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Thematic shifts and structural continuities in COIL/virtual exchange research: a longitudinal bibliometric study (2010–2025)

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This study presents a longitudinal bibliometric analysis of Collaborative Online International Learning (COIL) and closely related virtual exchange scholarship from 2010 to 2025, examining the evolution of research themes, geographic distribution, and methodological approaches. Using Scopus data ($n = 176$ records) and co-word analysis techniques, we identify three distinct phases: foundational consolidation (2010–2017), expansion and technification (2018–2021), and institutional consolidation (2022–2025). Findings reveal steady growth in publication volume and thematic diversification, with intercultural competence remaining central while competencies such as digital literacy, critical thinking, and communication skills gain prominence. Geographic analysis shows broader participation from middle-income countries post-2020, yet leadership remains concentrated in high-income contexts. Co-word mapping suggests lexical drift rather than clear structural renewal: new terminology related to policy, equity, and assessment frameworks accretes around stable pedagogical templates, while evidence of substantially reconfigured task architectures or evaluative paradigms remains limited. The study concludes that while COIL/Virtual Exchange has achieved administrative mainstreaming and scale, its future contribution to language education and CALL depends on more explicit L2 task design, interactional evidence, feedback integration, and equitable collaboration structures.

Keywords: COIL, virtual exchange, bibliometric analysis, internationalization, higher education

Introduction

Over the past decade and a half, Collaborative Online International Learning (COIL) has progressed from an experimental pedagogical format to a recognized component of global higher education. Its origins date to the mid-2000s, amid a growing need to foster meaningful, sustained connections between

students and faculty across borders, circumventing the logistical and financial barriers of physical mobility. Initially embraced by a small community of practitioners, COIL embedded intercultural engagement into curricula, aligning with calls for “internationalization at home” and expanding access to global learning opportunities (Beelen & Jones, 2015; Rubin, 2017). Over time, these initiatives developed into institutionally supported programs, shaped by advances in digital technology, shifts in policy, and the recognition that fewer than 10% of students can participate in study abroad (De Wit & Hunter, 2015).

Despite COIL’s pedagogical merits, systematic academic investigation emerged only recently. Early implementation was mostly limited to a few institutions, most notably the State Universities of New York (SUNY), and publications largely consisted of practice-oriented reports. Scholarly engagement gained momentum in the mid-2010s, producing a still-limited but steadily growing body of research (Çiftçi & Savaş, 2017). As Makda (2024) notes, however, current COIL scholarship remains disproportionately concentrated in high-income countries, reflecting its Global North origins and underscoring the need for broader geographical representation.

The COVID-19 pandemic marked a turning point. With international travel suspended and higher education shifting online, many universities adopted COIL to maintain global learning opportunities (Pokhrel & Chhetri, 2021). This was followed by a sharp rise in initiatives, with COIL studies documenting implementation in previously less represented contexts such as South Africa (Naicker et al., 2022). By 2021, COIL had evolved from boutique innovation to a mainstream element of international education, attracting new stakeholders, diverse implementation models, and heightened scholarly interest in its pedagogical and institutional dimensions (Weaver et al., 2024).

Parallel to this expansion, COIL has increasingly been examined through bibliometric and mapping approaches offering field-level perspectives on thematic scope, geographic distribution, and evolution over time (Balula, 2022; Barbosa & Ferreira-Lopes, 2023; Makda, 2024; Sharma & Panackal, 2025). Yet these contributions remain limited in coverage and highlight persistent imbalances, for instance, the dominance of high-income contexts and the underrepresentation of the Global South. It remains unclear whether COIL research has genuinely moved in new directions or continues to revisit familiar themes under evolving terminology (O’Dowd, 2021).

This study addresses that gap by conducting a longitudinal mapping of COIL scholarship from 2010 to 2025. Using bibliometric and co-word analysis (Passas, 2024; Kumar, 2025), it charts thematic developments, traces new competencies, and introduces structural proxy indicators for examining geographic equity in authorship and collaboration. The analysis distinguishes three phases in COIL research: foundational (2010–2017), expansion and technification (2018–2021), and institutional consolidation (2022–2025).

The study is guided by the following research questions (RQs):

- **RQ1:** How has COIL research evolved over time in terms of publication volume, disciplinary scope, and thematic diversity?

- **RQ2:** What conceptual and pedagogical foci have characterized COIL scholarship across its different phases of development?
- **RQ3:** What structural proxy evidence of equity can be identified in the geographical distribution of authorship and collaboration in COIL research?
- **RQ4:** What thematic gaps and emerging directions can be identified in the COIL literature, and how might these inform future research agendas?

Rather than treating COIL research as a homogeneous or linear field, this study adopts a periodized approach to capture its internal shifts, both conceptual and structural. The tripartite division reflects changes not only in output or implementation scale but also in discourse, goals, and the actors shaping the field. Such differentiation is essential to understanding the interplay between pedagogical innovation, institutional embedding, and the broader dynamics of global higher education. Given the prominence of language education within COIL/Virtual Exchange, the study also considers how these longitudinal patterns inform L2 task design, assessment of online intercultural interaction, feedback practices, and teacher development in CALL-oriented contexts.

Background and literature review

The practice of Collaborative Online International Learning (COIL) emerged in the early 2000s as part of a broader continuum of online intercultural learning initiatives, including telecollaboration, virtual exchange, and online intercultural exchange (O'Dowd & Lewis, 2016; Dooly & Sadler, 2016; Dooly, 2017). While these approaches share reliance on digital communication tools to connect students across borders, COIL is distinctive in its emphasis on integrated curriculum design, co-teaching between partner faculty, and credit-bearing activities embedded in existing courses (O'Dowd, 2018; Hackett et al., 2023). In this sense, COIL represents not only a pedagogical innovation but also a structural response to the limitations of physical mobility, namely financial costs, accessibility, and the persistent “elite bias” of study abroad (Van Mol & Timmermann, 2014; Shields, 2019; Mittelmeier et al., 2020). Its expansion has paralleled wider transformations in international higher education, where the paradigm of “internationalization at home” has gained traction as a way to democratize global learning opportunities (Leask, 2016; De Wit & Altbach, 2021). The COVID-19 pandemic acted as an accelerator, normalizing online collaboration and reinforcing COIL's potential to sustain international engagement during restricted mobility (Liu & Shirley, 2021; Barbosa & Ferreira-Lopes, 2023). In this context, many institutions began to view COIL not as a stopgap but as a long-term strategy for embedding inclusive internationalization in curricula (Guth & Rubin, 2015).

Research on COIL consistently highlights benefits across intercultural, linguistic, digital, and institutional dimensions. A robust body of evidence points to its role in fostering intercultural competence, raising awareness of cultural diversity, and developing empathy and openness to alternative perspectives (Dooly & Sadler, 2016; Avgousti, 2018; Marsee & Pineda-Hoyos, 2025). Beyond interculturality, COIL contributes to digital literacy, notably in students' ability to

collaborate online, manage intercultural communication, and critically engage with information across cultural contexts (Chaiyasat, 2024; Jie & Pearlman, 2018; Wekerle et al., 2022). Language learning outcomes are equally prominent, especially in EFL contexts, where students report increased communicative confidence and adaptability through authentic peer interactions (Bueno-Alastuey & Esteban, 2016; Godwin-Jones, 2019; Wach et al., 2022). Nishio (2023) emphasizes the pragmatic and communicative gains among Japanese learners, while Mestre-Segarra and Ruiz-Garrido (2022) document motivational and linguistic benefits in Spanish classrooms. At the institutional level, COIL advances curriculum internationalization and faculty development. Cardoso et al. (2024) describe how projects facilitate interdisciplinary collaboration, while Helm (2019) notes their potential to foster inclusivity and innovation. Faculty often report growth in collaborative teaching, digital pedagogy, and intercultural awareness (Swartz, 2021; Vahed, 2024).

