contexto con limitaciones tecnológicas.

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INTRODUCTION

The development of clinical skills throughout the medical curriculum is essential to ensure that future professionals acquire the competencies needed to face the challenges of contemporary medical practice [(1)]. Among these skills, clinical diagnosis, understood as the ability to integrate clinical data, complementary tests, and critical reasoning to identify diseases, is fundamental, as it is directly linked to the quality of care and patient safety [(1,2)].

In the current context, marked by rapid advances in information and communication technologies (ICTs), medical education has undergone significant transformations [(3)]. These digital tools complement traditional methods by allowing students to engage with diverse clinical scenarios and receive immediate feedback, which has been shown to enhance diagnostic accuracy. They also overcome geographical and temporal barriers, facilitating access to educational resources that promote the development of clinical skills aligned with the needs of the twenty-first century [(3,4)].

Various institutions and organizations worldwide advocate for the integration of virtual platforms, augmented-reality simulators, artificial intelligence (AI), and interactive problem-based learning systems [(5)]. These tools not only improve knowledge retention but also foster critical thinking, optimize decision-making under pressure, and strengthen the ability to interpret complex results, all essential components for accurate diagnosis [(5,6)].

Internationally, a 2020 study conducted in Ecuador by Cherrez et al. [(7)] reported that more than 90% of physicians used ICTs to address urgent challenges, such as health training, although critical gaps in effective implementation persist. Another study from Mexico by Ordóñez et al. [(8)] found that 38.3 % of faculty members reported lacking adequate training, despite the fact that 70.4 % used some form of ICT in their classes and 50.6% requested preparation in virtual classroom design. Similarly, in 2023, Marrero et al. [(9)] at the Universidad de Ciencias Médicas de Villa Clara, Cuba, described that only about half of instructors in resource-limited settings possess the necessary competencies to employ ICTs for pedagogical purposes, deepening the gap between student expectations and the available educational offerings [(9,10)].

However, the implementation of these technologies varies considerably. In countries with limited resources, digital exclusion, weak infrastructure, and insufficient teacher training hinder their adoption [(6)]. In the national context, Cuba stands out as a particular case: despite having a structured health system and free specialized medical education, the country faces constraints in technological resources, unequal Internet access, and a pressing need to update teaching methods [(11)]. In this setting, ICTs emerge as strategic allies to enhance the development of diagnostic skills through interactive simulations, updated databases, and virtual environments that recreate complex clinical scenarios [(11,12)].

In the local context of the Universidad de Ciencias Médicas de Sancti Spíritus (Cuba), medical students face challenges related to limited access to patients in hospital settings and the lack of immediate feedback [(9,10)]. The insufficient integration of ICTs in simulation and the reinforcement of clinical diagnosis further exacerbates this problem. Although traditional methodologies remain the foundation of instruction, they are insufficient to fully address these shortcomings [(12-14)].

Therefore, it is essential to systematically explore how ICTs can improve students' diagnostic abilities. Despite isolated initiatives, such as the project of the Universidad Virtual de la Salud (Cuba), their impact on diagnostic training remains limited, especially after the COVID-19 pandemic, which underscored the need to strengthen distance medical education [(14,15)]. This approach also seeks to modernize health training while upholding the principles of equity and universality that characterize the Cuban system. Technological innovation must go hand in hand with ethical and humanistic commitments, preparing physicians capable of confronting future diagnostic challenges without abandoning the values that guide medical practice in Cuba.

For these reasons, this study aimed to assess the impact of an intervention based on information and communication technologies on the development of diagnostic skills among medical students at the Universidad de Ciencias Médicas de Sancti Spíritus, Cuba.

METHODS

Study type and area

This was a prospective cohort quasi-experimental study that included a control group (CG) and an experimental group (EG). It was conducted at the Universidad de Ciencias Médicas de Sancti Spíritus, Cuba, between November 2024 and April 2025.

Population and sample

The study population consisted of 320 third-year medical students (academic year 2024-2025). The sample was determined to include 160 students, distributed into two groups (80 in the experimental group and 80 in the control group). Sample selection was based on statistical criteria ensuring 80.0% study power, a 95.0 % confidence level, and an expected effect size of 20.0 %, following calculations performed with G*Power 3.1.

