

# International Online Collaborative Learning, an interdisciplinary educational experience.

## Aprendizaje Colaborativo Internacional en Línea, una experiencia educativa interdisciplinaria.

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### Summary

**Introduction:** Innovative learning methodologies such as Collaborative International Online Learning (COIL) constitute a strategy that allows students from different countries to connect in order to develop global and intercultural competencies through the joint creation of academic products relevant to their professional training. **Objective:** To present the learning experience and perceptions of students from two higher education institutions in a COIL activity on the role of micronutrients in immune system health. **Methodology:** This was an observational, descriptive, and cross-sectional study, comprised of third-semester medical students from a Colombian university and nutrition and dietetics students from a Mexican university. The sample consisted of 67 students, selected by convenience sampling. Data were collected using an anonymous Likert-type questionnaire and open-ended questions. Absolute and relative frequencies were analyzed for qualitative variables, and inductive thematic analysis was applied to the open-ended responses. **Results:** Of the 67 participants, 56 (83.58%) were medical students and 11 (16.42%) were nutrition and dietetics students. The majority of participants strongly agreed that the activity strengthened their understanding of the relationship between immunology and nutrition (67.17%), promoted a holistic view of health (76.12%), and improved their preparedness to work with professionals from other disciplines (86.57%). **Conclusions:** The COIL methodology was perceived favorably by the participants and showed formative potential for fostering interdisciplinary learning, collaborative work, and conceptual integration between immunology and nutrition. It is recommended that future experiences be complemented with objective learning assessment tools.

**Keywords:** immunology, nutritional sciences, professional education, collaborative learning, internationalization of education.

### Resumen

**Introducción:** las metodologías de aprendizaje novedosas como el Aprendizaje Colaborativo Internacional en Línea (COIL) constituyen una estrategia que permite conectar estudiantes de distintos países con el fin de desarrollar competencias globales e interculturales mediante la creación conjunta de productos académicos pertinentes para su formación profesional. **Objetivo:** presentar la experiencia de aprendizaje y la percepción de estudiantes de dos instituciones de educación superior en una actividad COIL sobre el papel de los micronutrientes en la salud del sistema inmune. **Metodología:** estudio observacional, descriptivo y transversal, conformado por estudiantes de tercer

semestre de Medicina de una universidad colombiana y estudiantes de Nutrición y Dietética de una universidad mexicana. La muestra fue de 67 estudiantes, seleccionados por muestreo a conveniencia. La información se obtuvo mediante un formulario anónimo tipo Likert y preguntas abiertas. Se analizaron frecuencias absolutas y relativas para las variables cualitativas y se aplicó análisis temático inductivo para las respuestas abiertas. **Resultados:** de los 67 participantes, 56 (83,58%) eran estudiantes de Medicina y 11 (16,42%) de Nutrición y Dietética. La mayoría reportó estar totalmente de acuerdo con que la actividad fortaleció su comprensión sobre la relación entre inmunología y nutrición (67,17%), promovió una visión integral de la salud (76,12%) y mejoró su preparación para trabajar con profesionales de otras disciplinas (86,57%). **Conclusiones:** la metodología COIL fue percibida de manera favorable por los participantes y mostró potencial formativo para favorecer el aprendizaje interdisciplinario, el trabajo colaborativo y la integración conceptual entre inmunología y nutrición. Se recomienda complementar futuras experiencias con instrumentos de evaluación objetiva del aprendizaje.

**Palabras clave:** inmunología, ciencias de la nutrición, educación profesional, aprendizaje colaborativo, internacionalización de la educación.

## 1. Introduction

The use of active learning methodologies is increasing in higher education and allows students to develop transversal skills that have a positive impact on the workplace (1-2). The term Collaborative International Online Learning (COIL) was coined by the COIL Center at the State University of New York, is protected by a registered trademark, and emphasizes co-created curricula, internationalization, interactive learning, and the use of accessible technology (3-4).

Key components of COIL courses include the co-creation of the curriculum by instructors, with content shared for at least four weeks; student participation in problem-solving with international peers; the use of technology accessible at both institutions; and the guarantee that students remain enrolled and are assessed by their own institutions (1). This structure ensures that students receive the necessary support and evaluation from their home institutions (1, 5). Documented benefits of COIL include the development of intercultural competence, improved cross-cultural communication skills, greater flexibility and openness, and strengthened teamwork skills (1, 4). Its pedagogical value lies specifically in the technology-mediated intellectual exchange between students from diverse cultural backgrounds, which helps prepare healthcare professionals for increasingly diverse and multicultural work environments (4-6).

