Collaborative Online International Learning: Scale Validation and Reliability

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Abstract

Collaborative Online International Learning (COIL) is a powerful tool for improving higher education by fostering intercultural competencies, broadening access to international experiences, and preparing students for an increasingly globalized and digitized world. The measurement of COIL experiences in students is fundamental to know the impact it has on learning and the student experience, as well as to make decisions with scientific evidence. The field of COIL measurement is a little explored area, so there is an important gap in the literature to consider. The study presents the psychometric properties of construct validity and reliability of the scale to measure the COIL experiences of higher education students. The sample included 100 students from Colombia, Venezuela, Spain, China, and Mexico; 66 were female (66%), 34 were male (34%), and their ages ranged from 17 to 27. The calculated indices confirmed the fit of the data to the Collaborative Online International Learning measurement model, highlighting three dimensions: digital interaction, multicultural collaborative work in teams, and reflection during collaborative activity. This article represents a contribution to the field of COIL by showing adequate psychometric properties that ensure the correct measurement of the construct. It is a valid tool for educational bodies responsible for the internationalization of the curriculum.

Collaborative Online International Learning (COIL) is recognized as a pedagogical approach or strategy that thrives on collaboration. It involves the exchange of learning experiences between two or more educational institutions in different geographical areas or that present significant cultural variations. The professors of these institutions decide to partner bilaterally by proposing activities for their students to develop joint projects in a period averaging between 5 and 8 weeks (Rubin & Guth, 2023). SUNY (2015) describes COIL as a teaching tool or learning paradigm that fosters intercultural competency using Internet tools and innovative online pedagogies through meaningful exchanges that last from 5 to 15 weeks. It also defines it as an approach that brings students and faculty from different cultures to discuss, learn, and collaborate in a classroom setting (SUNY, 2023). Similarly, it has been conceived as an international virtual mobility experience, where two teachers collaboratively design and implement a course, aligning learning outcomes, activities, and modules that emphasize the intercultural and transnational dimensions (Helm, 2020; Naicker et al., 2021). The intercultural dimension derives from two courses usually located in different geographical locations but are synchronized by the institutions to address global content or problems.

The proposal of creating or co-designing a collaborative online learning experience among colleagues from different universities and geographical areas is quite attractive to participating faculty and students. The idea is not new; it is based on Vygotsky's (1978) theory of social constructivism, where students, as active subjects, use social skills to work, discuss, and complete group tasks. In Vygotsky's time, the activities occurred in a presential (face-to-face) classroom. Now, integrated digital technologies allow synchronous and asynchronous deliveries, enriching the learning process and breaking the barriers of the traditional classroom (Otchie, 2018).

Moreover, COILs respond to an imminent need in universities to train students for a multicultural world with global problems or needs and discussions of global citizenship and education (O'Dowd, 2017; Woodley et al., 2023). These activities are possible thanks to the internationalization of the curriculum, which also enhances the intercultural dimension through student-centered content that develops global competencies through multidisciplinary teamwork and strengthens complex thinking, creativity, and appreciation for diversity, among other competencies (Leask, 2015; Romero-Rodríguez et al., 2022). For these and other reasons, COIL courses comprise a pedagogy that responds to the current demands of education and society.

Literature Review

Few documented studies on COIL courses exist. They first appeared in the early 2000s, although some literature has unveiled the underlying perspectives of their applications, intentions, and nuances in the last five years. Some studies are presented below, emphasizing the results that impact the evidence.

Some universities worldwide have tried to introduce their professors to this innovative educational alternative and support it through two initiatives: a) COIL Connect, an initiative of the COIL Virtual Exchange Foundation, and b) the SUNY COIL Center (State University of New York). These initiatives provide access to a bank of institutions, classes, and professors interested in connecting and co-designing a COIL experience and other services, such as training, workshops, and support. These valuable actions have intrigued teachers to investigate

these experiences for various reasons, such as Anderson & Or (2023), who examined the intercultural effectiveness of a COIL on adult students in the United States and Brazil, in line with the brief discussion in our introduction and perhaps representative of COIL's genesis.

Membrillo-Hernández et al. (2023) sought to identify how the global classroom facilitates developing disciplinary and transversal competencies in sustainability, plant physiology, and SDG compliance through collaborative work, critical thinking, and problem-solving. Notably, their proposed COIL centered on challenge-based learning, resolving a real-world challenge remotely using digital communication tools.