Regarding inclusion criteria, only students enrolled in clinical subjects (Propaedeutics, Semiology, and Internal Medicine) who had signed the informed consent form were considered. As for exclusion criteria, students with previous training in advanced use of ICTs applied to the medical field were excluded to avoid bias stemming from differing technological experience. To identify such cases, a preliminary diagnostic questionnaire was administered, based on the descriptors of the digital competence framework for health professionals established through a multidisciplinary international consensus in 2023 [16]. This instrument made it possible to detect students who had prior training experiences with digital clinical simulators, complex virtual learning platforms, or AI applied to medical education. Those who reported advanced levels in two or more dimensions of the questionnaire were excluded.

Variables and data collection instruments

The independent variable was the "use of the MedInter virtual course." An automated tracking system recorded objective indicators such as frequency of access (sessions per week), time spent per session (in minutes), and resources used (completed clinical cases, videos/tutorials viewed). The variable was operationalized through a binary metric: "0" if the participant used less than 80.0 % of the course content, and "1" if they used 80.0% or more. The validity and reliability of this instrument were certified through a pilot test with 20 students, which yielded a Kappa coefficient of 0.92, indicating excellent consistency in data collection.

The dependent variable was "development of diagnostic skills," which was measured across the following dimensions:

Diagnostic accuracy

Diagnostic accuracy was assessed using the Diagnostic Skills Test (PHD-2025, by its Spanish acronym), developed and validated by a panel of five specialists from the Cuban Society of Internal Medicine, following guidelines similar to those of the Script Concordance Test (SCT) [17]. The test comprises ten standardized clinical cases, distributed into five of common difficulty and five of higher complexity, with a scoring rubric that assigns 10 points per case for a total possible score ranging from 0 to 100. Validity was supported by high inter-rater agreement, with a Fleiss' Kappa coefficient of 0.85, and strong internal consistency, with a Cronbach's alpha of 0.89.

Average time required per case

The time taken to resolve each case was automatically recorded using a built-in timer in the PHD-2025 test. The timer activates at the start of each case and stops when the answer is submitted, ensuring precise measurement in minutes with an accuracy of ± 0.5 seconds. Reliability was established through a test–retest procedure, which produced an intraclass correlation coefficient (ICC) of 0.96 in the pilot test, confirming the stability and precision of the measurement.

Self-perceived confidence level

To assess participants' perceived security and confidence, a diagnostic self-efficacy scale was used, adapted from the instrument proposed by Weurlander et al. [18], previously validated in clinical settings. This scale consisted of five items written as affirmative statements, such as "I feel capable of adequately interpreting a chest X-ray" or "I trust my ability to establish accurate diagnoses based on the available clinical and imaging information."

Each item was rated on a 5-point Likert scale, where 1 represented "strongly disagree" and 5 "strongly agree," yielding a total score ranging from 5 to 25 points. Higher scores were interpreted as reflecting greater levels of self-perceived diagnostic self-efficacy. For analytical purposes, the results were categorized into three levels: low (5-13 points), moderate (14-19 points), and high (20-25 points).

The reliability of this scale was confirmed through an internal consistency analysis, achieving a Cronbach's alpha of 0.87, which indicates high reliability for measuring subjective perception constructs in clinical-educational contexts.

Scientific search skills

The ability to locate and apply scientific information in real-world conditions was assessed through an informational competence test (PCI-10), developed by Li et al. [19]. The test consisted of five practical tasks, such as identifying relevant articles in PubMed, graded on a 0–10 scale, assigning two points for each correct task. Validity was demonstrated through a convergent-correlation analysis using evidence-based medicine (EBM) scoring rubrics, yielding $r = 0.78$ ($p < 0.001$).

Control variables

Internet access

Home Internet availability was recorded using a technological resources questionnaire designed by experts, including two computer science professors and a master's-level specialist in information management. The dichotomous question *"Do you have Internet access at your residence? (Yes/No)"* allowed for categorization and analysis of potential biases related to access to digital resources.