These benefits, however, coexist with persistent challenges. Practical barriers such as mismatched academic calendars, inconsistent assessment practices, and credit recognition difficulties are widely reported (O'Dowd, 2020; Uzhegova & Baik, 2022). Language issues and unequal access to technological infrastructures also complicate implementation, especially in collaborations involving less digitally resourced institutions (Kayumova & Sadykova, 2016; Fragouli, 2021). Moreover, inequities in Global North–South partnerships remain a critical concern. While COIL is often presented as inclusive, evidence reveals persistent imbalances in whose perspectives shape project design, reporting, and publication (Gui et al., 2019). Mittelmeier et al. (2020) highlight the concentration of knowledge production in high-income contexts, and Sharma and Panackal (2025) confirm the continued dominance of the Global North. Such asymmetries raise questions about not only logistical sustainability but also epistemic justice and equity in global higher education (Tight, 2022).

The versatility of COIL has supported its adaptation across diverse academic fields. In the social sciences and humanities, projects typically promote intercultural dialogue, critical reflection, and comparative analysis (Dooly & Sadler, 2016; Naicker et al., 2022). In STEM, the focus often shifts to collaborative problem-solving, applied research, and digital tools for addressing real-world challenges (Marcillo-Gómez & Desilus, 2016; West et al., 2022). In health sciences, COIL simulates professional intercultural encounters, preparing students for globalized work environments (Woodley et al., 2023). Language education remains the most prominent domain, not only due to its natural alignment with intercultural interaction but also because of abundant empirical evidence documenting positive outcomes (Godwin-Jones, 2019; Mestre-Segarra & Ruiz-Garrido, 2022). This disciplinary spread confirms the pedagogical flexibility of COIL, but it also fuels terminological variation, complicating cumulative knowledge-building and bibliometric analysis (O'Dowd, 2022).

Bibliometric perspectives on COIL are relatively recent but revealing. Balula (2022) conducted one of the earliest mappings of the field, identifying growing visibility alongside fragmentation and terminological inconsistencies.

Sharma and Panackal (2025) expanded this work with a large-scale study, uncovering exponential publication growth since 2020, particularly in the post-pandemic period while also highlighting the persistent dominance of Global North contexts. Barbosa and Ferreira-Lopes (2023) similarly analyzed telecollaboration and virtual exchange literature (2008–2020), documenting thematic diversification yet limited international collaboration. Makda (2024) offered a broader bibliometric overview of virtual teaching, emphasizing the surge in digital education research and ongoing regional imbalances. Ghani et al. (2022) demonstrated the value of bibliometric tools in identifying thematic clusters such as digital literacy, equity, and sustainability that mirror the field’s evolving priorities. Together, these studies underscore the need to move beyond isolated case studies toward field-level perspectives, while also revealing the relative scarcity of bibliometric research on COIL compared to related practices like virtual exchange and online learning (Mittelmeier & Yang, 2022).

Taken together, the literature shows signs of both consolidation and fragmentation. On the one hand, ample evidence supports COIL’s positive impact on intercultural, linguistic, and digital skills, along with its role in promoting inclusive internationalization (Paudel, 2021; Calvo & Hartle, 2024). On the other hand, gaps remain. Most research focuses on short-term outcomes, with little longitudinal tracking of academic or professional effects. Tools to measure competencies like critical thinking, adaptability, and resilience are underdeveloped (Ghani et al., 2022). Conceptual ambiguities persist, as overlapping terms like “virtual exchange” and “telecollaboration” hinder cumulative knowledge development (O’Dowd, 2018; Hackett et al., 2023). Moreover, the overrepresentation of high-income contexts continues to challenge the narrative of COIL as a truly democratizing practice (Mittelmeier et al., 2020).

Addressing these gaps calls for methodological innovation and greater equity. Scholars have urged more comparative, cross-regional studies, shared evaluation frameworks, and deeper engagement with epistemic justice in international collaboration (Uzhegova & Baik, 2022; Mittelmeier & Yang, 2022). This study responds to that agenda by offering a longitudinal bibliometric and co-word analysis that traces COIL’s thematic evolution while highlighting underexplored areas and directions for future inquiry.

Methodology

Data sources and search strategy

We conducted a longitudinal bibliometric study focused on COIL scholarship between 2010 and 2025, combining performance indicators with science-mapping (co-word) techniques (Donthu et al., 2021; Zupic & Čater, 2014). Scopus was selected as the primary source because of its broad coverage in education and social sciences, consistent metadata (DOIs, author affiliations, keywords), and stable export formats suitable for reproducible processing. Relying on a single index avoids cross-database deduplication artifacts and facilitates replication, while we acknowledge (and later discuss) the trade-off in potential omissions from non-indexed venues.

The query targeted title, abstract, and keywords and combined the canonical term and close equivalents: “Collaborative Online International Learning” OR COIL together with related labels used in the literature (virtual exchange, online intercultural exchange, telecollaboration). The resulting corpus should therefore be understood as COIL-centred but not COIL-exclusive: it maps the broader COIL/virtual exchange/telecollaboration ecosystem insofar as these labels are used to describe curriculum-embedded online international collaboration in higher education. To minimize false positives from non-educational uses of “coil” (engineering/biomed), we included exclusion tokens frequently found in those domains (e.g., magnetic, inductor, MRI, coil spring).

The complete search strategy, including the Boolean string, retrieval date, screening criteria and technical processing, is summarized in Table 1.

Table 1. Search strategy and retrieval parameters

Element	Description
Database	Scopus
Date of retrieval	25 May 2025
Search fields	Title, Abstract, Keywords
Boolean string	“collaborative online international learning” OR “COIL” OR “virtual exchange” OR “virtual mobility” OR “online intercultural exchange” AND PUBYEAR > 2009 AND PUBYEAR < 2026
Languages included	No restrictions
Document types	Articles & Reviews (core); Conference papers & Editorials conditionally included
Subject area filters	Education, Social Sciences, Arts & Humanities, Computer Science–EdTech
Years covered	2010–2025
Software used for analysis	Bibliometrix/Biblioshiny (preprocessing and statistics); VOSviewer 1.6.20 (network construction)
Initial retrieval size	475 entries
Automated filtering	Excluded 62 irrelevant entries (e.g., “coil” in engineering/biomedical contexts)
Export format	.ris

Although some documents existed before 2010, the sustained scholarly conversation around COIL consolidates thereafter; hence the analytical window begins in 2010 to balance coverage with thematic signal.

The initial export comprised peer-reviewed articles and reviews in any language, provided their metadata included English abstracts or keywords. Conference papers and editorials were considered only if they reported empirical or programmatic findings directly relevant to COIL practice; otherwise, they were excluded during screening. All records were ingested into Bibliometrix/Biblioshiny for preprocessing and descriptive statistics (Aria & Cuccurullo, 2017) and into VOSviewer for network construction (van Eck & Waltman, 2015).

Following best practices in bibliometric research, the selection and inclusion process was reported using the PRISMA 2020 guidelines (Page et al., 2021), which enhance the transparency and reproducibility of literature-based studies. Figure 1 presents the PRISMA flow diagram summarizing the number of records identified, screened, excluded, and retained for analysis.

