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COIL PROJECTS AS A STRATEGY FOR THE INTERNATIONALISATION OF HIGHER EDUCATION: REFLECTIONS FROM A PORTUGUESE-BRAZILIAN EXPERIENCE

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Abstract:
COIL (collaborative online international learning) projects offer an accessible pedagogical approach to internationalise higher education, particularly for students unable to participate in physical mobility programmes. By connecting students from diverse countries and cultures, COIL democratises internationalisation and prepares students for dynamic, intercultural job markets, fostering essential transversal skills. This article presents the COIL project, Environmental management and protection: analysis of initiatives adopted by Portuguese companies, a collaboration between the University of Aveiro in Portugal and São Paulo State University in Brazil. The project aimed to analyse the investments, costs, and benefits of environmental management measures in Portuguese companies, applying statistics, mathematics, and project management. The project structure involved binational teams, environmental data analysis, report preparation, and results presentation. The participants found the experience enriching, highlighting the development of international collaboration, teamwork, and intercultural communication skills. They noted that the exchange expanded their perception of cultural diversity and promoted intercultural collaboration. Challenges included uneven participation, unbalanced task distribution, and difficulties in time management and communication. Suggestions for improvement included increased teacher supervision,

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better time management, greater student commitment, and balanced task distribution. Student feedback was gathered through questionnaires from the University of Aveiro's office and the project's instructors.

Keywords: COIL, transversal skills, virtual exchange, internationalisation, higher education

1. Introduction

In an increasingly globalised, competitive, and rapidly evolving world, transversal skills have become essential for both individual and organisational success. The fast pace of technological, social, and economic change requires individuals not only to adapt to shifts in the labour market but also to develop greater awareness, critical thinking, and social engagement.

Amid this rapid transformation, higher education institutions (HEIs) face significant challenges, particularly in ensuring that their students are adequately prepared to meet the demands of the labour market and broader societal challenges. In addition to acquiring specialised technical skills, students must cultivate openness to diversity, the ability to navigate multicultural environments, and the ability to communicate effectively with individuals from diverse religious, cultural, and value-based backgrounds. Moreover, higher education should equip students with the confidence and adaptability necessary to address new and unfamiliar issues with ease.

By exposing students to diverse environments and encouraging interactions with peers from different cultural backgrounds, HEIs play a crucial role in fostering transversal skills, which is often difficult to achieve within the confines of a traditional classroom setting. Collaborative online international learning (COIL) has emerged as a viable and cost-effective approach, enabling students from different countries to engage in collaborative activities without the need for physical mobility and leveraging digital technologies for virtual communication and cooperation.

The literature on COIL highlights the various positive impacts of such collaborative projects, including the development of cultural (Blumthal et al., 2023) and intercultural skills (Hackett et al., 2023). Additionally, COIL has been shown to enhance social and intercultural skills such as empathy, respect for others, communication, and collaboration (Simões & Sangiamchit, 2023), as well as increasing awareness of linguistic differences (Jiang, 2022). Other reported benefits include improvements in both verbal and nonverbal communication (Gray et al., 2023), enhanced creativity (Romero-Rodríguez et al., 2022), and strengthened problem-solving abilities (Inada, 2022).

In addition to fostering intercultural skills, COIL initiatives enhance interpersonal communication in multicultural contexts by exposing students to various interaction styles and approaches to teamwork. The virtual exchange environment also cultivates essential skills such as empathy, tolerance, adaptability, and flexibility—key skills for navigating the diversity and complexity of today's world.

Engaging with other cultures promotes cultural self-awareness and encourages participants to reflect on their own perceptions and values, fostering a deeper understanding of cultural differences. In this way, COIL is not merely about sharing academic knowledge; it provides a transformative space for developing transversal skills that are essential for both workforce integration and global citizenship.

This article presents the COIL project Environmental Management and Protection: Analysis of Initiatives Adopted by Portuguese Companies, which involved students from the Quality Management undergraduate programme at the Águeda School of Technology and Management, University of Aveiro (Portugal), and the Chemical Engineering programme at São Paulo State University (Institute of Chemistry, Araraquara, Brazil). As part of this international collaborative project, students were organised into binational groups and tasked with analysing investments in environmental management measures, expenditures on environmental protection initiatives, and revenue generated from corporate environmental management practices. This analysis required the application of interdisciplinary knowledge in statistics, mathematics, and project management.

This article discusses the relevance of virtual exchange as a pedagogical tool that democratises international experiences in higher education. It begins by exploring the origins and evolution of COIL as a learning methodology, outlining its key characteristics and benefits. The focus then shifts to the specific case of the collaborative project between students from the University of Aveiro and São Paulo State University, detailing its objectives, methodology, implementation stages, and, finally, the students' perceptions regarding the skills developed, challenges encountered, lessons learned, and opportunities for improvement in future initiatives.

2. Literature Review

2.1 The Context and Origins of Virtual Exchange

The internationalisation of higher education was defined by Knight (1993) as "*the process of integrating an international dimension into the research, teaching, and service dimensions of higher education*", an idea that has evolved significantly over time. Initially, the prevailing view in Europe was that internationalisation was predominantly associated with the physical mobility of students and teachers. However, reality revealed that only a fraction of students had access to this experience, leading to the search for other forms of international interrelation.

Virtual exchange, as a strategy for the internationalisation of higher education, had its genesis with the pioneering discussion on internationalisation at home (IaH), proposed by Bengt Nilsson in 1999. In his article written for the European Association for International Education (EAIE) forum, Nilsson questioned the limited accessibility of traditional student mobility programs, such as ERASMUS, which at the time covered only 10% of higher education students. Faced with that scenario, the author suggested the need to explore alternative strategies that would grant an international and

intercultural dimension to the education of the majority of students, fostering a comprehensive understanding of and respect for different cultures.