English language proficiency

English proficiency was assessed with a rapid medical English test developed by three language professors, two of whom hold doctoral degrees in pedagogical sciences. This test consisted of 20 multiple-choice questions evaluating B1/B2-level comprehension. Scores were recorded on a continuous 0-100 scale and used to classify participants into three levels: low (< 50), medium (50-80), and high (> 80). Validity was established through correlation with the TOEFL examination, yielding $r = 0.85$ ($p < 0.001$).

Availability and type of technological devices

To determine access to and variety of devices, a technological availability inventory was administered through a checklist including categories such as: mobile phone only, tablet plus mobile phone, laptop computer, or desktop computer. This variable was analyzed in categorical form due to the differing technological access profiles.

Measurement instruments and validation

a) Diagnostic Skills Test (PHD-2025): This test consisted of ten standardized clinical cases validated by expert criteria and guided by the principles of the Script Concordance Test (SCT) [17]. The evaluation of the cases was performed by three independent physicians, achieving a Fleiss' Kappa coefficient of 0.85, ensuring high scoring consistency.

b) DigCompMed Survey: This instrument included 20 items focused on digital skills, reaching a Cronbach's alpha of 0.91, which demonstrates excellent reliability.

c) Automated Tracking System of the MedInter Virtual Course: Data were collected on time spent, number of correct and incorrect responses, and use of the various resources available in the course.

Data collection techniques and procedures

Students in the experimental group used the MedInter virtual course, which incorporated an interactive module consisting of 30 simulated clinical cases (15 common and 15 complex). This module was developed in collaboration with the Virtual Health Classroom at the Universidad de Ciencias Médicas de Sancti Spíritus and included:

a) An AI-based simulator grounded in clinical rules and supervised learning, which dynamically adjusted case difficulty, outlined diagnostic reasoning, and recorded error patterns to provide immediate personalized feedback.

b) A database with access to medical articles in English and Spanish, accompanied by interactive summaries. This database included materials selected from publicly available open-access sources, as well as articles obtained through institutional agreements managed by the Universidad de Ciencias Médicas de Sancti Spíritus. Content management was carried out by a team of instructors from the Virtual Health Classroom.

c) Tutorial videos focused on the interpretation of diagnostic tests, such as chest X-rays and electrocardiograms (ECGs).

The MedInter virtual course was structured into four self-instructional modules, accessible asynchronously through the University's Moodle platform. Each module included:

1. Recorded classes and multimedia materials:

a) Five video lessons (15-20 minutes each) taught by specialists in internal medicine and diagnostic imaging.

b) Supporting PDF documents with diagrams, imaging interpretation guides (X-ray, ultrasound, CT), and key bibliographic references.

2. Interactive clinical case simulations:

a) Ten clinical cases per module (40 total), with progressively increasing levels of difficulty.

b) Automatic feedback after each response, explaining the diagnostic reasoning and citing updated evidence.

The simulator employed a rule-based engine combined with supervised machine learning to generate personalized feedback. Its main features included:

a) User-adaptive capability: the system dynamically adjusted the complexity of cues and hints based on students' previous responses, promoting an individualized learning process.

b) Step-by-step detailed explanations: the simulator broke down diagnostic reasoning at each stage, facilitating comprehension and deep learning of clinical procedures.

c) Generation of case variants: starting from a base case, multiple scenarios with different data were created, helping to avoid mechanical memorization and promoting transferable knowledge.

d) Analysis of common errors: the system identified recurrent patterns of mistakes and offered specific instructional recommendations, contributing to targeted improvement of clinical competencies.

e) Recording of interaction history: it logged each student's responses and times during sessions, enabling instructors to monitor learning trajectories and adjust pedagogical strategies accordingly.

3. Formative and summative assessments:

a) Self-assessment quizzes: five multiple-choice questionnaires (10 items each) at the end of each module, with immediate feedback.

b) Pre- and post-tests: ten standardized clinical cases identical in structure to the PHD-2025 test, automatically timed.

4. Usage metrics and tracking tools:

a) Automated logs of platform access, navigation time per module, number of completed cases, and content reviews.

b) A teacher dashboard with individual and group progress charts, facilitating the identification of difficulty areas.