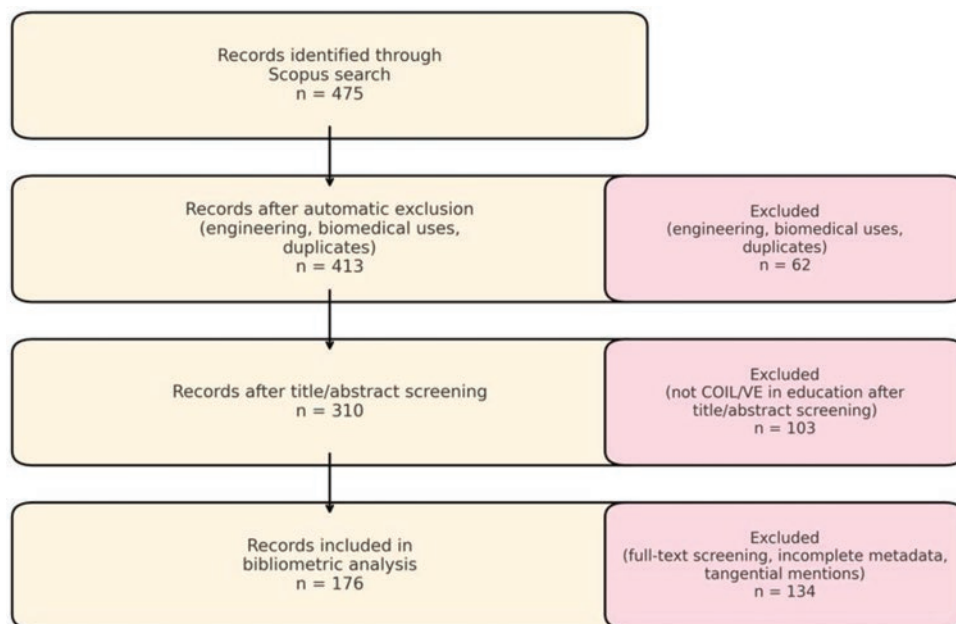


Figure 1. PRISMA flow diagram of the inclusion and screening process

The initial Scopus query returned 475 records. After automated filtering to remove non-educational uses of ‘COIL’ (e.g., magnetic coil, inductor, medical imaging), incomplete entries, and duplicates, 62 records were excluded. Title and abstract screening of the remaining 413 entries led to the exclusion of 103 records that did not directly address COIL or related practices in educational contexts. This left 310 full records assessed for eligibility. After full-text screening and evaluation of metadata completeness and thematic relevance, 134 records were excluded. A final dataset of 176 records was retained for bibliometric and co-word analysis.

To further support methodological transparency, a visual representation of the full analytical workflow is also provided. Figure 2 outlines the main steps involved in the study, from the initial query design and dataset cleaning, to the descriptive analysis and thematic mapping using co-word techniques.

Screening, normalization, and harmonization

Screening proceeded in two automated and one manual pass. First, a rules-based filter removed obvious false positives by scanning titles/abstracts for the exclusion tokens above. Second, we restricted to education-relevant categories by checking Scopus subject areas (Education; Social Sciences; Arts

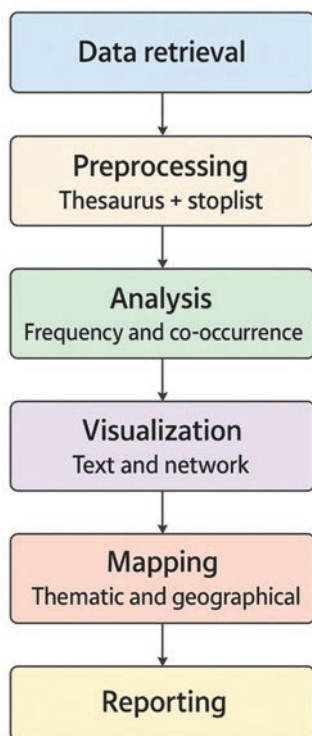


Figure 2. Overview of the bibliometric workflow

& Humanities; Computer Science – EdTech). Third, one reviewer manually checked all flagged items and edge cases, retaining studies where COIL functioned as an educational initiative even if the acronym usage differed from the SUNY lineage. Because this manual screening stage was conducted by a single reviewer, no inter-rater agreement statistic was calculated.

Deduplication used DOIs as primary keys; when absent, we applied a fuzzy match on normalized titles (lowercased, diacritics removed, punctuation stripped) with conservative thresholds to avoid over-merging. Author names were disambiguated by collapsing frequently occurring variants (e.g., initials vs. full names; diacritics) while preserving distinct identities when co-authorship patterns or affiliations diverged. Affiliations were standardized to country level for the structural equity proxy indicators (see Table 3), drawing on the affiliation field in Scopus exports and a curated list of country aliases.

Because COIL/VE terminology is heterogeneous, we built a thesaurus to merge near-synonyms and orthographic variants (e.g., Collaborative Online International Learning, COIL course, virtual exchange, online intercultural exchange, telecollaboration). In parallel, we constructed a stoplist to suppress high-frequency but low-discrimination terms (students, higher education, course, semester, intervention), which otherwise inflate centrality without adding thematic specificity. These descriptors were excluded because they primarily represented the generic educational setting shared by a large proportion of the corpus rather than analytically distinctive themes. Retaining such ubiquitous terms would have increased their apparent centrality in the

Table 2. Thesaurus of merged terms and stoplist of excluded descriptors

Merged terms (Thesaurus)	Excluded terms (Stoplist)
Collaborative Online International Learning → COIL	students
online intercultural exchange → virtual exchange	higher education
COIL course → COIL	course
telecollaboration → virtual exchange	semester
virtual mobility → virtual exchange	intervention
online international collaborative learning → COIL	teaching
Collaborative Online Learning → COIL	global
virtual exchange course → virtual exchange	mobility

Table 3. Top 15 countries by number of COIL-related publications (corresponding author) with HDI classification

Country	Articles	HDI rank (2022)	HDI category
United States	28	21	Very High
Spain	20	27	Very High
Germany	16	9	Very High
United Kingdom	14	18	Very High
Mexico	12	86	High
Italy	10	23	Very High
Netherlands	10	8	Very High
Brazil	9	87	High
Canada	9	16	Very High
China	8	79	High
Japan	7	19	Very High
Australia	6	5	Very High
India	6	134	Medium
Colombia	6	95	High
South Africa	5	109	Medium
Other	10		

co-occurrence networks while reducing the visibility of more discriminating concepts relevant to thematic differentiation across periods.

To facilitate transparency and replication, Table 2 presents a representative selection of merged terms from the thesaurus and the most frequently excluded terms from the stoplist.

Both thesaurus and stoplist were applied to the Scopus keyword fields before map generation in order to reduce terminological noise and improve semantic consistency across records.

For the co-word maps, keyword sources were standardized using VOSviewer's "All keywords" option, which combines author keywords and index keywords. Both keyword sources entered the co-occurrence analysis without differential weighting. Title and abstract fields were used for retrieval, screening, and eligibility assessment, but they were not used as an additional term-extraction source in the VOSviewer co-word maps. Author keywords and index keywords nevertheless represent different forms of conceptual categorization: the former reflect authors' own framing of their studies, whereas the latter incorporate database-mediated indexing. Combining them may therefore influence the thematic structure of the resulting maps by increasing the visibility of concepts introduced or standardized through indexing. The maps should consequently be interpreted as representations of the combined author- and index-keyword structure of the Scopus-indexed corpus rather than as direct representations of authors' conceptual choices alone.

Analytical procedures

Our approach combines performance analysis (to address RQ1 and part of RQ3) and science mapping (RQ1–RQ2–RQ4), following standard bibliometric protocols (Donthu et al., 2021). Performance indicators include annual output, outlets, most-productive authors/institutions, and simple collaboration measures (single- vs. multi-country authorship; international co-authorship share). These provide a descriptive baseline for the field's growth and its diversification across venues and actors.