Nilsson's article sparked substantial interest within the academic community, culminating in the creation of the Special Interest Group on IaH within the EAIE. Shortly after the 1999 conference, this group adopted as its main objectives the delimitation and description of the IaH concept, the stimulation of debate on the topic, the compilation of best practice examples, and the production of publications that disseminated knowledge about IaH to students (Crowther et al., 2000). The creation of this group represented an initial milestone in the evolution of virtual exchange, recognising the urgency of expanding access to international education beyond physical mobility.

From subsequent debates and works, IaH consolidated itself as an approach that sought to integrate international and intercultural dimensions into the formal and informal curricula of higher education institutions (Crowther et al., 2000). Much of the academic community began to recognise that internationalisation was not limited to physical mobility but could be achieved through a diverse range of activities and projects, among which virtual exchange stood out, enabling students to experience international experiences without needing to cross their country's borders.

Wächter, a member of the interest group, proposed that IaH be understood as "*any internationally related activity, except for student and staff mobility*" (Crowther et al., 2000). This definition, although admittedly broad, allowed for a significant contextual analysis of IaH. The context of IaH was shaped by a set of factors external to higher education institutions, which act as variables influencing the internationalisation process. These factors include government policies, globalisation, the information technology (IT) revolution, the increasing demand for accountability, and the commodification of higher education.

Globalisation, a process characterised by the intensification of economic competition, market integration and the expansion of communication networks, has exerted a growing influence on the internationalisation of higher education (Reichert and Wächter, 2000). The global race for students, professors, and researchers has led institutions to adopt marketing strategies and to seek the internationalisation of their curricula and activities. In this context, IaH emerged as a response to the demands of globalisation, preparing students for an international and intercultural job market.

The IT revolution has also played a key role in the evolution of IaH, enabling the creation of international collaboration networks and the development of virtual exchange activities. Despite these challenges, IaH has consolidated itself as a fundamental approach to the internationalisation of higher education, allowing institutions to prepare their students for a globalised and intercultural world. International collaboration, the development of intercultural skills and the adaptation of curricula to international needs have become essential elements of IaH.

2.2 Relevance and Importance of Virtual Exchange for Universities

The globalisation and integration of European societies have stimulated global migration and demographic changes, impacting all social institutions, especially education (Otten, 2000). By connecting students and teachers from different cultures, virtual exchange reflects and responds to these global transformations, providing a rich and diverse learning environment. Cultural diversity, in this context, was not limited to nationality or ethnicity but encompassed other social distinctions, such as gender, profession, and age.

The internationalisation of higher education, driven by globalisation and the growing demand for global skills, has become a priority for HEIs. In this context, virtual exchange has emerged as a relevant strategy, with significant implications for institutional management and development. However, cultural diversity has become a fundamental challenge for European universities. Internationalisation, although often focused on organisational and managerial aspects, has an intrinsic cultural dimension that cannot be neglected (Otten, 2000). In this context, virtual exchange has allowed universities to fulfil their role as transmitters of cultural value while adapting to global cultural changes.

Virtual exchange has also strengthened the international reputation of universities by demonstrating their commitment to cultural diversity and internationalisation. Furthermore, this type of exchange has been more accessible and inclusive than physical mobility, allowing students who cannot travel abroad to experience international experiences. On the other hand, the adoption of virtual exchange has required HEIs to adapt their structures and processes to promote systemic internationalisation (Crowther, 2000). This has included the creation of institutional policies, the allocation of resources and the training of teachers and staff to work in intercultural environments. Internationalisation has ceased to be a marginal activity carried out by enthusiasts and has become a central dimension of the institutional mission. HEIs need to monitor global trends, such as the commodification of higher education and the pursuit of international quality certifications, and adapt their strategies to remain prominent in the international academic landscape.

Virtual exchange, by promoting international collaboration and the development of intercultural skills, contributes to the formation of engaged global citizens prepared for the challenges of the 21st century (Crowther, 2000). HEIs that have adopted virtual exchange demonstrate their commitment to internationalisation and cultural diversity, strengthening their international reputation and attracting students and teachers from around the world.

2.3 Skills Developed in Virtual Exchange

The virtual exchange experience provides a rich environment for the development of various skills, both for international and local students. For international students, adapting to a new culture, even virtually, requires a significant adjustment process. Research on adapting to new cultural environments has highlighted the importance of

social support for the success of this experience, especially in communication and social interactions with other students (Wilczewski and Alon, 2023). The absence of close social relationships can negatively impact the predisposition for learning and academic performance. In this sense, virtual exchange, when well structured, offers social support at different levels, from basic needs to specific academic challenges.

For local students, virtual exchange offers the opportunity to develop intercultural skills without leaving their country. Studies have shown that even in universities with many international students, many local students have little or no contact with them (Wong and Chapman, 2023). However, interest in interacting with international students is high, indicating an untapped potential for intercultural learning at home. Virtual exchange, by facilitating this contact, promotes sensitivity to one's own culture and the development of positive attitudes towards other cultures.

Intercultural learning, for both international and local students, involves cognitive, affective and behavioural dimensions. The experience of cultural diversity, even in a virtual environment, is a powerful form of learning. However, contact alone does not guarantee intercultural learning. Reflection on the experience is fundamental to transforming contact into meaningful learning. In this sense, virtual exchange must include activities that encourage reflection, both in formal environments, such as classrooms, and in facilitated informal activities.

In addition to students, teachers and staff also need to develop intercultural skills. Virtual exchange requires educators to be sensitive to different learning and teaching styles and adapt their practices to meet the needs of diverse audiences (El-Sabagh, 2021). The lack of intercultural preparation can lead to misunderstandings and frustrations, harming the learning process. When well planned, virtual exchange can promote the development of skills such as interpersonal communication, international collaboration, critical thinking, empathy, tolerance, adaptability, flexibility and cultural self-awareness. Virtual exchange, therefore, is not limited to the exchange of academic knowledge. It offers space for the development of skills essential for the 21st century, preparing students for a globalised and intercultural world.