Measurement of Collaborative Online International Learning (COIL)

Several elements configuring a COIL experience can be evaluated and measured, including its formulation and planning, which spotlight the primary intention of a COIL course, which, in some cases, may be developed to favor or privilege internationalization, learning, motivation, and interculturality, among other purposes. Mestre-Segarra & Ruiz-Garrido (2022) used a questionnaire applied before and after the experience to measure participant perception and semi-structured interviews that inquired about expectations and perceptions. They concluded that the COIL course improved language learning, which is linked to both intercultural and interdisciplinary skills.

The above aligns with the claim that COILs are a pedagogical approach to enrich learning and positively impact students' cultural awareness. Davis et al. (2023) concluded this through perception surveys applied before and after the experience to measure the growth of knowledge and behavior.

In the same sense, the research by Naicker et al. (2022) inquired about barriers and facilitators through focus groups. Regarding obstacles, the study highlighted digital skills, language, and dynamics among colleagues to overcome them. Again, the facilitators indicated that COIL could comprise an effective learning system, depending upon the structure of the courses and the academic self-efficacy of the participants. As observed, each research study used different measuring instruments to assess the COIL experience's success in meeting the proposed course's intention. Likert-type questionnaires and open methods such as interviews and focus groups were used to measure participants' perceptions.

Other studies assessing the competencies developed through COIL courses rely on a variety of instruments, aligned with the intended goals of the specific COIL design. Online COIL courses are significantly challenging, requiring discussion and dialogue about working on a joint project remotely and how to evaluate the personal, social, and cognitive competencies of the participants through various collection instruments, including online surveys, in-depth interviews, focus groups, review of teaching diaries, field notes, and others (Ballesteros-Sola & Magomedova, 2023). House et al. (2022) demonstrated a strong relationship between participation in COIL initiatives and the development of cultural competence, mediated by gains in cultural knowledge resulting from COIL-oriented discussions. Their findings and conclusions were obtained after applying a survey with closed and open questions to students.

On the other hand, the research of Marconi et al. (2023) in the Tuning Project assured that the COIL allowed the development of several transversal competencies for professional

development, including interculturality, collaboration, disciplinary professional learning, and self-efficacy. Their research was based on an empirical phenomenological design using opinion surveys applied in each session.

The above results related to implementing COIL in universities suggest a promising panorama for learning and developing competencies necessary for contemporary society. University research on COIL is increasingly present. However, an aspect that must be addressed is the development of objective measurement instruments to assess understanding of phenomena, evaluate results, and support informed decision-making. Adequate measurement allows comparing data from different studies and generalizing the findings, which contributes to advancing and consolidating knowledge in a specific area. In this sense, the measurement of COIL experiences is in its infancy. An example is the scarcity of measurement tools for COIL experiences that provide evidence of validity and reliability. Therefore, the present study addresses this gap in the literature with a measurement scale for COIL experiences among university students, exploring the construct validity of the scale and its reliability.

Method

The analysis of COIL literature led to delimiting the scale's dimensions and items in its first version, which was submitted to experts who evaluated the clarity, coherence, relevance, and sufficiency of the scale's items. After affirming the content validity, we applied the scale to higher education students participating in a COIL course (an inclusion criterion). The sample consisted of 100 students from Colombia, Venezuela, Spain, China, and Mexico, of which 66 (66%) were women and 34 (34%) were men. The ages ranged from 17 to 27.

Instrument

The instrument aims to measure students' experiences in COIL courses. According to the definition of COIL, these courses should foster the development of intercultural competencies by providing students with international experiences and preparing them for an increasingly globalized and digitized society.

In this context, the instrument titled "Perception of Experiences in Collaborative Online International Learning," designed based on a review of the literature (Appiah-Kubi & Nichwitz, 2020; Tecnologico de Monterrey, 2023; Rozo et al., 2024) evaluates experiences in COIL courses through three main dimensions. This instrument consists of 19 items distributed across the following dimensions:

1. **Student interaction in digital environments:** This dimension includes seven items that assess interaction between students in digital platforms. An example is: "I respect my peers' opinions in the online course, even if I disagree with them."

2. **Collaborative work in multicultural teams to achieve objectives:** This dimension comprises six items that measure collaboration to achieve common goals in multicultural teams. An example is: *"Working collaboratively with peers from other cultures helped me develop my communication skills."*

3. **Reflection on differences and similarities with peers during collaboration:** This dimension includes six items that explore how students reflect on differences and similarities with their peers during collaboration. An example is: "Working with peers from different cultures helped me realize the importance of respect."

The scale uses a Likert-type response format with values ranging from 1 ("Strongly disagree") to 7 ("Strongly agree").

Procedure

Before administering the instrument, we requested the voluntary participation of students who had previously participated in a COIL. The students who agreed to participate gave informed consent, and we explained ethical considerations such as confidentiality and data handling. The Google Forms instrument administered electronically took approximately 15 minutes to answer.