To clarify the analytical workflow, the cleaned Scopus.ris export served as the common input for both strands of analysis. Bibliometrix/Biblioshiny generated descriptive performance indicators, including annual production, sources, authorship, affiliation, country distribution, and collaboration patterns. The same cleaned metadata were then used in VOSviewer to construct co-word maps from the "All keywords" field after thesaurus and stoplist processing. VOSviewer outputs, including clusters, link strength, overlay information, and period-specific maps, were interpreted alongside the Bibliometrix/Biblioshiny results and inspected cluster-exemplar records.

A central element of performance analysis is the geographic distribution of COIL-related scholarship. Based on standardized Scopus affiliation data, we computed national-level productivity by country of corresponding author and coded countries using two external classifications: World Bank income group and Human Development Index (HDI) category. World Bank income groups distinguish low-, lower-middle-, upper-middle-, and high-income economies on the basis of GNI per capita calculated through the Atlas method; HDI categories were taken from the UNDP Human Development Reports. Table 3 presents the 15 most-represented countries in the dataset by corresponding-author country, together with their HDI rank/category and income group. Figure 3 presents a choropleth world map reflecting the same distribution.

For science mapping, co-word analysis was implemented in VOSviewer 1.6.20 using the "All keywords" unit of analysis, fractional counting, and association strength normalization. Nodes represent harmonized keywords after



Figure 3. Geographic distribution of COIL-related publications (2010–2025)

thesaurus and stoplist processing, and links represent keyword co-occurrence within the same record. Fractional counting was used to avoid overweighting records with unusually long keyword lists. Separate co-occurrence maps were generated for the full corpus and for each analytical period, and an overlay visualization was produced for the full corpus using average publication year as the temporal attribute.

To improve reproducibility and parameter transparency, Table 4 reports the VOSviewer settings used for each map.

Table 4. Map-specific VOSviewer parameters

Map/figure	Analytical slice	Records (n)	Minimum occurrence threshold	Clusters
Global co-occurrence map/Fig. 4	2010–2025	176	5	5
Period 1 map/Fig. 5	2010–2017	27	2	4
Period 2 map/Fig. 6	2018–2021	58	3	5
Period 3 map/Fig. 7	2022–2025	91	4	5
Overlay visualization/Fig. 8	2010–2025	176	5	5

All terms meeting the relevant threshold were retained after thesaurus and stoplist processing. VOSviewer’s default layout parameters were retained, and no manual repositioning or deletion of nodes was performed after map generation. Visual adjustments were limited to label visibility and figure export. Community detection used VOSviewer’s modularity-based clustering with a resolution parameter of 1.00. Cluster labels were assigned abductively by combining the highest-weighted terms in each cluster with close reading of the ten records with the highest link strength in that cluster. Accordingly, co-word maps are interpreted here as evidence of lexical and thematic association, not as direct proof of pedagogical practice; claims about “lexical drift” and “structural continuity” are therefore read in conjunction with cluster-exemplar inspection rather than inferred from network position alone.

Given the prominence of competencies in COIL design, we tracked competency markers beyond intercultural competence using a seeded list (e.g., communication skills, critical thinking, digital literacy, self-efficacy and close variants). We examined (a) whether these terms met the inclusion threshold in each period, (b) their cluster membership and betweenness/degree (when available), and (c) representative records for substantive usage (to distinguish genuine engagement from passing mentions). This procedure directly addresses RQ2 and feeds into RQ4 by highlighting under-served competency areas (e.g., critical thinking outside language education).

To approximate structural patterns relevant to geographic equity (RQ3), we computed two replicable bibliometric proxy indicators from standardized affiliation data:

1. Income-group participation – the period share of papers by corresponding-author income group. For multi-country papers, the corresponding-author country was used for the main leadership-oriented count, while internationally co-authored papers were also inspected to identify cross-income collaboration patterns.
2. North–South co-authorship density – among internationally co-authored papers, the proportion that included at least one author affiliated with a high-income country and at least one author affiliated with a low-, lower-middle-, or upper-middle-income country.

These indicators do not measure equity directly. Rather, they provide structural bibliometric proxies for participation, visible authorship leadership, and cross-income collaboration, allowing cautious comparison across periods.

Finally, to inform RQ4 (gaps and emerging directions), we read the latest-period map through overlay visualizations by average publication year and inspected peripheral-yet-coherent term constellations that have recently crossed the inclusion threshold. We then triangulated those signals with cluster exemplars to propose plausible research frontiers grounded in the data (e.g., SDG alignment beyond rhetoric; assessment of self-efficacy/critical thinking with validated instruments; South–South partnerships and leadership distribution).

Periodization, robustness checks, and visual supports

To capture thematic shifts across time, we adopted a conceptually specified three-phase periodization based on documented developments in the field and observable changes in publication growth and thematic emphasis. The phase boundaries were not algorithmically derived from change-point detection or network-based segmentation. Rather, they were established as analytically meaningful intervals and subsequently subjected to boundary-sensitivity testing to assess whether the findings depended on the selected cut-offs:

- 2010–2017: foundational consolidation and early pilots;
- 2018–2021: expansion and technification (including pandemic-era scale-up);
- 2022–2025: institutional consolidation, diversification, and equity discourse.

A pooled network would mask early signals and visually recenter late-emerging terms (e.g., policy, equity, SDGs, critical thinking) because they tend to co-occur with ubiquitous pedagogical tokens and are thus drawn toward the core. Periodization avoids this temporal compression, enabling like-for-like comparison across time and revealing not only what becomes central overall, but also how centrality is achieved and when new thematic corridors appear.

We conducted boundary sensitivity analyses by shifting cut-offs ± 1 year and rerunning the co-word maps. Cluster composition and the centrality of thematic terms remained substantively stable, indicating that conclusions are not artifacts of arbitrary phase boundaries. We also tested threshold robustness by varying the minimum term occurrence cut-off per period; while visual density and network shape changed slightly, cluster structures and key competency markers proved stable.

Reproducibility is further supported by the reporting of the search strategy, screening process, thesaurus/stoplist examples, and VOSviewer parameters in the manuscript. The Boolean query, thesaurus, stoplist, period-specific exports, VOSviewer map files, and Bibliometrix processing files have been prepared as supplementary materials and can be provided in anonymized form during review or deposited in an open repository upon acceptance.

Record flows across processing stages (retrieval, automated screening, manual eligibility, and final inclusion) are documented in the PRISMA-style diagram (see Figure 1).

As a compact orientation before the Results section, Table 5 summarizes corpus composition by analytical phase. Period-specific science maps and overlays appear later with interpretive captions.

Methodological limitations

Two limitations are intrinsic to our design. First, single-database reliance (Scopus) improves reproducibility but risks coverage bias, especially for non-indexed or regional outlets; we mitigate this by (i) reporting equity indicators as proportions (less sensitive to absolute coverage) and (ii) triangulating competency signals through cluster exemplars rather than frequencies alone. Second, terminological heterogeneity in COIL/VE creates retrieval and mapping challenges; the thesaurus/stoplist pipeline and manual validation of cluster exemplars reduce (but do not eliminate) this noise. Because the co-word maps are based on VOSviewer's "All keywords" option, they capture

Table 5. Corpus composition by analytical phase

Phase	Years	Records (n)	% of total	Notes (salient features)
I	2010–2017	27	15.3%	Conceptual consolidation; early pilots
II	2018–2021	58	33.0%	Growth & pandemic scale-up; technification
III	2022–2025	91	51.7%	Institutionalization; equity & competencies
Total	2010–2025	176	100%	

the author- and index-keyword structure of Scopus records, not the full lexical content of titles and abstracts or the qualitative depth of pedagogical enactment, learner interaction, and assessment practice. In addition, because the search strategy includes COIL and adjacent labels such as virtual exchange and telecollaboration, the findings should be read as mapping a COIL-centred online international learning ecosystem rather than COIL in a narrow institutional or programmatic sense.

