Chapter 10 / Capítulo 10

Emerging pedagogies: AI, territory, and situated knowledges (English Version)
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Teaching the subject of emerging and reemerging diseases based on integrative teaching tasks assisted by artificial intelligence

Enseñanza de la asignatura enfermedades emergentes y reemergentes basada en tareas docentes integradoras asistidas por inteligencia artificial

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ABSTRACT

Introduction: emerging and reemerging diseases are a growing threat to global health. Clinical bioanalysis graduates are a fundamental pillar of health services, which is why their ongoing and contextualized training is essential.
Objective: to evaluate the implementation of a pedagogical intervention based on integrative teaching tasks (ITT) assisted by Artificial Intelligence (AI) in the subject of Emerging and Reemerging Diseases.
Method: an educational intervention was carried out at the Medical Sciences Branch in Holguín, Cuba. With a sample of 22 fourth-year students in the Bachelor's Degree in Clinical Bioanalysis. Three integrative teaching tasks assisted by Artificial Intelligence were applied in the subject Emerging and Reemerging Diseases. The study was divided into two stages: Diagnosis - a questionnaire (N=22) and focus groups were applied.
Results: in the performance of students according to the evaluation criteria of the ITAs, "Concept Integration" showed the most marked evolution with 4,5 points. The data obtained indicate that more than 80 % of the students "agreed" with the perception of the development of competencies through the ITA methodology with AI. One of the greatest advantages was efficiency in research, and the deficiency was determined by information overload.
Conclusions: the application of integrative teaching tasks assisted by Artificial Intelligence constitutes a significant challenge for teaching in the bioanalyst degree program, although with limited and controlled management facilitated by the teacher.

Keywords: Emerging Diseases; Professional Skills; Educational Innovation; Integrative Tasks; Artificial Intelligence; Educational Technology.

RESUMEN

Introducción: las enfermedades emergentes y reemergentes son una amenaza creciente para la salud global. El licenciado en Bioanálisis Clínico constituye un pilar fundamental de los servicios de salud por lo que se hace esencial su preparación constante y contextualizada. **Objetivo:** evaluar la implementación una intervención pedagógica basada en tareas docentes integradoras (TDI) asistidas por Inteligencia Artificial (IA) en la asignatura de Enfermedades Emergentes y Reemergentes.
Método: se realizó una intervención educativa, en la Filial de Ciencias médicas de Holguín,

Cuba. Con una muestra de 22 estudiantes de 4to año de la Licenciatura en Bioanálisis Clínico. Fueron aplicadas tres tareas docentes integradoras asistidas por Inteligencia Artificial, en la asignatura enfermedades emergentes y reemergentes. El estudio se dividió en dos etapas: Diagnóstico -se aplicó cuestionario (N=22) y grupos focales.
Resultados: en el desempeño de los estudiantes según los criterios de evaluación de las TDI. La "Integración de Conceptos" fue el que mostró la evolución más marcada con 4,5 puntos. Los datos obtenidos indican que más del 80 % de los estudiantes estuvo "De Acuerdo" en cuanto a la percepción sobre el desarrollo de competencias mediante la metodología de TDI con IA. Una de las mayores ventajas fue la eficiencia en la investigación y la deficiencia estuvo determinada por la sobrecarga de información.
Conclusiones: la aplicación de las tareas docentes integradoras asistidas por Inteligencia Artificial, constituye un desafío significativo para la docencia en la carrera del bioanalista, aunque con un manejo limitado y controlado facilitado por el docente.

Palabras clave: Enfermedades Emergentes; Competencias Profesionales; Innovación Educativa; Tareas Integradoras; Inteligencia Artificial; Tecnología Educativa .

INTRODUCTION

Emerging and re-emerging diseases pose a growing threat to global health (Orozco, 2024). Population growth, migration, changes in land and water use, wildlife trade, intensive farming, climate change, pollution, and the effects of environmental degradation have increased the risk of future pandemics (Liao et al., 2024; Morales, 2024). Urbanization and globalization, in turn, have exacerbated the scope of outbreaks, facilitating the spread of infectious diseases through trade networks. The global COVID-19 pandemic, the 2014 Ebola epidemic in West and Central Africa, antimicrobial resistance, and the spread of arboviruses highlight the vulnerability of health systems in responding to these global problems (Orozco, 2024; Murillo et al., 2025; Ha, 2024; Cesaro et al., 2025; Sanmartin & Calva, 2025).