Despite the growing body of literature on the subject, there remains a scarcity of studies documenting student perceptions in COIL experiences across health sciences programs, particularly in the Latin American context (6-8). Therefore, this article aims to describe the learning experience and perceptions of students from two higher education institutions participating in a COIL activity on the role of micronutrients in immune system health.

## 2. Methods

The educational experience unfolded across four sequential stages, following a learning methodology based on weekly submissions under the COIL (Coordinated Online Learning) model. Participants included students from the Medicine program at the Pontifical Bolivarian University (UPB), Medellín campus, Colombia, and students from the Nutrition and Dietetics program at the University of the Valley of Atemajac (UNIVA), Colima campus, Mexico. Working groups were formed with students from both programs in similar proportions.

The chosen topic was the role of micronutrients in immune system health, allowing for an integrative approach between the two professions. Each group was assigned a micronutrient (iron,

zinc, calcium, magnesium, iodine, vitamin A, vitamin C, vitamin D, vitamin B12, and folic acid). Prior to the activity, a synchronous virtual meeting was held to facilitate initial contact between the students, contextualize both cultures, and address the organizational aspects of the activity, including team assignments, deadlines, and agreed-upon deliverables. This meeting was led by instructors from both institutions.

During the first week, the groups explored their assigned micronutrient, its function in the immune system, the recommended daily intake for adults, and local food sources in both countries, and created an illustrated fact sheet with the information gathered. In the second week, each group drafted a recipe based on their assigned micronutrient, supported by scientific evidence on its role in the immune response. In the third week, the students visually designed a menu using artificial intelligence tools, incorporating nutritional information (calories, carbohydrates, fats, and proteins). In the fourth week, each group presented their final product, integrating all the elements worked on—fact sheet, recipe, and design—and created a TikTok-style video with a conclusion about the learning and collaborative work. Figure 1 graphically illustrates the stages of the COIL activity.



**Figure 1.** Distribution of binational work by weeks.

A rubric was used to evaluate the submissions, including criteria such as clarity of information, use of reliable sources, design appeal, timeliness of submission, and appropriate use of digital tools. The team with the best performance had the opportunity to present their project virtually at the Sixth UNIVA GOAL 2025 Outstanding Projects Forum, Colima Campus.

At the end of the experience, an anonymous perception survey was administered via Microsoft Forms. The survey consisted of six questions using a four-point Likert scale (strongly agree, agree, neutral, disagree), designed to explore interdisciplinary learning, skills development, and understanding of the link between immunology and nutrition. The instrument was developed specifically for this purpose by the instructors responsible for the activity, based on the learning objectives of the COIL experience and the literature on the assessment of intercultural and interdisciplinary skills in higher education (1,4). A formal psychometric validation process was not applied, which constitutes an instrumental limitation acknowledged in the discussion section. The data were downloaded to Microsoft Excel and analyzed using the Jamovi program (latest version).

Additionally, four students were randomly selected to answer three open-ended questions: What was the most positive aspect of your experience in the binational project? What difficulties did you face and how did you resolve them? And what suggestions would you make to improve future versions of this experience? The responses were analyzed using inductive thematic analysis in four stages: familiarization, coding, search, and review of themes, in order to identify recurring patterns and key experiences. Qualitative variables were analyzed using absolute and relative frequencies, expressed as proportions and percentages.

### *Ethical aspects*

In accordance with Resolution 8430 of 1993 from the Colombian Ministry of Health, the study was classified as low-risk research, as it involved the evaluation of an educational activity using an anonymous survey. This classification corresponds to the Colombian regulatory framework applicable to UPB. The participating Mexican institution (UNIVA) followed equivalent ethical criteria according to its own institutional regulations, both being consistent with the international ethical principles of educational research: respect for autonomy, anonymity, and voluntary participation. Participation was voluntary, and participants were aware of the study's purpose. Given the binational nature of the experience, equivalent ethical criteria were followed in both institutions. It should be noted that 25.37% of the participants were between 16 and 18 years old; in both participating countries, university students in this age range have the capacity to provide informed consent autonomously according to applicable law, and their participation was completely anonymous and voluntary. Ethics committee approval was not required given the type of study, but the activity was approved within the institutional academic framework of both universities.