The course was conceived as an interactive platform aimed at fostering active learning and strengthening clinical reasoning based on contemporary evidence in medical education. To achieve this, the following resources were incorporated:

a) Immediate feedback for each simulation: allowing students to correct errors instantly and consolidate diagnostic concepts in real time.

b) Flexible navigation pathways: enabling users to freely select cases or study materials according to their level of mastery, promoting metacognitive reflection on their own learning process.

c) Moderate gamification elements: such as digital badges for completed modules and anonymous leaderboards, designed to stimulate intrinsic motivation and encourage deliberate practice.

d) Integrated discussion forums: which facilitated collaborative exchange of diagnostic approaches and critical analysis of clinical cases, strengthening social learning and collective knowledge-building.

This interactive structure, complemented by a self-instructional design, allowed students to progress at their own pace, rewatch recorded lessons as often as needed, and repeat simulations to reinforce concepts. This combination of flexibility, immediate feedback, and multimodal resources enhanced motivation and supported the transfer of diagnostic skills to real clinical settings.

The intervention was conducted over 12 weeks, with three weekly sessions lasting 45 minutes each. Participants in the control group continued learning through traditional methods, including lectures and case discussions using printed materials, without the support of the digital platform.

Data analysis

For descriptive analysis, quantitative variables were summarized using measures of central tendency (means and medians) and dispersion (standard deviations and interquartile ranges). Qualitative variables were expressed as frequencies and percentages. Regarding inferential analysis, to assess the effects of the intervention and the relationships between variables, different statistical tests were applied as appropriate. Student's *t*-test for paired samples was used to compare the mean values of dependent variables between pretest and posttest measurements within the same group. Before applying this test, homoscedasticity was verified using Levene's test to ensure equality of variances between groups.

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To evaluate differences in the progression of dependent variables (diagnostic accuracy, average time per case, and self-perceived confidence level) between pretest and posttest in both groups, a 2×2 repeated-measures ANOVA (group × time) was conducted. Sphericity was checked with Mauchly's test, and in cases of violation, Greenhouse–Geisser corrections were applied.

Repeated-measures ANOVA was also used to analyze temporal variation in scientific search skills and other performance indicators within the MedInter platform.

Linear mixed models (LMMs) were additionally employed, implemented through the "lme4" package in R Studio 4.3.1, to analyze the longitudinal effect of the course on diagnostic performance outcomes, considering both fixed effects (pretest–posttest condition) and random effects (individual variability between students). This technique allowed for appropriate modeling of the hierarchical structure of the data (measurements nested within subjects) and for controlling potential confounding effects stemming from participant heterogeneity.

All statistical analyses were conducted using SPSS version 28 and R Studio 4.3.1, with a significance level of $\alpha = 0.05$. This methodological approach made it possible to combine comprehensive analyses to ensure the validity, reliability, and relevance of the results, thereby enabling precise and well-grounded interpretations regarding the effects of the MedInter course on the variables studied.

Ethical considerations

The study adhered to the ethical principles of the Declaration of Helsinki [20] and received approval from the Research Ethics Committee of the Universidad de Ciencias Médicas de Sancti Spíritus (Record No. CEI-UCMSS-2024-087). All participants signed an informed consent form after receiving a detailed explanation of the study's objectives, procedures, potential risks, and benefits. Confidentiality of the data and the right to withdraw from the study at any stage were guaranteed.

RESULTS

The initial comparison between the experimental group (EG) and the control group (CG) revealed homogeneity in key variables, ensuring the validity of the intervention. Both groups showed similar rates of home Internet access (68.0 % vs. 65.0 %) and high English proficiency (28.7 % vs. 26.2 %), with no statistically significant differences ($p > 0.050$) (see Table 1).

The ANOVA test revealed a significant interaction for diagnostic accuracy, $p < 0.001$, indicating that the pretest–posttest improvement was greater in the experimental group than in the control group. Likewise, the time per case showed a significant interaction, $p < 0.001$, confirming that the reduction in resolution time was significantly greater in the experimental group. For self-perceived confidence, a notable group-by-time interaction was also observed, $p = 0.001$. In all analyses, sphericity was assessed using Mauchly's test; when violated, the Greenhouse–Geisser correction was applied (see Table 2).