The University of Malmö, in Sweden, was one of the pioneers in the implementation of virtual exchange. The institution faced significant challenges in implementing IaH, revealing obstacles common to other higher education institutions (Nilsson, 2003). Many of these obstacles persist to this day in institutions that begin virtual exchange activities. In the case of this university, the author highlights that internal communication proved to be an obstacle, with many employees unaware of the university's strategic internationalisation plan. The lack of alignment between the central administration, faculties, and departments resulted in different levels of interest and commitment to IaH. Furthermore, some teachers resisted the idea, arguing that their programmes were already overloaded and that internationalisation was not their priority.

Recognising obstacles is the starting point for overcoming them and carrying out a successful virtual exchange proposal. Thus, despite these obstacles, the University of

Malmö recognised the importance of internationalisation and sought to overcome it (Nilsson, 2003). The institution began to value international experience in hiring new employees and recruiting internationally renowned professors. However, there are still challenges to overcome, such as the integration of immigrant students into the IaH and the expansion of regional studies beyond Europe. The change in university leadership brought new perspectives and hopes for internationalisation. The importance of leadership in promoting IaH was highlighted, and the expectation was that new management would boost the process. However, there is still a long way to go to achieve the desired level of internationalisation in the HEI.

Internationalisation at home (IaH) was, until the second half of the 2010s, increasingly recognised as a valuable approach to ensure that all students, not just the few who participate in physical mobility, had access to internationalised education (Beelen and Jones, 2015). However, the definition of IaH initially proposed needed updating. In this sense, Beelen and Jones (2015) suggested a new conception that sought to reflect the breadth and depth of IaH for HEIs and for student education: "*Internationalisation at Home is the intentional integration of international and intercultural dimensions into the formal and informal curricula for all students in domestic learning environments*."

This new definition highlights the importance of the intentional integration of international and intercultural aspects into curricula, both formal and informal (Beelen and Jones, 2015). This means that simply adding internationalised elements or elective disciplines is not enough to internationalise a programme. IaH must permeate all aspects of the curriculum, aiming at the development of international and intercultural knowledge, skills, and attitudes in all students. Furthermore, the definition suggested by Beelen and Jones (2015) broadens the understanding of "*domestic learning environments"*, which can extend beyond the campus and the formal learning context, including intercultural and international learning opportunities in the local community. This may involve working with local cultural, ethnic or religious groups and using alternative learning systems or other ways of engaging national and international students.

The update of the IaH definition represented an important step to improve its implementation and ensure that all students have access to an internationalised education (Beelen and Jones, 2015). Although the definition alone does not guarantee implementation, it provides a solid foundation for the development of strategies and actions that effectively promote IaH. The striking characteristics that differentiate virtual exchange from other forms of exchange have become better recognised. Among these characteristics, IaH provides a form of collaborative learning that connects students from different nationalities in regular communication; offers an online communication experience in different languages and learning in an open and inclusive environment; is more accessible and inclusive than physical exchange, as it requires only internet access; and prepares students and teachers to develop innovative activities in the classroom (O'Dowd, 2018).

From the initial idea and the concept updates, some types of virtual exchange have emerged, shaped by the characteristics of HEIs around the world, such as Collaborative Online International Learning (COIL) from the State University of New York (SUNY); Global Learning Experience (GLE), from DePaul University; Global Classroom, from Drexel University; Experiential Digital Global Engagement (EDGE), from Penn State University; Brazilian Virtual Exchange (FAUBAI-BRaVE), in Brazil; Collaborative Online International Learning (COIL), from Coventry University, in the United Kingdom; and Unicollaboration, a European platform that favours the development of virtual exchanges. Among these types, COIL stands out in the international context as one of the most commonly used proposals.

2.4 Conceptualisation of Collaborative Online International Learning (COIL)

The Collaborative Online International Learning (COIL) methodology emerged in 2006 as a redefinition of collaborative online international learning, which had been experienced since the mid-1990s by teachers who wished to promote learning among their students by connecting their classes with others in distant locations (Rubin, 2023). Despite being successful, these experiences depend heavily on the individual effort of teachers, who bear most of the bilateral management, course planning and technological support work (Rubin, 2017). The absence of institutional support or recognition also hindered the expansion and sustainability of these pioneering initiatives, which received various denominations, such as "*globally networked learning*", "*global connections*", "*virtual mobility*" and "*telecollaboration*".

With the creation of the SUNY COIL Centre in 2006, there was a significant improvement in the structuring and dissemination of the programme, which allowed for the expansion of access to this methodology beyond the institution's walls through the creation of a collaboration network that connects higher education institutions worldwide, the Global Partner Network (SUNY, 2025). In addition, the centre began to offer training and professional development programmes for teachers interested in applying COIL in their courses through workshops and the provision of online materials and resources, which ensures the quality and scalability of the programme.

COIL emerged in the American educational scenario, driven by the intensification of globalisation and technological advances in the area of communication. The State University of New York (SUNY), in the United States, pioneered the development of the concept, seeking to offer an accessible and inclusive way to internationalise higher education. COIL is characterised as a teaching-learning methodology that integrates students and teachers from different countries in a collaborative online environment (Rubin, 2023). This collaboration is manifested through joint projects, intercultural activities and the strategic use of digital tools, providing a rich exchange of knowledge, experiences, and perspectives.

Currently, COIL is recognised as a teaching and learning paradigm that promotes intercultural awareness and international collaboration through the creation of shared learning environments and the use of online technologies (Rubin, 2023). It can be applied

in various areas of knowledge and in different formats, from online modules to face-to-face courses with virtual activities, and has proven to be an effective strategy for the internationalisation of higher education, especially to overcome restrictions on physical mobility.