In a world marked by wars, climate change, and pandemics, the Clinical Bioanalyst is a fundamental pillar of health services in the face of emerging and re-emerging diseases. Constant and context-specific training for our professionals is essential, responding to society's demands and aligning with goal number four of the 2030 Agenda for Sustainable Development (Herrera Zamora et al., 2021).

Currently, artificial intelligence is becoming a powerful technology to address major societal challenges and to generate new ones. In the field of education, its impact can be approached from a dual perspective. On one hand, it is essential to examine how artificial intelligence is currently being used in education, while on the other hand, it is crucial to promote learning about artificial intelligence from the most basic levels (Segarra Ciprés, Grangel Seguer & Belmonte Fernández, 2024).

Higher education has undergone a constant process of transformation, aiming to keep pace with new knowledge and scientific-technical advances and to fulfill the social mandate required by the growing needs associated with societal development. Therefore, systematic and continuous improvement in the quality and relevance of its academic programs must be ensured (García-González et al., 2021).

In this sense, integrative teaching tasks play a fundamental role in the training process of

bioanalysts. The purpose of the integrative teaching task is to develop competencies, conceived as a dynamic and integrated process of knowledge, skills, attitudes, and values, which must be induced and developed during the teaching process, assessing their degree of mastery (Panei, 2025; Rodríguez Molina, Meneses Martin & Velasco Martin, 2022).

The Emerging and Re-emerging Diseases (EER) course is essential for developing core competencies in surveillance, prevention, and rapid response. However, teaching this discipline faces significant pedagogical challenges. Traditional approaches, predominantly based on lectures, are insufficient for such a dynamic subject. These methodologies often foster fragmented learning, hindering the integration of complex knowledge spanning from microbiology to health policies. This is compounded by the challenge of keeping content up-to-date, as the scientific literature advances more rapidly than the updating of conventional teaching materials. The research objective is to evaluate the implementation of a pedagogical intervention based on AI-assisted Integrative Teaching Tasks (TDI) in the Emerging and Re-emerging Diseases course.

METHOD

The design of this research was based on the strategies and principles of the action-research approach. It provided a logical framework for developing an innovative educational intervention within its own context. The study was conducted at the "Arides Estévez Sánchez" Medical Sciences Branch located in the province of Holguín, Cuba. The experience was carried out in the "Emerging and Re-emerging Diseases" course for the 4th year of the Bachelor's degree in Clinical Bioanalysis, during the 2024-2025 academic year.

Educational context

The Emerging and Reemerging Diseases course addresses general aspects of the factors that have influenced the emergence and reemergence of infectious diseases, whether they are the most frequent in our community or internationally, and which, due to international epidemiological conditions, are trending upward. It is taught in the second semester, during the day, with a total of 72 hours of theory and practice, distributed over 18 weeks and consisting of seven units. The general objectives of the course are:

- To develop the intellectual and personal skills that will enable students to actively and consciously solve problems in the microbiology laboratory.
- To explain the epidemiological aspects of emerging and re-emerging diseases, with an emphasis on those most common in Cuba and African countries.
- To identify the risk factors that contribute to the emergence and reemergence of infectious diseases.
- Assess the clinical, epidemiological, and diagnostic aspects of emerging and reemerging diseases, emphasizing the importance of establishing community control programs to prevent infectious diseases.

The diagnostic stage was carried out through a non-probabilistic purposive sampling of 45 students enrolled in the course, of whom 22 constituted the study sample. All participants provided informed consent, ensuring confidentiality and the anonymous use of their data for research purposes.

Description of the Pedagogical Intervention

The proposed intervention was to redesign the course's teaching strategy. Three Integrative Teaching Tasks (ITT) were applied using Artificial Intelligence tools, all of which were sequenced throughout the semester.

Phase 1: Design of Integrative Teaching Tasks (ITT)

ITT 1: "Epidemiological Surveillance with Digital Tools." Students, organized into groups, used an AI platform, with specific commands in ChatGPT, Deepseek, and qwen, to analyze outbreak data in real time. They also identified patterns and drafted a preliminary epidemiological bulletin.

ITT 2: "Analysis of a Complex Case: From Outbreak to Comprehensive Response." A simulated case of a new disease was presented.

The teams had to delve into the infectious agent and the factors driving its reappearance, then plan how to control it, using AI to find and summarize the latest scientific research and to predict how the disease would spread.

