

INNOVATING BIOLOGY EDUCATION IN PHYSIOTHERAPY: A MULTICULTURAL, INCLUSIVE, PROJECT-BASED WORKSHOP

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Abstract

Within the framework of the Teaching Innovation Strategies promoted at Universidad San Pablo-CEU, an educational innovation project was developed at the School of Medicine for first-year students enrolled in the Physiotherapy degree. This program welcomes a highly heterogeneous and multicultural student population and is taught in both Spanish and English. A recurrent challenge identified among Physiotherapy students is the perceived lack of relevance of basic science subjects (particularly Biology) to real-world clinical practice, which can negatively affect motivation and learning outcomes. To address this issue, an innovative workshop was designed for the Biology course (first semester), which integrates Cell Biology and Biochemistry through a cross-disciplinary and applied approach. The main objective of the project was to promote active, dynamic learning strategies that enhance student engagement while fostering the development of transferable skills essential for clinical decision-making in future physiotherapy practice. An inclusive, multicultural activity centered on gastronomy was implemented using Project-Based Learning and clinical case methodology. Students were provided with a dossier describing fictional characters whose names and profiles reflected specific physical activity levels or pathological conditions. These characters were intentionally designed to allow students to establish connections between cellular, biochemical, tissue, and organ-level alterations. Each student was assigned a character and asked to select a traditional dish from their country of origin that would be nutritionally appropriate for the character's metabolic condition, with the aim of improving their physiological state. Students analyzed the biochemical and cellular implications of the selected dish, identified the affected tissues and organs, and justified their choices based on scientific reasoning. The activity concluded with the submission of individual dossiers and an oral presentation, followed by a guided group discussion that encouraged peer feedback, critical thinking, and the exploration of alternative approaches. Student feedback, collected through online questionnaires, was highly positive. Outcomes included increased motivation and engagement with the Biology course, improved academic performance, and enhanced creativity, empathy, tolerance, and cultural awareness. Overall, this innovative workshop successfully demonstrated the clinical relevance of basic sciences for Physiotherapy students while promoting digital competence, internationalization, appreciation of cultural heritage, healthcare and sustainability. Additionally, the activity fostered an inclusive and collaborative classroom environment, contributing positively to students' academic and professional development throughout their university studies.

Keywords: *Project-based learning, internationalization, transversality, physiotherapy, biology.*

1. Introduction

Improving student motivation and academic performance in foundational science courses remains a central challenge in health-science education, particularly in Physiotherapy programs where learners frequently struggle to perceive the relevance of subjects such as Biology and Biochemistry to their future professional practice. Contemporary research demonstrates that active methodologies—especially Project-Based Learning (PBL)—enhance both intrinsic and extrinsic dimensions of memory, promoting deeper learning and long-term retention. This occurs because project-based environments stimulate internal cognitive drivers (e.g., curiosity, autonomy, personal relevance) while simultaneously providing structured external supports (e.g., clear task requirements, evaluative criteria), thus strengthening complementary memory systems essential for academic success (Muslim et al. 2021).

Intrinsic memory processes are fostered when students engage in learning tasks that they perceive as meaningful, personally relevant, and aligned with real-world contexts. Evidence shows that PBL increases intrinsic motivation by placing students at the center of the learning process, encouraging autonomy, and promoting ownership of learning outcomes (Stoica, 2024). When learners actively construct knowledge and justify decisions within authentic scenarios, they develop stronger cognitive associations, deeper conceptual understanding, and more durable memory traces. In the context of health-science education, student-centered approaches such as PBL, Problem-Based Learning (PBL), and Case-Based Learning (CBL) have demonstrated moderate and consistent positive effects on motivation, particularly regarding students' beliefs, values, and attitudes toward scientific subjects (Wijnia et al. 2024).

In parallel, extrinsic memory, which is supported by structured expectations, external reinforcement, and clearly defined performance demands, is also strengthened within PBL environments. Meta-analytic studies reveal that PBL significantly improves academic achievement, affective attitudes, and higher-order thinking skills when compared with traditional instructional models, with especially strong results in STEM and healthcare disciplines (Zhang & Ma, 2023). These improvements reflect the synergy between intrinsic engagement and extrinsic structure: students not only find personal meaning in the task but also benefit from guided inquiry, scaffolded resources, and external evaluative elements that consolidate learning.