International collaboration is the cornerstone of this methodology, promoting interaction between individuals from different cultures and nationalities. Intercultural learning is another fundamental pillar that aims to develop the capacity for mutual understanding and respect between cultures, fostering empathy and intercultural communication. Digital technologies play an essential role in enabling communication, collaboration, and interaction between participants. Finally, student-centred learning is valued, encouraging autonomy, creativity, and the development of critical thinking.

Over the years, COIL has spread to various higher education institutions around the world, adapting to different realities and areas of knowledge such as the social sciences, humanities, exact sciences and health. International networks and organisations have contributed significantly to the promotion and dissemination of COIL, offering support, training, and resources for teachers and institutions. This expansion demonstrates the growing relevance of COIL in the context of virtual exchange.

Collaboration in COIL can last the entire semester or be carried out in modules of 5--7 weeks, called "*COIL-enhanced modules*". Although it started in the social sciences, humanities and language teaching, COIL is now used in various areas of knowledge, providing students with new perspectives and tools to develop their intercultural awareness (Rubin, 2017). Participation in COIL programmes promotes the development of crucial 21st century skills, such as intercultural communication, international teamwork, critical thinking and problem solving, while providing virtual international experiences, expanding horizons and enriching learning with dynamism and interactivity.

2.5 Virtual Exchange Experiences at UNESP and UA

At São Paulo State University (UNESP), virtual exchange is called the Brazilian Virtual Exchange (BRaVE) and is configured as a virtual exchange initiative that aims to promote intercultural collaboration between undergraduate and postgraduate students through the joint development of online academic activities. The pedagogical proposal is anchored in the partnership between professors from different universities, who establish common learning objectives and plan collaborative activities, using digital resources and applications. The collaboration materialises in activities jointly planned by the professors, which include everything from "*icebreaker*" sessions and the exploration of intercultural elements to complex tasks, such as solving problems from an interdisciplinary perspective, often aligned with the United Nations Organisation's Sustainable Development Goals (SDGs). The activities culminate in the presentation of a final product, such as reports, multimedia presentations or audiovisual productions, prepared by mixed groups of students from the partner universities.

UNESP's experience in virtual exchange, up to December 2024, has taken place across 31 campuses and 77 disciplines, demonstrating the breadth and diversity of the initiative (UNESP, 2024). The collaborations involved various areas of knowledge, such as dentistry, veterinary medicine, letters, engineering, and social sciences. The active participation of campuses distributed throughout the state of São Paulo and the variety of disciplines demonstrate UNESP's engagement with internationalisation and the promotion of intercultural experiences for its students.

At the University of Aveiro (UA), COIL is configured as a virtual exchange modality that aims to democratise the internationalisation experience for students and teachers. Through online collaboration, students from different geographical, linguistic and cultural backgrounds develop joint projects, enriching the individual and collective learning process and promoting the development of transversal skills. The COIL initiative at the UA presupposes a partnership between teachers from different countries, who plan collaborative activities for their students. Students, organised into multinational teams, carry out predefined tasks, which can include synchronous and asynchronous moments, via online communication tools. The COIL methodology, which is adapted to the pedagogical objectives of curricular units, also allows teachers to improve their teaching practices and strengthen international partnerships. The duration of a COIL project should not be less than four weeks to allow an initial phase of familiarisation between the elements of the teams. In cases where this familiarisation has already occurred, for example, in previous projects, these can have a minimum duration of two weeks.

Since the 2018 academic year and until the end of the 1st semester of 2025, 38 COIL projects have been registered with the Pedagogical Innovation office, with a total of 38 curricular units (CUs) involved, some of which have already carried out more than one project. Some cases involve more than one CU and foreign higher education institution and cover various areas of knowledge, namely, social sciences, languages, information science, secretarial and business communication, biomedical sciences, and engineering, among others. In the specific case of UA and UNESP, collaboration in COIL projects began in the 2020 academic year, and four projects were carried out until the end of the 2024 academic year, all of which are within the scope of biomedical science curricular units.

3. Material and Methods

The COIL project Environmental management and Protection: analysis of the initiatives adopted by Portuguese companies represents the first collaboration between the University of Aveiro (School of Technology and Management of Águeda) and São Paulo State University (Institute of Chemistry, Araraquara), involving course units from distinct disciplinary areas. The 2024 edition of the project brought together students from the Bachelor's degree in Quality Management (2nd year/3rd semester) and Chemical Engineering (2nd year/4th semester), with a total of 58 participants. The course units

involved were Complementos de Estatística (Further Statistics) and Gestão de Projetos (Project Management) from the University of Aveiro and Matemática Aplicada à Engenharia (Applied Mathematics for Engineering) from UNESP. Each course had a workload of 26 hours, and Portuguese was the working language.

Environmental management and protection within the corporate context are intrinsically linked to sustainability, a widely debated topic that features prominently on the agenda of numerous governments and international organisations. A striking balance between economic development and the preservation of natural resources is essential to ensure that present needs are met without compromising the ability of future generations to meet their own needs.

By implementing environmental management practices, such as emission reduction, efficient use of resources, and proper waste treatment, companies can significantly reduce the environmental impact of their activities. In this context, it is essential to gather information on the environmental protection initiatives adopted by companies, including data on investments made, operational costs, and the benefits derived from the implementation of sustainable equipment and processes.

The project aimed to analyse the sustainability efforts of companies in Portugal via mathematical tools and project management techniques. Students, organised into binational groups, analysed data on the environmental management initiatives adopted by Portuguese companies, such as investments in clean technologies, pollution control costs, and revenue generated from sustainable practices. At the conclusion of the project, the groups presented a report and a pitch showcasing the analysis results by region in Portugal.