### **3. Results**

A total of 67 students participated: 56 (83.58%) were in their third semester of the Medicine program at UPB and 11 (16.42%) were in their third semester of the Nutrition and Dietetics program at UNIVA. Regarding age distribution, 40 (59.70%) were between 19 and 21 years old, 17 (25.37%) were between 16 and 18 years old, and 10 (14.93%) were over 22 years old. Regarding their perception of developing competencies in immunology and nutrition, the majority of students strongly agreed that the activity strengthened their understanding of the relationship between the body's defense mechanisms and nutrition (Table 1). When asked whether the immunological concepts covered had been useful in integrating knowledge from both disciplines, 64 students (95.52%) [95% CI: 87.6–98.5] responded affirmatively, and 3 (4.48%) [95% CI: 1.5–12.4] responded negatively. When asked whether the experience had better prepared them to work with professionals from other health disciplines, 58 (86.57%) [95% CI: 76.4–92.8] responded favorably, and 9 (13.43%) [95% CI: 7.2–23.6] responded unfavorably.

Table 2 summarizes the results regarding the perceived relevance of academic activities for health sciences training. The vast majority of students considered that addressing micronutrients from an immunology perspective contributed to a more holistic view of health.

**Table 1.** Students' perception of skills development.

Question	Response options	n (%)	95% CI*
Do you feel that the project allowed you to understand how nutrition directly influences the body's defense mechanisms?	Totally agree	45 (67.17)	55.3–77.2
	OK	16 (23.88)	15.3–35.3
	Indifferent	5 (7.46)	3.2–16.3
	Disagree	1 (1.49)	0.3–8.0
Did the activity help you recognize the relationship between immunological principles and clinical practice?	Totally agree	43 (64.18)	52.2–74.6
	OK	18 (26.87)	17.7–38.5
	Indifferent	4 (5.97)	2.4–14.4
	Disagree	2 (2.98)	0.8–10.3
Do you feel that this work allowed you to better understand the interaction between the immune system, diet, and disease?	Totally agree	45 (67.17)	55.3–77.2
	OK	17 (25.37)	16.5–36.9
	Indifferent	4 (5.97)	2.4–14.4
	Disagree	1 (1.49)	0.3–8.0

\*95% CI calculated using the Wilson method (n = 67).

**Table 2.** Students' perception of the relevance of the activity.

Question	Response options	n (%)	95% CI*
Do you believe that studying micronutrients from an immunological perspective promotes a holistic view of health?	Totally agree	51 (76.12)	64.7–84.7
	OK	14 (20.90)	12.9–32.1
	Indifferent	1 (1.49)	0.3–8.0
	Disagree	1 (1.49)	0.3–8.0
Do you believe that immunology can connect medical diagnosis with nutritional prevention?	Totally agree	50 (74.63)	63.1–83.5
	OK	15 (22.39)	14.1–33.7
	Indifferent	2 (2.98)	0.8–10.3
	Disagree	0 (0.00)	0.0–5.4
Do you believe that the project fostered a more comprehensive understanding of well-being and disease prevention?	Totally agree	44 (65.68)	53.7–75.9
	OK	17 (25.37)	16.5–36.9
	Indifferent	5 (7.46)	3.2–16.3
	Disagree	1 (1.49)	0.3–8.0

\*95% CI calculated using the Wilson method (n = 67).

Regarding the overall assessment of the experience, on a scale of 1 to 5, 37 students (55.23%) [95% CI: 43.4–66.5] rated it as very enriching, 17 (25.37%) [95% CI: 16.5–36.9] as enriching, 9 (13.43%) [95% CI: 7.2–23.6] as neutral, 3 (4.48%) [95% CI: 1.5–12.4] as not very enriching and 1 (1.49%) [95% CI: 0.3–8.0] as not enriching at all.

Regarding the open-ended questions, the thematic analysis of the responses identified three main categories: positive intercultural experience, logistical difficulties, and evaluation of the teaching organization. Representative excerpts from the responses are presented below:

*Student 1 (intercultural experience): "Well, the most positive thing was really getting to know the culture of another country, interacting with people from another country, like in this case it was Mexico. It's really "cool" [Colombian colloquial expression equivalent to "very enriching or "very valuable"] to learn about the study methodology, since in this case it's the nutrition students from Mexico, to learn about their customs, and to interact with them more than anything."*

*Student 2 (logistical difficulties): "The only difficulty we had was with the time each of us had available, because sometimes the schedules didn't work out. However, we tried to ensure that everyone could work within their own time and that everyone ultimately met the required objective."*

*Student 3 (teacher evaluation): "I really don't have any suggestions, everything seemed very well organized. Good communication from both teachers for the completion of the activities and their execution as well."*

Taken together, the three identified categories—positive intercultural experience, logistical difficulties, and assessment of the teaching organization—are consistent with the overall favorable perception of the COIL methodology reported in the quantitative data, and reinforce the conclusion that the experience was well valued by the participants from multiple dimensions of the training process.