Results

Global overview and combined map

The screened corpus (n = 176 records) shows steady growth from 2010 to 2019 and a sharp post-2020 acceleration aligned with the normalization of digitally mediated collaboration and “internationalization-at-home.” Outputs in 2022–2025 remain well above pre-pandemic levels, suggesting persistence as policy and practice. The combined co-word map (Figure 4) serves only as orientation: by pooling years it compresses time, so we read it cautiously before the periodized maps.

At the center of Figure 4 lies a stable pedagogical core (course, curriculum, task, collaboration, intercultural learning) that has anchored the field since 2010. Around it, three recurrent neighborhoods appear across periods and parameterizations: (i) technology/assessment (technology, online learning, questionnaire, survey, reflection); (ii) language-education (EFL, language development, communication); and (iii) institution/policy (internationalization, mobility, virtual exchange, policy). Labels were validated by inspecting high link-strength records. The picture suggests lexical drift rather

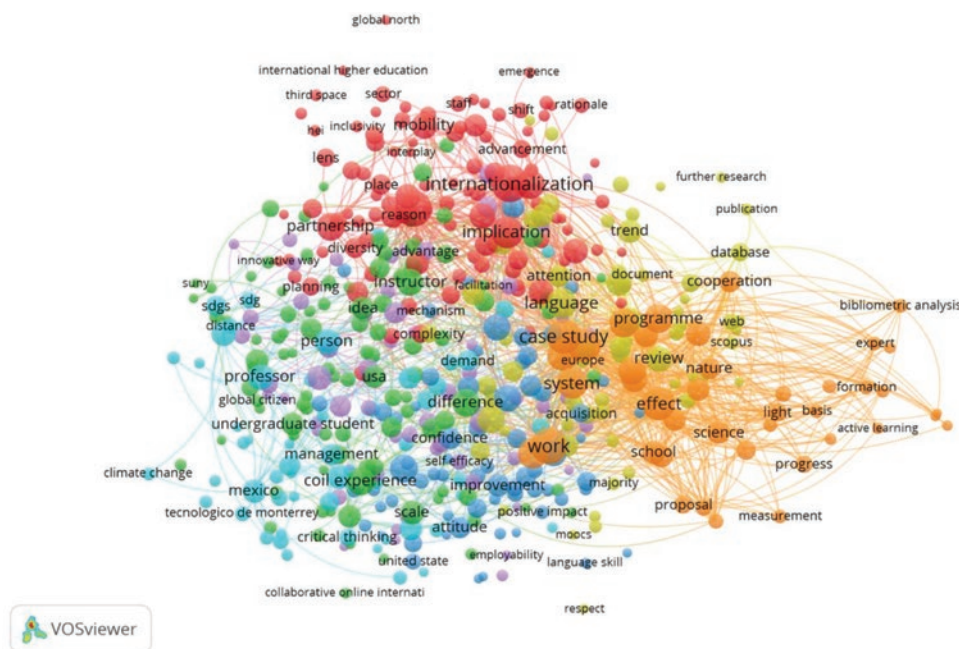


Figure 4. Global co-occurrence network (2010–2025)

than clear structural renewal: late-emerging tags (policy/equity/SDGs) attach to the same backbone more than they point to a visibly different organization of the field.

Publication venues and disciplinary spread

COIL studies cluster in three outlet families (internationalization/policy, technology-enhanced learning, and applied linguistics/intercultural communication) mirroring COIL’s dual identity as method (task/assessment/technology) and strategy (curricular embedding). Post-2020 contributions extend into education, engineering, business, and health sciences, often blending disciplinary content with transversal outcomes. Yet this diversification of outlets does not provide strong evidence of new task architectures or evaluative paradigms; connections to the core remain mediated by familiar pedagogical tokens.

Geographic distribution of authorship and structural equity proxies

Affiliation metadata confirm long-standing concentration of corresponding authors in high-income systems, with broader participation after 2020 via multi-country teams. The corresponding-author share shifts from 55.6% → 41.4% → 30.8% (high-income) alongside rises in upper-/lower-middle groups (25.9%/14.8% in 2010–2017 to 35.2%/30.8% in 2022–2025), while low-income contributions stay ≈3–4%. Our two structural proxy indicators, (1) income-group participation and (2) North–South co-authorship density, suggest diversification without clear redistribution of visible authorship leadership: (1) remains skewed to high-income contexts; (2) increases (37.5% → 50.0% → 65.5%), indicating more mixed-income teams but not necessarily a shift in agenda-setting power. The periodized values for both indicators are summarized in Table 6.

Table 6. Structural equity proxy indicators by period

Income group (World Bank)	2010–2017 (n = 27)	2018–2021 (n = 58)	2022–2025 (n = 91)
High-income	55.6% (15)	41.4% (24)	30.8% (28)
Upper-middle income	25.9% (7)	34.5% (20)	35.2% (32)
Lower-middle income	14.8% (4)	20.7% (12)	30.8% (28)
Low-income	3.7% (1)	3.4% (2)	3.3% (3)
Total	100%	100%	100%
NS-density (% of internationally co-authored papers with ≥1 HI + ≥1 LMIC)	37.5%	50.0%	65.5%
N(IC) (internationally co-authored, count)	8	26	55

Notes. Percentages are rounded to one decimal; column totals may sum to 100% by rounding while counts remain exact. NS-density numerators used: 3/8, 13/26, 36/55. LMIC = low + lower-middle + upper-middle income countries (World Bank). Indicators are structural bibliometric proxies and should not be read as direct measures of equity.

Thematic maps by period

As shown in Table 5, records increase from 27 (2010–2017) to 91 (2022–2025). The maps, however, suggest growth with limited structural novelty: a stable pedagogical backbone persists across periods, while new labels attach incrementally to it. Below we read each slice with identical counting/normalization rules.

Period 1: 2010–2017: Foundational consolidation

Figure 5 shows that the earliest map is compact and polarized into two tightly connected neighborhoods, consistent with a field still settling its nomenclature, rationale, and curricular footprint. One neighborhood concentrates the conceptual–curricular case for COIL: anchor terms (*internationalization*, *global learning*, *curriculum*, *students*, *collaboration*, *project*) cohere around programmatic texts that argue for embedding sustained, credit-bearing international collaboration in the syllabus, present COIL as an inclusive alternative to mobility, and outline first-generation architectures (partner matching, jointly designed tasks, light assessment rubrics). The second neighborhood revolves around terminological convergence and adjacent traditions, with *COIL*, *telecollaboration*, *online intercultural exchange*, *virtual exchange*, and *faculty* as anchors; records explicitly link COIL to earlier European and North-American online intercultural exchange while emphasizing distinctives such as joint syllabus design and reciprocal teaching.