The main objectives of the project were (1) to assess corporate investments in technologies that reduce environmental impact; (2) to determine the costs associated with pollution control and prevention; (3) to evaluate the revenue generated from pollution control initiatives; (4) to apply statistical techniques and mathematical tools to analyse environmental management initiatives; and (5) to apply project management techniques and tools. The transversal skills to be developed by students included collaboration within international teams, critical thinking, digital proficiency, time management, and intercultural communication.

The COIL ESTGA-UNESP Project 2024/25 was planned with reference to some learning objectives of the participating course units and was structured into distinct phases to facilitate its development. The project began with an introduction to its objectives, followed by the formation of teams comprising students from both universities. At this stage, tasks are allocated, and a timeline is established. Prior to the phases dedicated to the core theme of environmental management in companies, an icebreaker activity was carried out: each group produced a video highlighting aspects of their universities, cities, and cultural background.

In the next phase, each student group was assigned a dataset from the Portuguese National Statistics Institute regarding corporate environmental management and

protection in a specific Portuguese region, which was based on the Nomenclature of Territorial Units for Statistics (NUTS) 3, for the years 2018 and 2019.

Given the short duration of the project, each group was assigned one of the following datasets for analysis: investments, expenses, or revenues related to corporate environmental management. To gain a deeper understanding of the data, each group was required to conduct research on the theme of environmental management, as well as on the region on which their analysis focused. Additionally, they were tasked with reviewing and comprehending the survey that underpinned the data provided to them. Once the tasks, timeframe, and human resources had been defined, the students developed the project timeline, a work breakdown structure, and a corresponding dictionary. Additionally, a communications plan was proposed. The following phase involved the application of statistical techniques to analyse the data. On the basis of this analysis, the teams discussed their preliminary results and adjusted their approaches as necessary.

They subsequently began drafting the final report, in which the analysed data were structured and interpreted. Simultaneously, the teams prepared a pitch presentation to showcase the main findings of their study, receiving feedback to refine their materials. Finally, the project concludes with a final presentation, where students share their conclusions. The project closed with a reflection on the learning outcomes and an evaluation of the impact of international collaboration on participants' development. Student interaction took place through both synchronous sessions (via Zoom) and asynchronous communication, with weekly meetings of 1--2 hours on video conferencing platforms chosen by each group. Each team had a project manager and a secretary, who were responsible for preparing the meeting minutes. Communication also occurred via a digital noticeboard on Padlet.

The project activities included (1) an initial icebreaker session and project presentation; (2) research and data analysis on environmental management initiatives by Portuguese companies; (3) intermediate presentations and discussions; (4) preparation of the final report and pitch; and (5) individual reflections on the project. Tasks were completed over an 8-week period, with a total workload of 26 hours per course unit, distributed between synchronous and asynchronous activities.

Following the icebreaker activity, groups were supported on a weekly basis, with the teaching staff, where students could clarify their doubts during each session. These sessions were voluntary, and not all groups attended them.

4. Results and Discussion

At the end of the COIL project, students were invited to complete two questionnaires: one created by the Pedagogical Innovation Office of the University of Aveiro (QUA), which is used in all UA COIL projects, and a supplementary questionnaire (SQ) developed specifically by the organising team of this project. The QUA questionnaire covered topics such as prior participation in COIL projects, the main transversal skills

developed, and the three most successful and the three least successful aspects of the experience. It also included a question on overall satisfaction with the project, measured on a 5-point Likert scale, as well as an open-ended question for suggestions.

The supplementary questionnaire (SQ) consisted of open-ended questions about group dynamics, communication methods used, the role of meetings in the development of the work, and the lessons learned from the project, with the aim of promoting continuous improvement in future editions.

With respect to the QUA questionnaire, approximately 64% of the students who participated in the project responded. Of these, 95% reported that it was their first time participating in a COIL project. Among the most developed transversal skills (Figure 1), international collaboration (64.9%), teamwork (56.8%), and intercultural communication (48.6%) stood out.

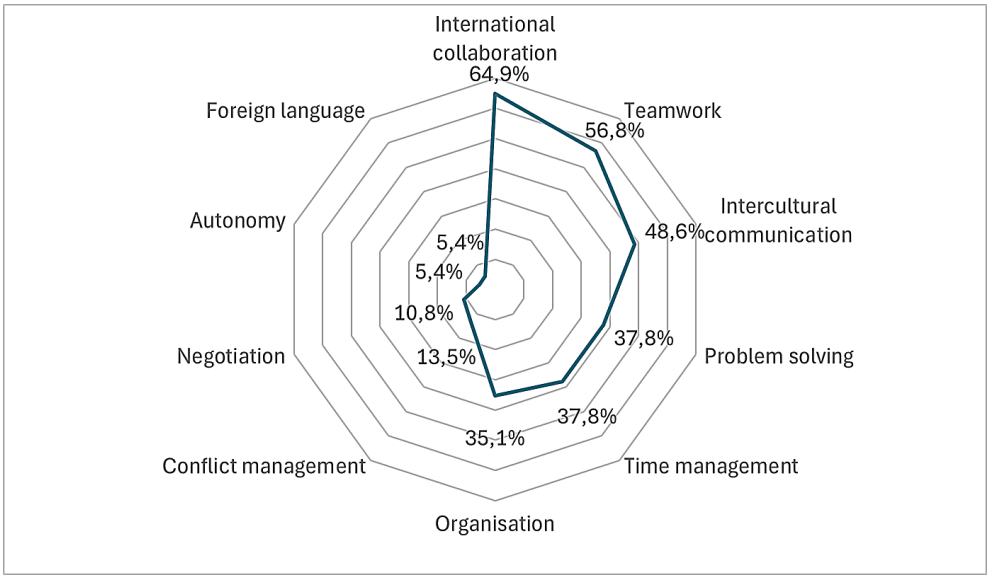

Figure 1: Most developed transversal skills

Figure 2 shows overall satisfaction with the COIL project: 54% of the respondents reported being satisfied or very satisfied, whereas 40% expressed a neutral opinion. With respect to the three most successful aspects, most students highlighted transversal skills (Figure 3). Specifically, 19.3% referred to distinct competences, whereas 44.3% mentioned aspects related to the course units involved in the project, such as data handling, insights into the topic, problem solving, and teamwork.