The MedInter virtual course demonstrated greater effectiveness for complex clinical cases than for common cases. While accuracy for common cases increased from 65.0 % to 88.0 %, accuracy for complex cases improved from 42.0 % to 76.0 %—an 81.0 % relative increase in effectiveness (see Figure 1).

Table 1. Baseline characteristics of the sample

Variable	n = 80		n = 80		p-value*
	Experimental group		Control group		
	fi	%	fi	%	
Home Internet access	54	68.0	52	65.0	0.072
High English proficiency	23	28.7	21	26.2	0.069
Previous use of simulators	10	12.5	8	10.0	0.062

* Pearson's chi-square test for independent samples.

Table 2. Impact of the intervention on diagnostic skills

Variable	Experimental group		Control group		Adjusted difference (95 % CI)	*p*-value
	Pre	Post	Pre	Post		
Diagnostic accuracy (%)	58.4 ± 12.1	82.3 ± 9.7*	59.1 ± 11.8	63.2 ± 10.5	+19.8 (16.2-23.4)	< 0.001
Time per case (min)	14.2 ± 3.5	9.1 ± 2.1*	13.9 ± 3.1	13.5 ± 2.9	-4.3 (-5.1-3.5)	< 0.001
Self-perceived confidence	2.8 ± 0.9	4.1 ± 0.7*	2.7 ± 0.8	3.0 ± 0.6	+1.2 (0.9-1.5)	< 0.001

* Significant within-group change ($p < 0.050$) using paired t-test.

Multiple linear regression analysis identified the MedInter virtual course as the strongest predictor of diagnostic improvement (β = 0.67; 95% CI = 0.59-0.75; $p < 0.001$), followed by English proficiency (β = 0.18; 95% CI = 0.05-0.31; $p = 0.006$). Additionally, home Internet access did not show a significant association (β = 0.09; 95 % CI = -0.03-0.21; $p = 0.140$), suggesting that in resource-limited environments, the quality of the educational tool can compensate for connectivity barriers (see Table 3).

The linear mixed model showed a significant effect of the intervention on improvement in diagnostic performance (β = 3.21; 95 % CI = 2.14-4.28; $p < 0.001$), after controlling for inter-individual variability and the clinical subject enrolled. No significant random effects were observed for sex or prior diagnostic competence ($p > 0.050$). The inclusion of random terms improved model fit (ΔAIC = -11.4) (see Table 4).

DISCUSSION

The findings of this study reveal that the MedInter virtual course not only improved students' diagnostic accuracy but also reduced the time required to solve clinical cases—an advance of particular relevance in a context where access to complex patients is limited. These results align with previous research highlighting the value of ICTs as transformative pedagogical tools.

For example, Reyes [21], Gutiérrez et al. [22] and Sainz et al. [23] demonstrated that ICTs enhance the ability to integrate clinical data in hospital settings, while Ayala et al. [24], Ferrer [25], Reyes [21], and Vega et al. [26] emphasized how automated feedback accelerates learning through timely error correction. Consistent with these studies, the data obtained reinforce the idea that even in technologically constrained environments, innovative interventions can be

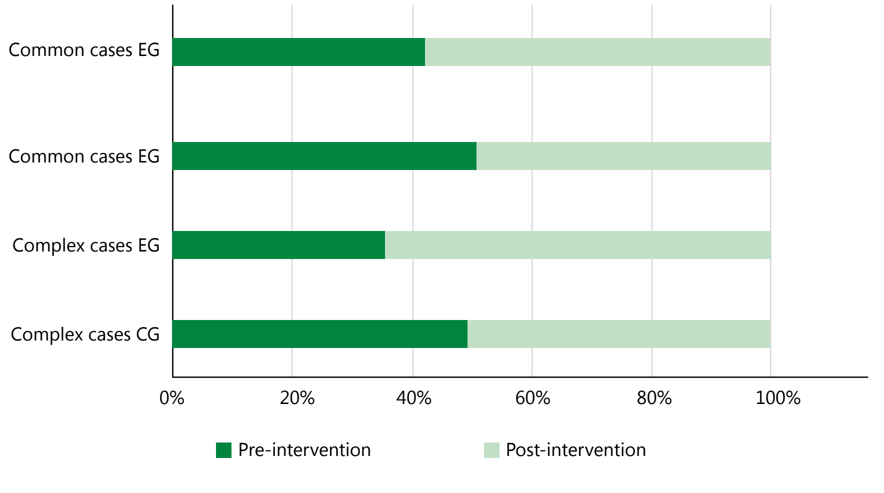

Figure 1. Improvement in diagnostic accuracy by case type among medical students at the Universidad de Ciencias Médicas de Sancti Spíritus, Cuba.