2. Design

In this context, the educational innovation project implemented at Universidad San Pablo-CEU for the students of Physiotherapy aligns closely with this empirical evidence. By integrating clinical case methodology, cross-disciplinary biological content, and culturally relevant gastronomic tasks, the activity simultaneously activates intrinsic motivation through cultural identity, creativity, autonomy, and personal relevance, and extrinsic motivation through structured dossiers, oral presentations, and rubrics. This dual activation promotes deeper understanding of biochemical, cellular, and physiological concepts, supporting more robust memory formation and improved academic outcomes consistent with findings from science-education meta-analyses (Balemen & Özer Keskin, 2018). Thus, this CEU San Pablo University project provides a pedagogically grounded example that can be effectively applied in Physiotherapy education to help students connect basic science knowledge to clinical reasoning and future professional practice.

Thus, to facilitate the integration of content from the subject, first-year Physiotherapy students were asked to select a traditional menu from their country for the character that was assigned to him/her by the lecturers. Throughout the semester, they were encouraged to complete a written report in which they condense and integrate the knowledge from the different areas of the subject. Furthermore, students prepared and delivered an oral presentation in class to share their analysis with their peers. As this strategy not only promotes knowledge acquisition but also enhances communication, it creates a robust framework for effective and inclusive education given the multicultural origins of the CEU San Pablo University students.

3. Objectives

- Creating an innovative strategy to increase students' interest and motivation in the subject involved.
- Integrating the concepts acquired during the semester, promoting interdisciplinary learning.
- Using information and communication technologies in the presentation of PBL results.
- Facilitating the development of other competencies such as creativity, critical thinking, and the transmission of complex concepts, skills necessary for their future professional careers.

4. Methods

4.1. Participants and topic assignment

This project was offered to students from all over the world in two languages, Spanish and English. A total of 247 out of 279 students enrolled in the Physiotherapy degree (89%) participated in the workshop over the last three academic years, including 147 male students (52.7%) and 132 female students (47.3%). At the beginning of the semester, the professors prepared a dossier with the names and descriptions of several characters with humorous, fictional names intentionally designed to reflect the pathology, physiological condition, or type of physical activity they represent. This naming style makes each case easier to remember and adds a playful component that helps students associate the character with their specific problem. The characters were assigned at the beginning of the course to the students to ensure proper organization of the work and encompassed transversal aspects across the subject.

4.2. Written report

Students were instructed to select a dish from their country or region that matched the characteristics of the fictional character assigned to them. As part of the activity, each student was required to complete a written report in which they justified their choice and addressed several questions linked to the course content. Specifically, the report included: (i) a description of the selected dish, its ingredients, and its geographical origin; (ii) an analysis of the nutritional composition of the main ingredients; (iii) a justification of the dish based on the character's activity level or pathological condition; (iv) recommendations for potential nutritional supplementation; (v) identification of the key metabolic processes involved in the case; and (vi) a discussion of the tissues or physiological systems that might be affected, together with the course chapters that could be illustrated or reinforced using the assigned character.

4.3. Oral presentation

In addition to the written component, students prepared and delivered a short oral presentation in class to share their analysis with their peers.

4.4. Evaluation

The workshop was assessed using analytic rubric with weights aligned to task complexity and cognitive demand. Core criteria included rationale for dish selection accounting for 20% of the total grade; description of ingredients and components, which contributed 15% to the final grade; relevant metabolic processes (15%); affected tissues or physiological systems (10%); and overall dish choice (10%). Regarding the secondary criteria, each of them weighed 5% of the workshop grade and covered character activity or pathology, country or region of origin, dish photograph, nutritional supplementation, relevant course topics, and the in-class presentation. Each criterion was rated on a four-level scale (Excellent, Good, Acceptable, Needs Improvement) based on completeness and quality of evidence, with binary scoring (present/absent) for country/region and dish photograph, thereby ensuring transparency and alignment between task complexity and assessment. The workshop contributed 10% to the final course grade, directly linking student performance in the activity to their overall evaluation.