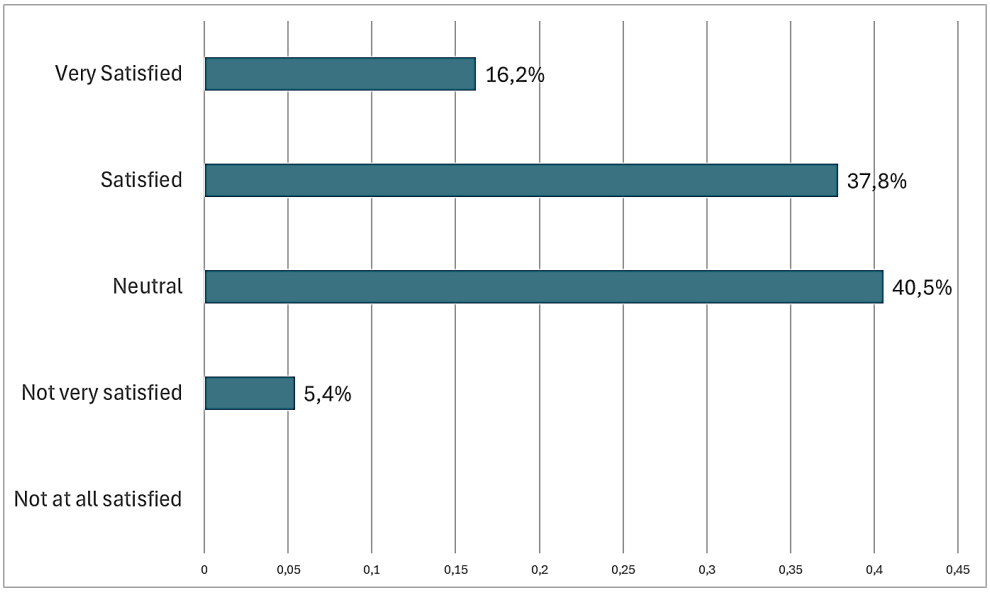

Figure 2: Overall satisfaction with the COIL project

These findings suggest that students perceived this learning experience as a valuable way of complementing their technical and scientific development with a range of transversal skills. The analysis of the responses to the SQ further supports this conclusion, indicating that, overall, the students felt that the COIL project provided an enriching experience that fostered collaboration, intercultural communication, teamwork, internationalisation, and adaptability to different working methods.

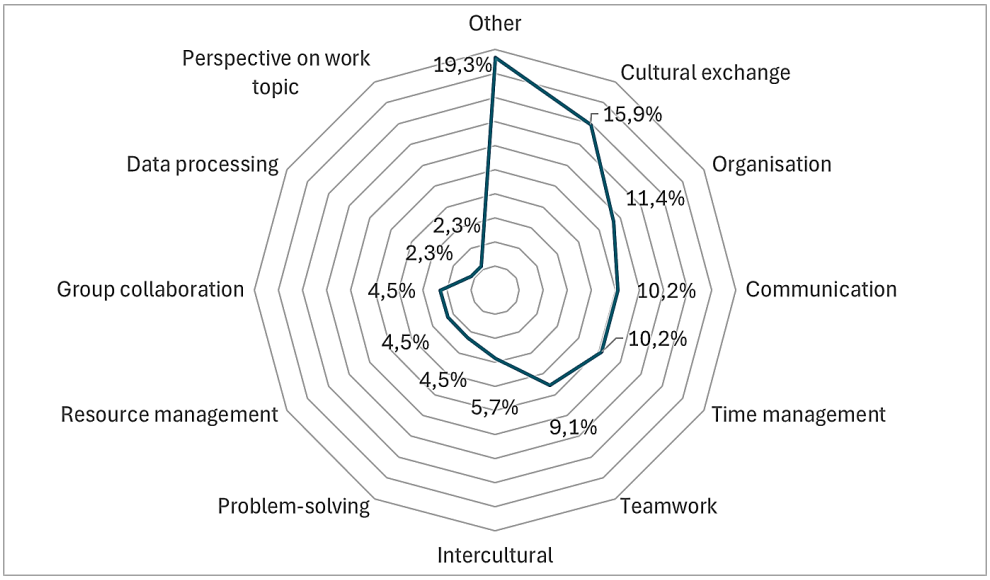

Figure 3: Most successful aspects of the COIL project

Collaboration and teamwork emerged as fundamental elements. The participants valued "*the unity of the group, the ability to organise themselves as a team, and the maintenance of cohesion when making decisions of common interest*." The need to coordinate schedules with peers from another country and to understand different approaches to work was

also noted. Moreover, group dynamics and the ability to manage diverse personalities within the team were seen as valuable, as one participant noted: "*We considered that some team members are more shy/introverted than others and therefore found it a bit harder to participate*." The importance of understanding different working styles and being patient was also emphasised: "*Each group member has their own way of working, different from the others, and this requires a great deal of patience to ensure the team functions well*."

Intercultural communication and the exchange of experiences were key themes in the participants' feedback. Engaging with peers from different countries allowed them to "*understand different cultures*" and become more aware of how context shapes communication: "*Since it is a different country from ours, even though the language is similar, it was hard to understand what the others wanted. Therefore, COIL increased our ability to find different solutions and new ways of communicating*." This experience facilitated a deeper understanding of another country's culture, both linguistically and behaviourally, as expressed in the following reflection: "*It was fascinating to learn about Portuguese culture and the people in my group. I didn't know how different customs, the way of speaking and behaving, were from Brazil*."