Bridging tokens like *course*, *partner*, and *collaboration* connect both areas, indicating that practice narratives, how to run a joint course, served as the conduit between conceptual justification and labeling work. Lexical diversity is low, and generic educational tokens (e.g., *students*, *classroom*) occupy central

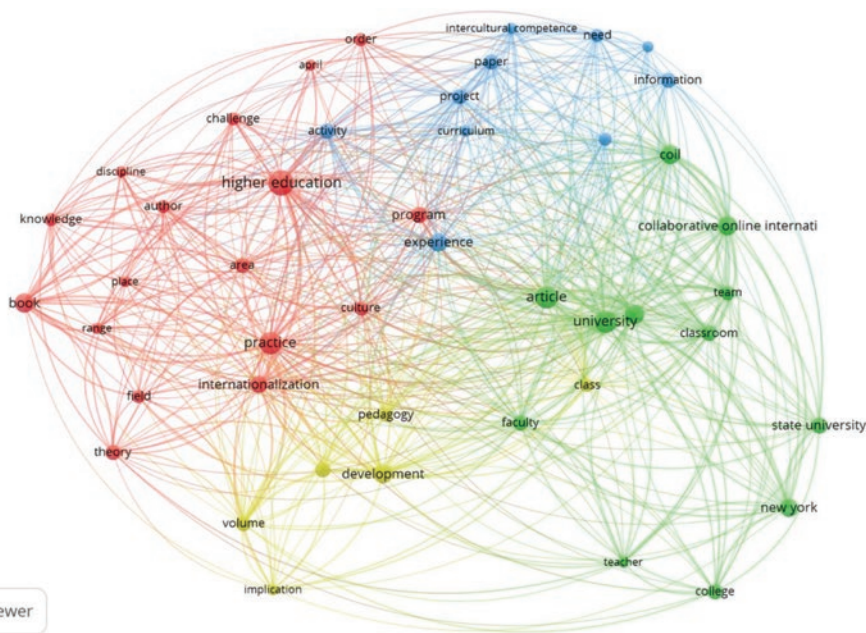


Figure 5. Co-occurrence network (2010–2017)

positions unless filtered by the stoplist, a pattern typical of nascent domains where advocacy outpaces standardized measurement. The outcome lexicon is correspondingly narrow: intercultural competence dominates, whereas other transversal outcomes (communication skills, self-efficacy, critical thinking) remain absent or peripheral. Methodologically, instrumented evaluations are rare; case narratives and reflective reports prevail, with little external validation. On the geographic axis, authorship is concentrated in high-income systems, LMIC participation is minimal, and most papers are single-country authored, features that mirror the small scale of early implementations and the prominence of a few pioneering institutions.

These characteristics establish the diagnostic baseline of task templates, genres of evidence, and authorship geography against which claims of later change can be assessed.

Period 2: 2018–2021: expansion, technology, and assessment

The intermediate map shown in Figure 6 is larger and more modular, resolving into three robust neighborhoods that mark the move from advocacy to implementation, though the underlying grammar remains familiar. One neighborhood centers the student experience under technological mediation and the rise of measurement. Anchor terms such as *technology*, *online learning/platform*, *questionnaire*, *survey*, *team*, *challenge*, and *language* accompany studies that report mixed-methods designs combining Likert-type scales (engagement, communication confidence, intercultural attitudes), reflective artifacts (journals, discussion transcripts), and performance tasks (joint products, peer feedback). Technology functions both as enabler (multimodal communication, synchronous/asynchronous workflows, authentic digital artifacts)

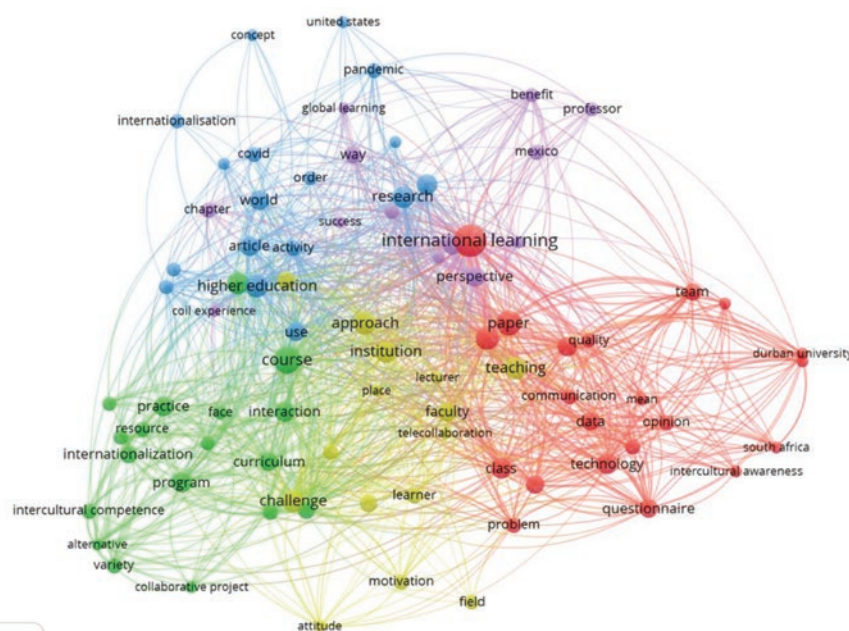


Figure 6. Co-occurrence network (2018–2021)

and as constraint (bandwidth, device access, uneven digital literacies). The assessment lexicon (*questionnaire, rubric, pre/post*) becomes salient, indicating evaluation designed into projects rather than appended post hoc; yet most designs continue to privilege short time frames and self-report metrics, with limited external validation.

A second neighborhood consolidates intercultural competence and instructional design. Terms like *intercultural competence, curriculum, task design, assessment, faculty*, and *telecollaboration* frame recognizable task architectures based on information-gap, problem-solving, and project-based activities, linked to IC development through clearer assessment logics (rubrics, peer/self-assessment, structured reflection). IC is more often operationalized (attitudes, knowledge, skills), and triangulation becomes common as scales are paired with qualitative evidence. Faculty development, including co-planning routines, expectation alignment, and assessment calibration, emerges as an enabling condition. Even so, these are iterative refinements of templates already visible in the first period rather than new task ecologies.

The third neighborhood reframes COIL within global learning and internationalization, where *higher education, internationalization, virtual exchange*, and *pandemic/COVID-19* act as conspicuous anchors. The pandemic operates as a system-level accelerant: papers generalize lessons from emergency adoption (recognition policies, workload models, timetable management) and argue for COIL's mainstreaming as an Internationalization-at-Home instrument. The discourse expands from course-level narratives to programmatic and institutional considerations, but the emphasis is largely administrative embedding rather than conceptual novelty.

Link structures between neighborhoods are instructive. *Assessment, feedback*, and *reflection* bridge technology/measurement with IC/design, suggesting evaluation practices increasingly embedded within pedagogy; *virtual exchange* and *online learning* connect the internationalization area with both pedagogy and technology, indicating that crisis-driven adoption flowed into codified implementations rather than remaining ad hoc. Two additional movements, weaker but persistent, anticipate the next phase: geographic diversification as country and region tags (notably in Latin America) become more frequent at the periphery even while corresponding-author leadership remains concentrated in high-income systems; and a modest broadening of the competency palette, with *communication skills* and *digital literacy* moving closer to the core while *critical thinking* and *self-efficacy* remain marginal or cluster-internal. Overall, the period records consolidation and toolchain normalization—more measuring, more institutional talk—without a corresponding shift in fundamental designs or evaluative paradigms.

Period 3: 2022–2025: policy integration, equity, and diversification

As Figure 7 shows, the final map is larger, more articulated, and less centralized. Several neighborhoods of comparable density coexist, which indicates a diversification of discourses and objects; however, the underlying grammar remains anchored in the same pedagogical backbone observed earlier.