For data analysis, the instrument's descriptive and univariate normality measures were calculated first using the SPSS 25 statistical package for social sciences. Normality values between 3 and -3 standard deviations were the reference for skewness and kurtosis.

Second, a Confirmatory Factor Analysis (CFA) was performed to examine the scale's internal structure; the CFA was calculated using the maximum likelihood (ML) estimation method. A bootstrap of 500 replicates with a 95% confidence interval was used to ensure that multivariate normality issues did not affect the calculations. The X2 is sensitive to sample size, so we used the fit indices proposed by Blunch (2013) and Byrne (2013): X2, p (Chi-square and associated probability), TLI (Tucker-Lewis Index), SRMR (Standardized Root Mean Square Residual), CFI (Comparative Fit Index) and RMSEA (Root Mean Square Error Approximation with its confidence interval). The indicators of data model fit were X2 values with $p > .001$; TLI, CFI, AGFI $\geq .95$; RMSEA and SRMR $\leq .08$ (Byrne, 2013; Sharma et al., 2005). Finally, Cronbach's Alpha and McDonald's Omega index were used to examine the reliability of the measurement model. Cronbach's Alpha and McDonald's Omega values $> .70$ were acceptable (Green & Yang, 2015).

Results

Table 1 presents the results of the means, standard deviations, range, and normality of the items that comprise the scale "Perceptions of Experience in Collaborative Online International Learning." The results indicate that the students had a favorable opinion about their experiences as participants in COIL courses. Regarding the normality of the items, the values obtained do not exceed the values suggested in the literature, except for items 3 and 16, which presented kurtosis values slightly above three standard deviations.

Table 1

Means, Standard Deviations, Minimum, Maximum, and Normality of the Scale "Perceptions of Experience in Collaborative Online International Learning.

| Item	M	SD	Min	Max	Asymmetry	Kurtosis
Item 1	5.06	1.44	1	7	-.52	-.40
Item 2	5.37	1.37	1	7	-.88	.12
Item 3	6.34	.91	1	7	-1.79	3.39
Item 4	5.89	1.34	1	7	-1.61	2.52
Item 5	5.54	1.42	1	7	-.83	.10
Item 6	5.82	1.35	1	7	-1.17	.62
Item 7	5.01	1.88	1	7	-.75	-.57
Item 8	5.73	1.46	1	7	-1.33	1.12
Item 9	5.57	1.52	1	7	-1.15	.56
Item 10	5.65	1.29	1	7	-.81	-.12
Item 11	5.89	1.18	1	7	-.92	.16
Item 12	5.96	1.18	1	7	-1.06	.40
Item 13	5.89	1.05	1	7	-1.45	2.10
Item 14	5.96	1.18	1	7	-1.28	.51
Item 15	6.15	1.46	1	7	-.96	-.17
Item 16	5.99	1.00	1	7	-.91	3.50
Item 17	6.06	1.16	1	7	-1.65	1.29
Item 18	6.02	1.26	1	7	-1.17	1.29
Item 19	5.81	1.45	1	7	-1.09	.68

Note: Min: minimum, Max: maximum

Construct Validity

The factor loadings of the items in the measurement model were significant, with values between .63 and .92 (see Figure 1). The indices obtained confirm the fit of the data to the measurement model for Collaborative Online International Learning in three dimensions: interaction among students in digital environments, collaborative work in multicultural teams to achieve goals, and reflection on differences and similarities with peers during collaboration ($X2 = 162.06$; $gl = 96$; $p =<.000$; SRMR = .05; TLI = .92, CFI =. 94; RMSEA = .07, IC 90% [.06, .08]).