Internationalisation without the need to travel was also seen as a positive aspect, making the exchange more accessible and inclusive, "*without the need to relocate to another country*." The experience also contributed to a greater awareness of cultural diversity and the formation of bonds among participants, despite initial hesitations and unfamiliarity. As one student noted, "*Although it was difficult to connect at first, we managed to build a bond, which taught me that it's possible to overcome barriers*."

Finally, students recognised the relevance of this experience in preparing for the professional world, as it helps "*to understand the reality of the job market, where we'll work with people we don't know who may have different opinions from ours – but through communication, we can build a proactive team*."

In terms of the least successful aspects, the QUA responses were more varied and are grouped in Figure 4 into six categories: group, technical work, time, cultural, planning, and individual. Among these, 38% referred to group-related issues, such as low participation from some members, unbalanced task distribution, and communication breakdowns. The technical work category (29.6%) included difficulties in understanding the project, communicating with instructors, and clarity of objectives. The time category accounted for 16.9% of the responses, mainly in terms of time zone differences, schedule coordination, and time management. The remaining three categories together accounted for 15.5% of the mentions; aside from individual proactivity, the responses in these categories were unique.

Six suggestions were made, half of which called for increased support from teaching staff to the groups, and two others recommended improving communication between the project organisers.

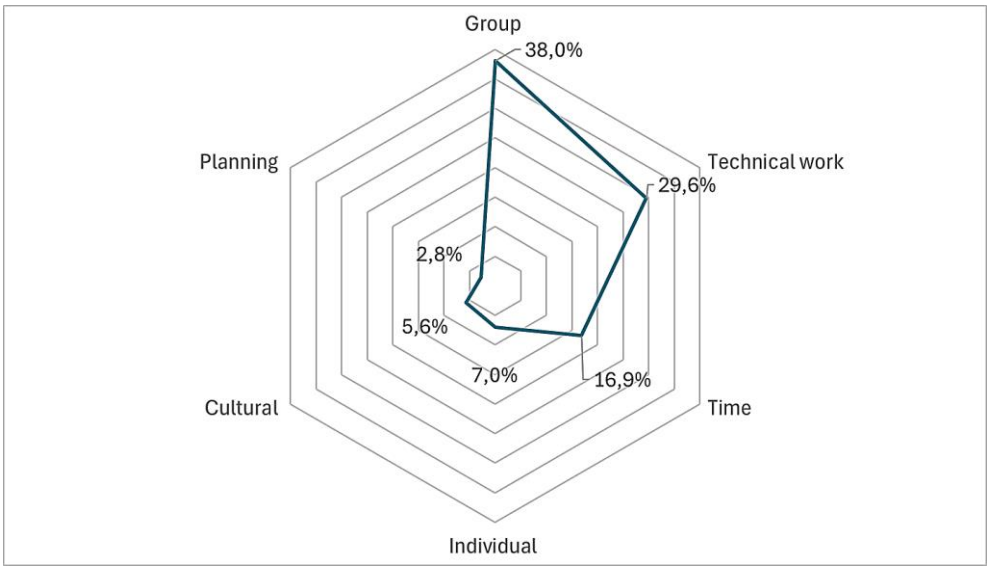

Figure 4: Least successful aspects of the COIL project (by dimension)

With respect to group size, the most prominent challenges also arise in group work settings within curricular units at a single institution and may become even more significant in an international and multicultural environment. Importantly, these challenges are frequently − more common than desirable − and are associated with scenarios typical of professional contexts. This exposes students to situations they are likely to encounter in the near future, although we believe such aspects should be minimised within the academic training framework.

To mitigate these issues, we propose, for future COIL projects, an increase in project-related activities that promote group cohesion and individual accountability. On the other hand, students should receive prior training in areas such as time management and collaborative work. We should also consider the possibility of reducing the number of students per group while adjusting the workload accordingly.

The significant percentage of shortcomings observed in this COIL project, attributed to the technical workload, along with the suggestions presented, prompts us to reflect retrospectively on the strategies adopted − both in the presentation of the project and in communication with the groups and their follow-up. To achieve the defined objectives regarding work on environmental management in companies, research and reading of documentation were needed. For this purpose, clarification sessions with lecturers were organised. However, some groups did not take advantage of these opportunities, which hindered their understanding of the task at hand. These sessions, together with weekly follow-ups − non-mandatory and held separately, in person, in both countries − proved not to be the most suitable approach. It is considered that joint follow-up sessions held virtually would have enabled more effective communication with all students. Moreover, encouraging greater exchange between groups could have supported the understanding of the project by the less proactive teams.

The information obtained through the SQ allows for a more nuanced analysis of the less successful aspects of the project. Despite sharing a common language, some

participants identified language barriers, noting that "*the way of speaking is completely different*," which initially made it difficult for Brazilian and Portuguese members to communicate effectively. However, as the project progressed, "*communication improved, and members began to speak more slowly to help everyone understand*."

The participants were asked in the CQ about communication, the channels and technologies used, and their suitability. The tools employed were consistent across the groups, with WhatsApp, Zoom, Google Meet, Email, and Google Drive being the most frequently used tools. There seems to be consensus among participants regarding their suitability, but underutilisation was also noted, as reflected in the statement, "*The channels and technologies used were suitable but not always well utilised*." Several factors contributed to this overall perception, including a lack of responses or engagement from some group members, challenges in scheduling meetings, and, when meetings did occur, issues such as absences, lack of active participation, or poor involvement from certain members. These challenges led many participants to express that this "*ultimately impacted the results of the work*."