#### **4. Discussion**

The results of this study show that most participants positively valued the COIL experience, both in its disciplinary skills development dimension and its intercultural dimension. This favorable perception can be explained, firstly, by the nature of the pedagogical design adopted: the sequential four-week structure, progressing from conceptual appropriation to the co-creation of a rubric-assessed product, facilitated the gradual construction of knowledge, which, according to the collaborative learning framework, promotes content integration and active student engagement (1, 2). Secondly, the explicit link between immunology and nutrition responded to a perceived training need, suggesting that the activity activated prior knowledge schemas and articulated them with new disciplinary perspectives, a central mechanism of meaningful learning in the health sciences (11, 12). Thirdly, direct contact with peers from another culture and educational system generated what the students described as genuine experiential enrichment, consistent with the theory of intercultural contact mediated by collaborative digital environments (4).

In the study by Rault et al. (6), 81.25% of the participants were medical students, a proportion similar to the 83.58% in the present study; the convergence in the positive perception between both experiences suggests that the interprofessional and intercultural component of COIL activates learning dynamics that transcend geographical context differences, although age and disciplinary differences limit direct comparability.

Regarding the development of competencies, in the present study, 67.17% of participants reported having strengthened their understanding of fundamental concepts for their training, while in the study by Ambrose et al. (9), between 39% and 85% of students, depending on the institution, considered that they had achieved the expected learning outcomes. These differences can be attributed to the specific context of each experience, the discipline involved, and the characteristics of the measurement instrument, rather than to actual differences in the impact of the method. It is important to highlight that the differences between the two studies also reflect distinct educational and cultural contexts: while the present study included students from Colombia and Mexico with a predominantly young age profile (59.70% between 19 and 21 years old) and disciplines in the health field (Medicine and Nutrition), the study by Ambrose et al. involved students from Australia and Indonesia in global health programs. These differences in disciplinary, geographical, and cultural context limit the direct comparability of the results and should be considered when interpreting the observed similarities and differences.

The difficulty in coordinating schedules among participants from different countries, noted by one of the students, coincides with the findings reported by Naicker et al. (10), who identified time

zone differences as one of the main barriers in COIL experiences. This finding suggests the need to consider complementary asynchronous communication strategies in the design of future activities.

Strengths of the study include the implementation of an interdisciplinary and binational COIL experience between health programs, with a sequential pedagogical structure, products evaluated through rubrics, and continuous teacher support from both institutions.

However, the results should be interpreted with caution. The observational and cross-sectional design, convenience sampling, small sample size, and lack of pre- and post-intervention measurements limit the generalizability of the findings and preclude establishing causal relationships. Furthermore, favorable student perception does not necessarily equate to objectively demonstrated learning; in educational contexts, satisfaction can be influenced by factors such as the novelty of the experience or close teacher support. Therefore, the results should be understood as evidence of a well-regarded experience with formative potential, not as proof of the methodology's causal effectiveness. Likewise, no analyses of association between variables were performed since the study design did not include predefined relational hypotheses; their subsequent incorporation would introduce the risk of unplanned inferences, which is why it is recommended as a line of inquiry for future studies with an analytical design.

Future studies could include longitudinal or quasi-experimental designs, validated competency assessment instruments, objective learning assessments, and greater diversity of institutions and disciplines. In this regard, the use of high-fidelity assessment strategies has proven effective in medical training for objectively measuring practical competencies (11); similar principles could be adapted to the context of COIL experiences to overcome the limitations of self-perception instruments.

## 5. Conclusions

- The implemented binational interdisciplinary COIL activity was perceived positively by the participating students, who valued its contribution to learning about the relationship between immunology and nutrition, to the development of a comprehensive view of health, and to preparation for interprofessional collaborative work.
- The experience showed educational potential for integrating immunology and nutrition content in an international and collaborative context.
- It is recommended that future implementations incorporate objective learning assessment tools that allow comparing student perception with measurable performance indicators.

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