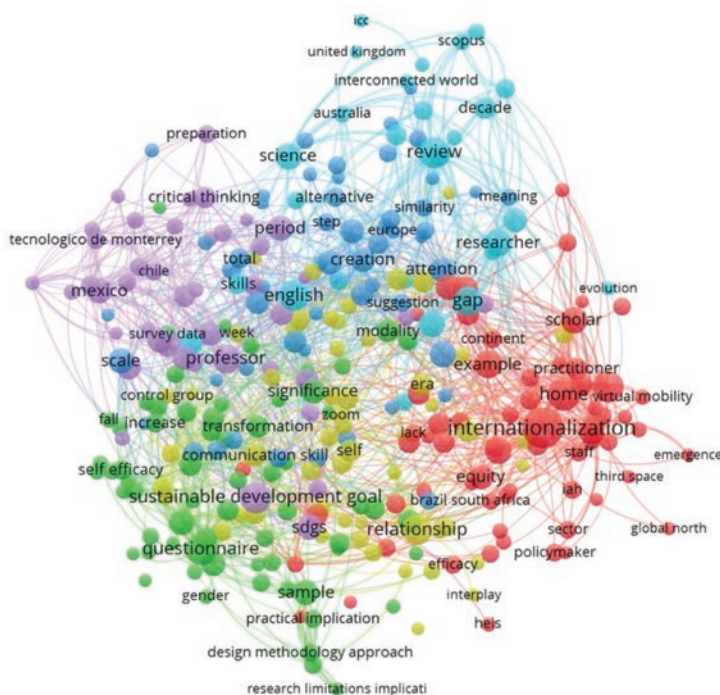


Figure 7. Co-occurrence network (2022–2025)

One neighborhood gathers policy and institutional integration, including *policy*, *recognition*, *institutionalization*, *higher education*, *internationalization-at-home*, and *strategy*, with frequent references to credit recognition, workload models, faculty support schemes, and funding instruments. COIL appears here less as an innovative course design than as a policy tool inscribed in institutional and national agendas, and the presence of *ministries*, *frameworks*, and *quality assurance* on the periphery ties the discussion to governance debates.

A second neighborhood foregrounds equity, inclusion, and access through terms such as *equity*, *access*, *diversity*, *Global South*, *opportunities*, and *participation*. The promise of democratizing global learning is interrogated through analyses of who benefits and under what conditions. Studies begin to incorporate equity-sensitive metrics (distribution of roles in teams, balance of institutional resources, differential digital readiness), and this vocabulary overlaps with the policy cluster, signalling that equity is framed simultaneously as pedagogical concern and policy imperative. Consistent with the indicators reported in 4.1, diversification of participation does not necessarily translate into redistribution of leadership.

A third neighborhood concentrates on competency diversification and outcomes beyond interculturality. While intercultural competence remains prominent, *digital competence*, *global competence*, *communication skills*, *critical thinking*, *collaboration*, and *self-efficacy* move closer to the core. Outcome talk is increasingly tied to instruments such as rubrics, standardized frameworks, and validated scales, suggesting methodological refinement. Yet designs

continue to privilege short time frames and self-reports, with limited externally validated or longitudinal evidence, which points to consolidation of tools more than to a shift in evaluative paradigms.

Another visible cluster is reflexive and meta-analytical, encompassing *systematic review*, *bibliometric*, *mapping*, and *meta-analysis*. Its growth is typical of consolidation phases: the field begins to study its own production, codifying canons and revealing blind spots (e.g., underrepresentation of African and South Asian institutions). This reflexivity improves transparency but can also stabilize prevailing templates.

Cross-links are denser than in earlier phases. *Equity* connects not only with *policy* but also with the competence lexicon via debates on equitable participation in learning outcomes; *assessment* bridges competence discussions and meta-studies, showing the integration of evaluative practices into both pedagogy and second-order research. The increase in connectivity reflects a weaving of debates rather than the emergence of new task ecologies.

Geographically, the signal is more plural. Latin America remains prominent, with increased contributions from Asia and, to a lesser extent, Africa; nonetheless, leadership in high-visibility venues continues to concentrate in North America and Europe, which helps to explain the salience of equity discourse in the map.

Overall, the 2022–2025 network depicts administrative mainstreaming and discursive diversification, but offers limited evidence of a commensurate redesign of core pedagogical forms or measurement strategies. The field expands and scrutinizes itself, but the central challenge remains moving from scale and rhetoric to demonstrable shifts in task architectures and robust evidence of durable impact.

Overlay visualization and integrative trends

The overlay visualization in Figure 8 links the three periodized maps into a single diachronic surface. Darker tones mark earlier tokens (e.g., *virtual exchange*, *internationalization-at-home*, *pilot project*), while lighter hues signal late entrants such as *policy*, *equity*, *assessment*, *digital competence*, and *systematic review*. Read with caution, the gradient shows timing rather than structural primacy: late terms co-occur with ubiquitous pedagogical tokens and are therefore drawn toward the core even when they do not reconfigure it.

Taken together, and within the limits of co-word mapping, the overlay suggests lexical drift more than clear structural renewal. Practice-oriented descriptors from the first period persist at the backbone of the graph; what changes is the vocabulary that accretes to them. The prominence of *policy*, *recognition*, and *frameworks* indicates institutional embedding, but the link patterns tie these tokens to the same task templates and course-level genres already visible earlier. In other words, governance language grows around stable pedagogical forms.

Competency talk also widens. Intercultural competence remains central while *digital competence*, *global competence*, *collaboration*, and *critical*

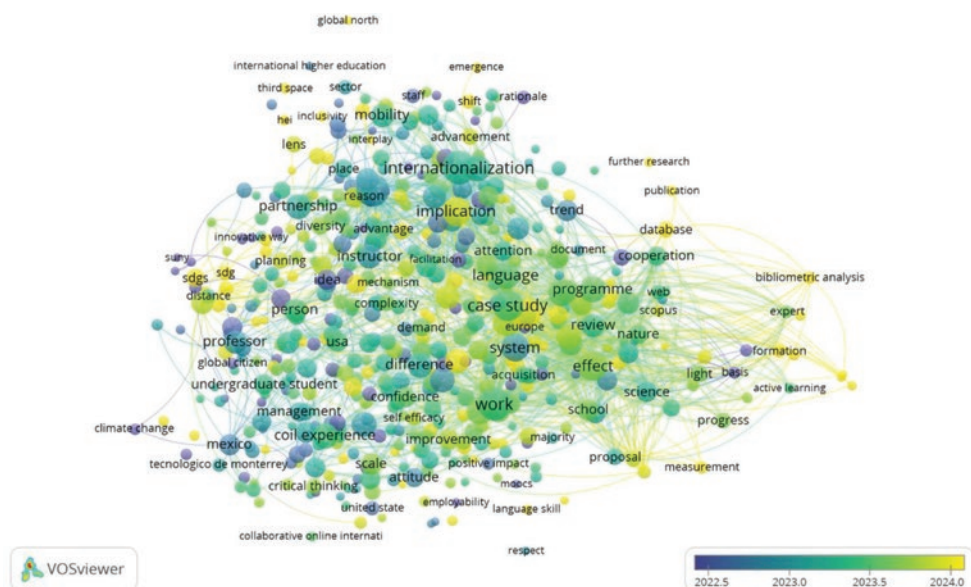


Figure 8. Overlay visualization of COIL/VE research (2010–2025)

thinking move inward. Yet their trajectories largely follow assessment and reflection links, pointing to the multiplication of instruments and rubrics rather than to new evaluative paradigms or longitudinal designs. The measurement repertoire becomes more explicit; the underlying designs change little.

Finally, the rise of *equity*, *access*, *Global South*, *systematic review*, and *bibliometric* signals a reflexive turn. This vocabulary occupies central positions in recent years and overlaps with policy tokens, reflecting a community that audits its own imbalances while codifying how COIL is studied. The integrative picture is therefore consistent with the period maps: administrative mainstreaming, broader labels, and stronger cross-cluster connectivity, accompanied by continuity in task ecologies and methods.