4.5. Satisfaction surveys

Following the workshop, students were invited to complete a voluntary online questionnaire via Microsoft Forms. These anonymous satisfaction survey included multiple-choice questions where the students could select the statement they most identified with on a scale from 0 "Totally disagree" to 5 "Totally agree" (Likert scale). Additionally, the questionnaire incorporated a specific item where students rated their overall interest in the workshop on a scale from 1 to 5, as well as an open-ended section in which they could freely provide comments aimed at improving the implementation of the project for future editions.

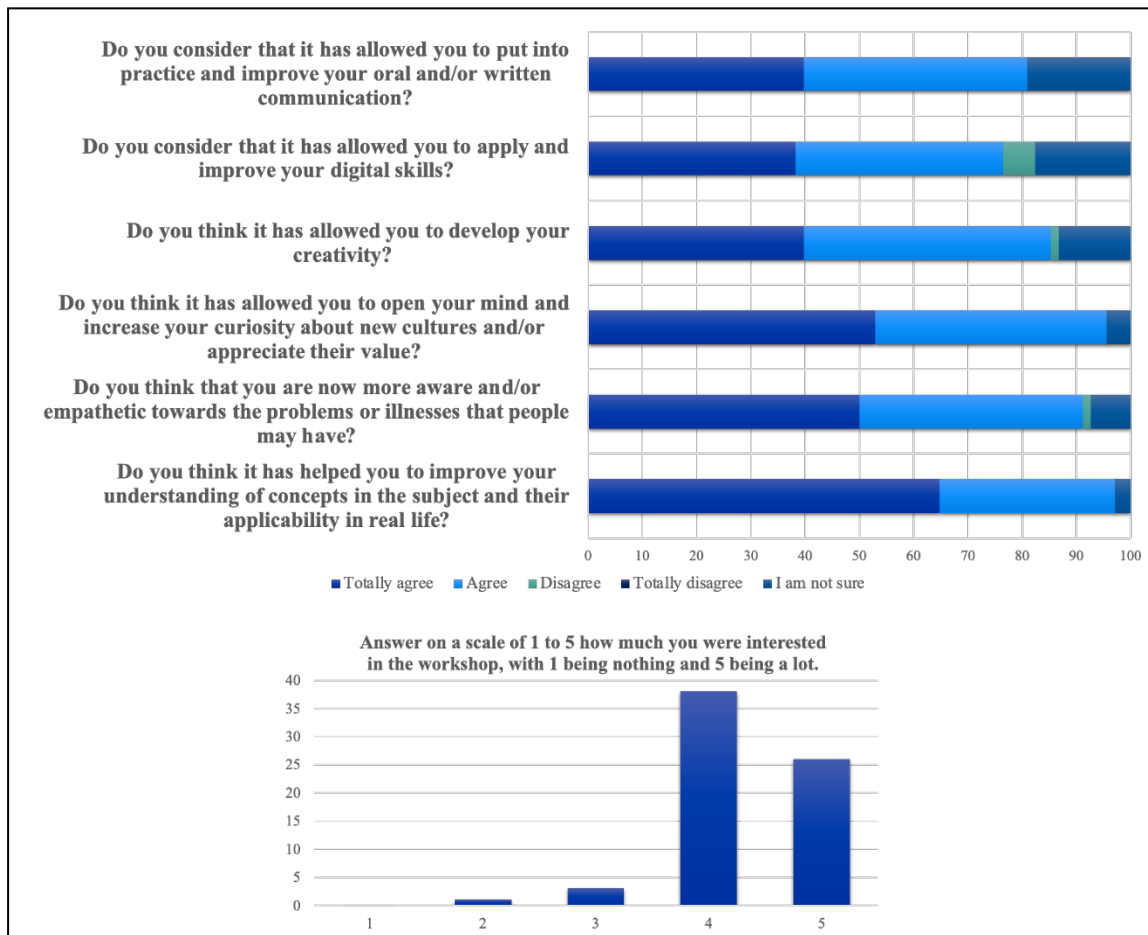
5. Results and discussion

From the moment the workshop was introduced in class, a high level of student motivation toward the activity became evident, a trend that has been consistently observed over the last three academic years. Following the workshop, students were invited to complete a voluntary online questionnaire, with a total of 68 responses received. The data collected provided insights into student engagement and perceptions of the activity, offering a basis for reflection on its effectiveness and potential areas for refinement. Overall, the results reflected the students' satisfaction with the project, where on average student interest in the workshop was high: 94% of the students chose 4 or 5 on a 1–5 scale, 1 being not at all and 5 very much (4 = 56%; 5 = 38%), with only 4% and 1% selecting 3 and 2 respectively (no one chose 1) (Figure 1). A large majority of the students agreed that the activity improved their understanding of course concepts and their real-life applicability (Totally agree = 65%; Agree = 32%; Unsure = 3%). Students likewise reported gains in awareness and empathy regarding health conditions (Totally agree = 50%; Agree = 41%; Disagree = 1,5%; Unsure = 7,5%). The workshop was perceived to broaden intercultural openness and curiosity (Totally agree = 53%; Agree = 43%; Unsure = 4%) and to foster creativity (Totally agree = 40%; Agree = 46%; Disagree = 1%; Unsure = 13%). Regarding skill development, students indicated improvements in digital skills (Totally agree = 38%; Agree = 38%; Disagree = 6%; Unsure = 18%) and in oral/written communication (Totally agree = 40%; Agree = 41%; Unsure = 19%) (Figure 1). Open comments of the students reinforced these patterns, highlighting that the workshop helped apply Biochemistry to concrete cases and supported nutrition-related learning and promoted cultural exchange. Recurrent suggestions included expanding the variety of characters and bringing in or preparing sample

dishes to taste them in class. Overall students described the activity as useful, engaging, and practical, emphasizing that it made the subject more tangible.

As outlined in the Methodology section, the combination of written and oral tasks may have contributed not only to sustained student engagement but also to deeper learning by encouraging students to actively apply theoretical knowledge in practical, reflective, and culturally contextualized activities. By linking biochemical and physiological concepts to familiar foods and narrative scenarios, the activity likely supported meaningful learning and helped students contextualize otherwise abstract metabolic processes within real-life situations.