TDI 3: "Developing a Prevention Proposal for a Reemerging Disease." Integrating all the knowledge from the course, students designed a community or health intervention proposal. AI was used to analyze socio-demographic data, generate tailored educational material, and evaluate the feasibility and effectiveness of the proposed strategies.

Phase 2: Using Artificial Intelligence.

Tools Used: Specific tools such as ChatGPT 4.0, Copilot, Qwen, and Deepseek for AI were named.

Training: An initial session was devoted to "AI Literacy for Learning," where ethical protocols for use, effective prompts, and criteria for verifying AI-generated information (critical thinking about the source) were established.

Role of the Teacher: The teacher transitioned from being a transmitter of knowledge to a designer of experiences and a facilitator, guiding students in the critical use of the tool and in integrating knowledge.

Techniques and Tools for Data Collection

A semi-structured questionnaire was developed and validated to evaluate students' TDI submissions. It assessed dimensions such as: Integration of concepts, Depth of analysis, Creativity in the solution, Ethical and critical use of AI, and Clarity in communication.

Focus Groups: Two focus group sessions were held (one halfway through and one at the end of the intervention) with a representative sample of 11 students per session to explore in depth their perceptions, challenges, and subjective experience with the educational proposal. A semi-structured question guide was used.

Perception and Satisfaction Questionnaire: At the end, an anonymous Likert-scale and open-ended questionnaire was administered to measure students' perceptions of skills development, the usefulness of ITD, and the effectiveness of AI as a learning support tool.

Procedure and Data Analysis

Procedure: The process followed an iterative cycle: TDI design, implementation, data collection, preliminary analysis, and adjustment of the next TDI.

Qualitative Data Analysis: Data from focus groups and open-ended questionnaire items were

analyzed using thematic content analysis, employing open and axial coding to identify emerging categories and patterns.

Quantitative Data Analysis: Data from the survey and Likert-scale questionnaire were processed using descriptive statistics (means, frequencies, and percentages) in [Excel].

Ethical Considerations

The anonymity and confidentiality of participants were guaranteed. Written informed consent was obtained, including an explanation of the research objectives. It was emphasized that participation would not affect academic evaluation. The project was reviewed and approved by the Ethics Committee of the Arides Estévez Sánchez Medical Sciences Branch.

RESULTS

Table 10.1 describes student performance according to the TDI assessment criteria. As shown, all criteria showed continuous improvement. The "Concept Integration" criterion showed the most significant progress, with a score of 4.5, suggesting that the TDI sequence enabled students to progressively connect knowledge of epidemiology, microbiology, and public health.

Table 10.1. Student performance according to the TDI assessment criteria

Assessment Criterion	TDI 1 (Epidemiological Surveillance)	TDI 2 (Clinical Case)	TDI 3 (Prevention Proposal)
Integration of Multidisciplinary Concepts	3,2	3,9	4,5
Depth of Analysis and Critical Thinking	3,0	3,7	4,4
Practical Application and Feasibility	3,4	4,0	4,6
Ethical and Critical Use of AI	3,1	3,8	4,3
Clarity and Structure in Communication	3,8	4,2	4,5
Average Total Score	3,3	3,9	4,5

Legend: 1=Insufficient; 2=In Development; 3=Acceptable; 4=Notable; 5=Outstanding

Table 10.2 shows the results of the questionnaire on students' perceptions of skills development using the TDI methodology with AI. The data indicate that more than 80 % of students "agreed" that TDI facilitated knowledge integration and improved their analytical skills. Likewise, 64 % found AI helpful in managing information, and all students found the methodology more motivating.

Table 10.2. Students' perceptions of skills development using the TDI methodology with AI (n=22)

Statement	Disagree	Neutral	Agree
TDI helped me integrate knowledge from different areas.	5 % (1)	14 % (3)	82 % (18)
My ability to analyze complex health problems improved.	0 % (0)	0	100 % (22)
The use of AI was useful for searching and synthesizing scientific information.	23 % (5)	14 % (3)	64 % (14)
I learned to use AI critically and to verify its results.	18 % (4)	40 % (9)	95 % (21)
This methodology is more motivating than traditional lectures.	0 % (0)	0	100 % (22)

As shown in table 10.3, among the perceived advantages in the educational context are an improvement in meaningful learning, speed, and efficiency in scientific research, and a more realistic dynamic for their professional preparation.