Discussion

The longitudinal analysis of COIL research (2010–2025) portrays a field that has consolidated administratively and expanded in volume, while the co-word patterns and cluster-exemplar readings suggest only incremental change in its dominant pedagogical forms and evaluative repertoire. In addressing the guiding research questions, we situate the bibliometric patterns within debates on pedagogy, internationalization, and equity, stressing where growth reflects relabeling or policy embedding rather than substantive redesign.

From advocacy to evidence-based scholarship

Regarding RQ1, the literature does move from conceptual advocacy toward evidence-seeking implementation, but the shift is partial. Early work focused on defining COIL within the continuum of telecollaboration and virtual exchange and on legitimizing it as an inclusive alternative to physical mobility (Helm, 2015). By 2018–2021, mixed-methods designs, validated scales, and

comparative frameworks became more common, and the post-2020 surge normalized evaluation as part of project design (O'Dowd, 2021). Yet most studies still rely on short time frames, self-report instruments, and pre-/post-measures, with limited triangulation beyond reflective artefacts and rubric-based judgments. Case narratives remain frequent and externally validated or longitudinal designs are scarce. The field has learned to measure more systematically, but the measures used are largely the same ones recycled across settings; the methodological canon has consolidated more than it has diversified.

Competencies and learning outcomes

In relation to RQ2, intercultural competence continues to anchor both the rationale for adoption and the expected outcome. Later periods add a wider competence palette, including communication, collaboration, critical thinking, and digital fluency, now framed as intentional targets embedded in course design. However, the co-word trajectories suggest accretion rather than replacement: new competence labels attach to stable task templates (joint projects, information-gap/problem-solving tasks, structured reflection). This pattern is consistent with recent studies documenting the explicit integration of transversal and digital competencies into course design (Wekerle et al., 2022; Mestre-Segarra & Ruiz-Garrido, 2022; Nishio, 2023), even as assessment practices and task architectures remain largely unchanged. Assessment follows suit: rubrics and standardized scales are used more explicitly, but performance-based evidence, externally benchmarked tasks, and durability/transfer studies remain the exception. Thus, the expansion of outcomes aligns with broader higher-education agendas on employability and transversal skills, while leaving largely intact the evaluative paradigms through which effects are inferred.

For language education and CALL, this pattern has a concrete implication: COIL should not be treated merely as additional speaking practice or international exposure. L2 task design needs to specify the linguistic work expected from collaboration, such as interactional repair, pragmatic choice, genre awareness, and mediation across perspectives; assessment should make this work visible through recorded exchanges, annotated drafts, reflective commentaries, peer feedback, and performance-based evidence. Teacher development should therefore prepare instructors to design COIL as a language-learning ecology, not simply as a digital exchange.

Institutionalization, policy, and the risk of standardization

Findings for RQ3 show a clear rise of policy and governance vocabulary, including recognition, workload, and frameworks, which signals COIL's integration into institutional strategies and accreditation logics. Dedicated offices, funding schemes, and staff development stabilize initiatives and reduce dependence on individual champions (Vahed, 2024). Yet such institutionalization can incentivize compliance-driven models, privileging procedural uniformity over pedagogical experimentation, a risk already noted in earlier analyses of virtual exchange (O'Dowd, 2018). The maps indicate stronger cross-cluster

connectivity in the most recent period, but this is better read as administrative embedding around a familiar backbone than as the emergence of new task ecologies. The challenge is to secure resources and visibility without freezing the design space that made early projects creative and responsive.

Authorship and co-authorship patterns show broader participation after 2020, with more teams that combine high-income and LMIC affiliations and a clear rise in North–South co-authorship density. Nevertheless, leadership and agenda-setting remain disproportionately concentrated in high-income systems (Makda, 2024). The discourse of equity is now central and studies increasingly adopt equity-sensitive metrics (role distribution, resource balance, digital readiness), but discourse alone does not alter the structures that shape who initiates projects, who controls funding and evaluation, and who is visible in high-impact venues (de Wit & Altbach, 2021). If COIL is to function as a vehicle for fair internationalization, shared leadership, equitable funding rules, and recognition frameworks must be treated as design constraints, not as optional add-ons.

Impact and benefits

For RQ4, the corpus documents consistent immediate benefits for students, including intercultural awareness, confidence in global communication, collaborative skills, and digital literacies, alongside institutional advantages such as scalable access to international learning, alignment with sustainability aims, and reinforcement of strategic partnerships. Faculty often report professional growth in curriculum design, digital pedagogy, and intercultural facilitation. Yet the strength of evidence supporting long-term claims remains limited, a gap also highlighted in recent bibliometric reviews (Sharma & Panackal, 2025). Few studies track outcomes beyond the course, validate competence gains with external benchmarks, or examine transfer to workplace settings. Where impact is asserted, it is usually proxied by self-report scales or course-embedded artefacts. The next step is not merely to collect more surveys but to retool designs toward longitudinal follow-up, quasi-experimental contrasts, and richer performance assessments that can speak to durability and generalization.

Analytical synthesis

Across questions, a consistent pattern emerges: COIL/Virtual Exchange has scaled, stabilized, and broadened its vocabulary, but its dominant task designs, evidence genres, and governance relations have changed more slowly. This pattern does not diminish the value of consolidation, especially for access and sustainability; rather, it clarifies the type of change observed. The field has become more institutionally visible and methodologically explicit, yet the strongest evidence points to incremental development around a familiar pedagogical core. The central analytical issue for future research is therefore whether expanded terminology, policy uptake, and broader participation are accompanied by demonstrable changes in task architecture, evidence quality, and partnership governance.

Conclusions and implications for future research

This longitudinal bibliometric study shows that COIL/Virtual Exchange research has moved from early definitional and advocacy work toward a more consolidated, institutionally embedded, and methodologically explicit field. Its main contribution is to show that this maturation has been uneven. Publication volume, policy visibility, competence vocabulary, and geographical participation have expanded, but the evidence also points to continuity in task templates, short-term assessment designs, and authorship leadership patterns. The resulting picture is not one of stagnation, but of consolidation with limited structural renewal.

These findings should be read within clear methodological boundaries. The study relies on Scopus-indexed records and therefore may underrepresent regional, non-indexed, or practice-based scholarship. Its co-word maps capture author- and index-keyword structures rather than the full qualitative depth of classroom interaction, task enactment, or learner experience. The equity-related measures are likewise structural proxies, useful for identifying participation and collaboration patterns but not direct measures of epistemic justice or partnership quality.

For future research, the priority is to test whether COIL/Virtual Exchange produces durable learning beyond immediate perceptions. This requires longitudinal and comparative designs, validated instruments, externally benchmarked performance tasks, and evidence of transfer across courses, disciplines, and professional contexts. In language education and CALL, particular attention should be paid to the linguistic work made visible in online intercultural collaboration, including interactional repair, pragmatic choice, mediation, genre awareness, feedback uptake, and revision.

For practice and policy, the findings point to two concrete priorities. First, COIL/Virtual Exchange designs should adopt a visible-evidence principle: task aims, interactional processes, feedback cycles, and assessment traces should be aligned from the outset, rather than inferred from post-course satisfaction or self-report alone. Second, institutional partnerships should adopt a reciprocal-governance principle: workload recognition, authorship expectations, data ownership, funding responsibilities, and partner leadership should be negotiated explicitly before implementation. In this sense, the next phase of COIL/Virtual Exchange should be judged not only by scale, but by the strength of its evidence, the explicitness of its language-learning design, and the fairness of its collaboration structures.

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