Meetings are essential management tools, allowing for the assessment of project progress and ensuring that all participants are aligned with the project's objectives and goals. They facilitate the creation of communication strategies that support the monitoring and development of work. The participants' opinions regarding the meetings and their role in the project's development varied. Some students reported communication issues and a lack of productivity during the meetings, noting that "*the group's internal communication wasn't ideal*" and that "*the group didn't work as efficiently or proactively as it should have*," which hindered the effectiveness and dynamics of the work.

However, several students emphasised the importance of the meetings, highlighting how the group used them to achieve the project's objectives. They stated that "the weekly meetings were very helpful in terms of alignment and the strategy to be followed" and, as a result, "*they were productive and allowed us to track our progress each week*," providing opportunities to clarify doubts and align objectives. One participant highlighted that "*communication during the week was very effective, as we used WhatsApp, allowing everyone to contribute when available. Additionally, all the documents related to the work were available on Google Drive. Therefore, everyone could edit and track the progress*." Although the meetings were brief (approximately 30 minutes on average), they were productive because there was always an agenda outlining the key points to be discussed.

This statement reflects the essential role that meetings play in the smooth functioning of the group, communication, and the organisation and monitoring of work. When meetings are planned, structured, and goals are clearly defined, they enable weekly progress and, as a result, enhance productivity.

The responses obtained through the SQ also highlighted problems related to the organisation and structuring of tasks. These issues included poor task distribution, lack of proactivity and involvement from some team members, difficulty maintaining an efficient work pace, and challenges in collaboration, which resulted in some team members being overloaded.

Reflecting on their teamwork experience, the students were asked in the SQ to share the main lessons learned from the project and what they would change or do differently in the future to improve productivity, communication, and team effectiveness. One of the keys and most frequently mentioned lessons was the importance of communication and teamwork. As one participant stated, "*I learned to work in a group with people I didn't know. I also learned to communicate better*," emphasising the need to adapt to different communication and collaboration styles. Interaction with colleagues from other nationalities also provided the opportunity to experience new cultures and working methodologies, fostering greater openness and flexibility in professional interactions.

Assertiveness was identified as a crucial aspect, with participants recognising the importance of "*being more assertive and direct about each participant's contributions from the outset*" and addressing issues related to agenda availability in advance to ensure better communication and organisation. Time management also emerged as a significant challenge, with some participants acknowledging the need to start work on time, organising their time more effectively, and avoiding tight deadlines. Leadership was highlighted as another key element for successful collaboration, with one participant emphasising that "*having a leader to help guide the process is always going to be the most crucial part*".

This experience prompted reflections on the need for more efficient communication and more strategic approaches to task division. As one participant expressed, "*I believe that in the future, I will be more proactive (...). I want to be more proactive in requesting tasks and thus have greater and more effective participation in the work*".

5. Conclusion

Collaborative online international learning (COIL) is an innovative pedagogical strategy that enables the internationalisation of higher education without the need for physical mobility. It contributed to the development of essential skills for the job market while allowing universities to strengthen their global reputation and promote cultural diversity in an accessible and inclusive way. The experience reported in this article demonstrates the potential of COIL to provide a more complete learning experience for higher education students. UA and UNESP have followed an assertive path in the development of COIL projects, seeking to democratise the internationalisation experience for students and teachers. The partnership between the two institutions in the project under study demonstrated the potential of COIL in academic education. Students from different areas analysed business sustainability in Portugal, applying mathematical and project management tools. The impact of the project was evident, as students developed skills in research, critical analysis and interpretation of financial information related to environmental management. The application of statistical techniques to assess investments, expenses, and revenues in companies' environmental management provided relevant learning for their future careers.

The results indicated positive reception by the students, with the majority of students expressing satisfaction or high satisfaction in participating in the project. However, a significant portion of the students did not have a clearly positive perception, which may be related to the difficulties and challenges faced during the project. Among the main challenges noted, the unequal participation of group members, the unbalanced distribution of tasks and communication failures were highlighted. These factors are common in virtual collaborative projects, especially when there are cultural differences and time zones involved. Time management was another obstacle, as students had to reconcile their academic and personal routines with the demands of the project. Even when they share Portuguese as a common language, students face linguistic barriers due to variations between the Portuguese spoken in Brazil and Portugal. This finding reinforces the importance of adapting and developing effective communication strategies to avoid misunderstandings. Despite these difficulties, COIL has proven to be an effective tool for internationalisation and professional development. Leadership within the groups was a determining factor for the success of the project, helping to overcome obstacles and maintain team cohesion. The experience highlighted the importance of teamwork, organisation and flexibility in international collaboration.

On the basis of these results, future COIL projects can benefit from strategies to minimise difficulties, such as prior training on intercultural communication, time management and balanced task division. The creation of more effective mechanisms to encourage the active participation of all members can also contribute to more homogeneous and productive engagement. In summary, the COIL project "Environmental Management and Protection: Analysis of Initiatives Adopted by Portuguese Companies" represented a unique opportunity for UA and UNESP students to develop essential 21st century skills, including international collaboration, intercultural communication, critical thinking and problem solving. Despite the challenges faced, the experience has proven to be highly enriching, contributing significantly to the education of university students with a global vision, who are engaged in and prepared for the challenges of the contemporary world. The results, and the lessons learned, reinforce COIL as an innovative and promising methodology for the internationalisation of higher education, allowing educational institutions to train their students in an increasingly globalised and intercultural job market. In this way, the continuity and improvement of COIL projects, such as the one developed between UA and UNESP, are fundamental for the promotion of more inclusive, innovative and aligned higher education with the demands of the current scenario.

Author Contributions

Magda Monteiro: conceptualization (equal), data curation (equal), formal analysis (lead), methodology (equal), writing – original draft (equal). Sónia Estrela: conceptualization (equal), data curation (equal), formal analysis (supporting), methodology (equal), writing – review and editing (equal). Henrique Faria: conceptualization (equal), supervision (lead), writing – review and editing (equal).

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