Figure 1. Students' perception in their learning experience during the project. Evaluation data were collected anonymously in Google Forms surveys at the end of the project.



The positive student perceptions observed in this workshop are consistent with evidence showing that project-based and case-based methodologies enhance motivation particularly students' beliefs, values, and attitudes toward scientific subjects when compared with traditional instruction (Wijnia et al. 2024). This activity has created an ideal environment for first-year students to meet and allowed their quick integration into university life. Beyond cognitive and motivational benefits, the workshop advanced inclusion and internationalization by embedding cultural diversity and cross-cultural exchange within the formal curriculum. The significant gains reported in intercultural openness and empathy also map onto early stages of Deardorff's Process Model of Intercultural Competence (Deardorff, 2006), which highlights attitudes of respect, openness and curiosity as precursors for effective intercultural communication. Moreover, integrating gastronomy as a lens to analyse metabolic needs aligns with culturally responsive pedagogies, which intentionally leverage students' cultural knowledge to enhance learning relevance and equity (Burnham, 2024).

In Physiotherapy education, the outcomes found in this study are particularly valuable because students often struggle to connect basic sciences with clinical practice. Case-embedded tasks like those used here have been shown to improve motivation, critical thinking, and integration of knowledge in health-science students. Taken together, the workshop not only fostered meaningful learning of biochemical

and physiological concepts but also supported intercultural competence and inclusive participation, dimensions increasingly essential in health-profession curricula.

To acknowledge students' effort and engagement, the workshop was also incorporated into the final grade of the course, although the score awarded is based exclusively on the professor's evaluation following the analytic rubric, ensuring fairness and transparency. As an improvement for the next academic year, we plan to introduce a student-generated peer-evaluation rubric, enabling learners to assess each other's contributions. We expect this addition to further promote active participation, reflective judgment, and collaborative responsibility, competencies closely linked to student-centered learning environments.

6. Conclusions

This workshop effectively stimulated students' creativity and fostered an international perspective, while also strengthening their interest in the subject and highlighting its relevance to everyday life.

The activity allowed students to connect biochemical concepts with real-world situations, cultural contexts, and their own nutritional habits, thereby reinforcing meaningful learning.

Student motivation, one of our primary objectives, is reflected in the results obtained from the perception survey, in which the majority perceived that this project has helped them understand different concepts in the subject and their applicability in real life.

As a result, participation in the workshop not only enhanced students' engagement, but also contributed positively to their academic development and overall performance.

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