Table 3. Predictors of diagnostic success using multiple linear regression

Variable	Coefficient (β)	95 % CI	*p*-value
Use of the MedInter virtual course	0.67	0.59-0.75	< 0.001
English proficiency	0.18	0.05-0.31	0.006
Home Internet access	0.09	-0.03-0.21	0.140

Table 4. Results of the linear mixed model on the effect of the educational intervention on diagnostic performance

Effect	Coefficient (β)	95% CI	*p*-value
Intervention (pretest vs. posttest)	3.21	2.14 - 4.28	< 0.001
Sex (random effect)	—	—	> 0.050
Prior diagnostic competence	—	—	> 0.050
Clinical subject (fixed effect)	Controlled	—	—
Model fit improvement with random terms	ΔAIC = -11.4	—	—

designed to compensate for structural limitations without compromising educational quality.

When comparing these results with studies conducted in higher-resource settings, noteworthy nuances emerge. While authors such as Zamora et al. [27], Mendoza [28], and Rojas et al. [29] associate the success of ICT-based interventions with state-of-the-art equipment or high-speed connectivity, this study demonstrates that low-cost tools, such as simulators built on open-source software, can achieve similar effects when adapted to local realities. However, this observation does not diminish the challenges identified.

Unlike English-speaking environments, where language proficiency does not represent a major barrier, in Cuba linguistic ability proved to be a key moderating factor. This reflects a persistent gap in access to up-to-date scientific literature. This finding underscores the need for educational policies that, without neglecting traditional clinical training, promote multilingualism as an integral component of digital literacy.

Despite these contributions, it is important to acknowledge the inherent limitations of the study design. The selection of a sample restricted to a single university, although representative of the local student population, limits the generalizability of the findings to other regions with different sociotechnological dynamics. Likewise, the twelve-week intervention period, while sufficient to measure short-term changes, does not allow for the assessment of long-term retention of acquired skills, a critical aspect for determining the sustainability of this type of educational tool.

Even so, these limitations do not overshadow the strengths identified. The MedInter virtual course proved to be a scalable model capable of operating with basic technological infrastructure, making it a viable alternative for institutions with limited resources. Moreover, unlike previous initiatives in Cuba that focused solely on equipment availability, this study proposes a structured pedagogical framework that integrates ICTs into the clinical curriculum, supported by both quantitative and qualitative evidence. This perspective, aligned with the principles of equity and universality of the Cuban health system, suggests that technological innovation should not be viewed as a luxury but as a bridge toward a more inclusive and adaptive medical education.

From this standpoint, the results extend beyond the academic sphere and enter the realm of social justice. In a world where the digital divide deepens inequalities, demonstrating that simple tools can empower students in adverse contexts not only validates institutional efforts but also honors the legacy of a human-centered medical education.

It is recommended that the study be expanded to other educational centers over a longer intervention period, allowing assessment of long-term retention of acquired skills and the implementation of a final course project in which students design diagnostic solutions for current health needs. Furthermore, from a curricular perspective, it is advisable to incorporate didactic strategies for diagnosing complex diseases, such as simulations and problem-based learning.

Conclusions

The implementation of the MedInter virtual course demonstrated a significant impact on diagnostic skills, with a 23.9 % increase in diagnostic accuracy ($p < 0.001$), a 5.1-minute reduction in case-resolution time ($p < 0.001$), and greater efficiency in complex cases, with a relative increase of 81%. In the Cuban context, characterized by technological limitations, these findings confirm that interactive ICTs enhance students' clinical performance.

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MAAG: data curation, formal analysis, funding acquisition, investigation, methodology, resources, supervision, validation, visualization, writing – original draft, writing – review and editing.

JAGC: formal analysis, investigation, methodology, resources, validation, visualization, writing – original draft, writing – review and editing.

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The authors declare no conflicts of interest.