Table 10.3. Emerging categories from the qualitative analysis of the experience with AI-assisted TDI

Category	Description and Representative Quotes
Perceived Advantages	Meaningful Learning: "By applying the theory to a real case with AI, the concepts stuck better" (E15).
	Research Efficiency: "AI helped me find key articles that I wouldn't have found on my own, saving me time" (E22).
	Preparation for Professional Practice: "I felt like I was solving a real problem, just like I will in my job" (E08).
Challenges and Difficulties	AI Learning Curve: "At first it was frustrating; I didn't know how to ask the right questions" (E11).
	Information Overload: "Sometimes the AI generated so much information that it was difficult to select what was important" (E29).
	Concern about Dependency: "You had to be careful not to just copy and paste, but to think for yourself" (E17).
Recommendations	Continuous Training: Students suggested more practical sessions on prompt engineering. Clear Structure: They appreciated detailed questions, as they provided clarity about what was expected.

Along the same lines, they suggest advancing training in the development of promts for AI management.

DISCUSSION

The research findings highlight the relevance and timeliness of AI-assisted integrative tasks. Authors who have worked on this topic suggest that integrative tasks can be designed to include various active methodologies, which helps keep students motivated and focused on their academic work (Quevedo & Obando, 2024). This approach allows them to engage with the content with a more open and receptive mindset, thereby facilitating more effective learning, which aligns with the results achieved in this study.

Studies on the inclusion of integrative teaching tasks in the courses of the Bachelor's degree in Clinical Bioanalysis are very limited, constituting a shortcoming in the educational teaching process. We agree with Molina et al. and Pérez et al. that including the integrative teaching task in the courses taken by the training student contributes to the development of their cognitive capacity, achieving developmental learning and a significant competency in their training as an education professional. However, better preparation of teachers in the application of these educational methodologies is also required, as students alone would not be capable of integrating and understanding them (Rodríguez Molina, Meneses Martin & Velasco Martin, 2022; Estado real de las tareas docentes integradoras en la disciplina Diagnóstico Integral de Laboratorio, n.d.).

Contextualizing the content addressing infectious diseases is fundamental in the training of bioanalysts, considering the global epidemiological situation, which is characterized as dynamic and unpredictable. This coincides with Fuenzalida et al. on the importance of starting from authentic situations or real cases that allow students to connect with elements of their future work context. Hence, the need to find new educational innovations that motivate a transformation in critical thinking and the analysis of learning situations (Céspedes, Batista &

Almaguer, 2024; Fuenzalida Valdebenito et al., 2024; Pazos-Yerovi & Aguilar-Gordón, 2024).

The arrival of artificial intelligence in this century constituted a shift in how the world is perceived across all fronts of human endeavor, and its influence on education is palpable. In this research, the integration of AI was achieved as a fluid, current, and forward-looking process committed to new changes in the educational paradigm. Students experienced an exponential shift in content assimilation, research skills, and professional and digital competencies, which aligns with the proposals of various international authors (Chao-Rebolledo & Rivera-Navarro, 2024; Muñoz & Delgado, 2025; Varela, 2024; Eduardo Félix et al., 2025).

Although the study's results align with international research on the topic, students maintained reservations regarding total dependency and lack of effort in decision-making and problem-solving as healthcare professionals, since AI can be inaccurate, superficial, and less analytical, omitting the human factor which is decisive in real-life health situations. The study revealed a need for training in prompt engineering. Although students were aware of AI tools, they had not used them for this educational purpose. Therefore, the teacher assumed the role of facilitator to achieve the proposed objectives, highlighting the need for up-to-date training for teaching staff and the correct structuring of planned activities in this regard (Segarra Ciprés, Grangel Seguer & Belmonte Fernández, 2024; Tramallino & Zeni, 2024; Aguirre Flórez et al., 2025; Kroff, Coria & Ferrada, 2024).

The training of the Bachelor in Clinical Bioanalysis demands continuous and innovative adaptation, preparing and strengthening professionals for the challenges of modern medicine, genomics, and global health. It is the duty of the university to effect a change in its curricula and teaching practices, incorporating emerging technologies, active methodologies, and competency-based training to effectively respond to society's new demands, enabling graduates to perform fluid roles in a changing and multidisciplinary environment.

CONCLUSIONS

The research revealed the importance of applying integrative teaching tasks as a significant challenge for teaching in the bioanalyst career. The use of Artificial Intelligence can be an essential support for current teaching methodology, though with limited, controlled teacher oversight. This change in the educational paradigm reflects modern society's evolution in the coming years.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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