Figure 1

Results of the Confirmatory Factor Analysis of the Scale "Perceptions of Experience in Collaborative Online International Learning."
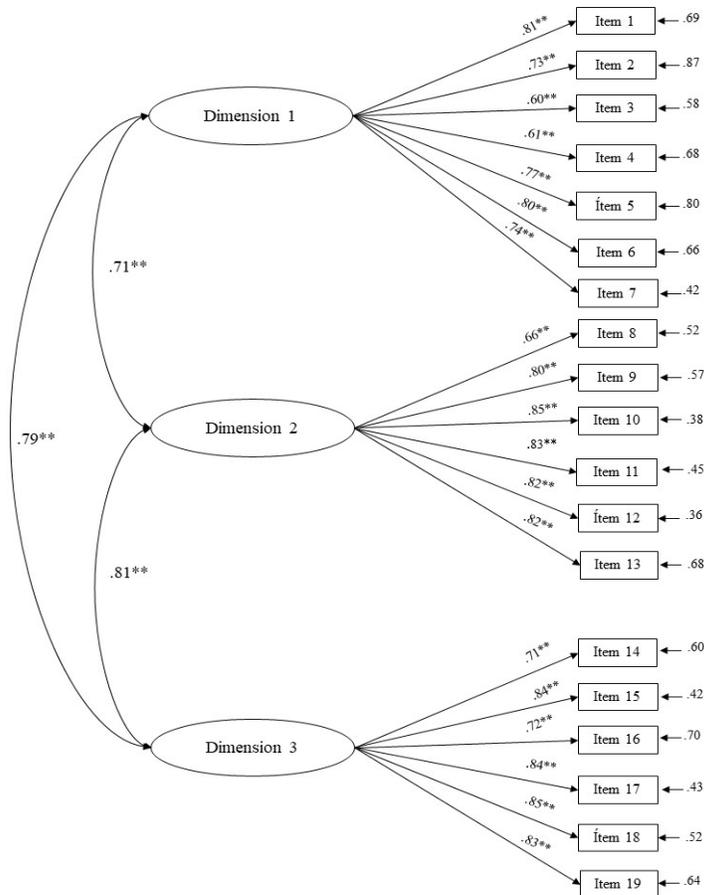
Note: Dimension 1: Interaction among students in digital environments; Dimension 2: Collaborative work in multicultural teams to achieve goals; and Dimension 3: Reflection on differences and similarities with peers during collaboration.

Reliability Analysis

Table 2 reports the reliability analysis results calculated by the omega coefficient (ω) and Cronbach's alpha (α). The values of both coefficients range between 0.84 and 0.89, suggesting good reliability of the items in measuring the variables they represent. Thus, the items are consistent with each other and reliably measure the dimension corresponding to the interaction between students in digital environments.

Table 2

McDonald's (?) Omega and Cronbach's Alphas of the Dimension "Interaction Between Students in Digital Environments."

Items	ω	α	Magnitude
1. Learning with my peers through interaction in digital environments was easy.	.86	.84	Good
2. I can communicate adequately with peers from other countries through tools in digital environments.	.87	.85	Good
3. I respected the views of my peers in the online course, even if I disagreed with them.	.89	.88	Good
4. My classmates considered my opinions, even if they differed from theirs.	.89	.87	Good
5. Interaction with my peers in digital environments favored my learning.	.86	.84	Good
6. The online course professor promoted a collaborative environment among classmates.	.87	.84	Good
7. I perceived a cooperative environment enjoyed by most classmates during the online course.	.86	.84	Good

Note: McDonald's ω, Cronbach's α

Table 3 reports the reliability of the dimension of collaborative work in multicultural teams to achieve objectives. The values of both coefficients range between 0.82 and 0.87, suggesting good item reliability in measuring the variables they represent; thus, the items are consistent with each other and reliably measure the construct.

Table 3

McDonald's Omega and Cronbach's Alpha of the Dimension "Collaborative Work in Multicultural Teams to Achieve Objectives."

Items	ω	α	Magnitude

Items	ω	α	Magnitude
8. My online coursemates and I were able to guide each other to meet the objectives despite language barriers.	.86	.86	Good
9. The collaborative work with my teammates let me know their organizational forms.	.87	.86	Good
10. Working collaboratively with colleagues from other cultures helped me develop my practical communication skills.	.82	.82	Good
11. Working collaboratively with my teammates from other cultures helped me to develop my leadership skills.	.83	.82	Good
12. Collaborative work with peers from other cultures made me commit to my tasks.	.84	.84	Good
14. I felt satisfied that I successfully achieved the course objectives.	.85	.85	Good

Table 4 reports the reliability of the dimension "Reflection on differences and similarities with peers during collaboration." The values of both coefficients range between 0.85 and 0.89, suggesting good item reliability for the measurement of the variables they represent; thus, the items are consistent with each other and reliably measure the construct.

Table 4

McDonald's Omega and Cronbach's Alpha of the Dimension "Reflection on Differences and Similarities with Peers During Collaboration."

Items	ω	α	Magnitude
15. Working with peers from different cultures helped me remember that everyone is different and must be considered when working in a group.	0.88	0.87	Good
16. Working with peers from different cultures helped me learn about new digital tools.	0.86	0.86	Good
17. Working with peers from different cultures helped me realize the importance of respect.	0.88	0.87	Good
18. Working with peers from different cultures helped me realize that we are not so different.	0.89	0.87	Good

19. Working cross-culturally helped me to reflect on global issues.	0.86	0.85	Good
Working with people from different cultures helped me to learn about study habits that can help me in the future.	0.86	0.86	Good

Finally, Table 5 reports the results of means, standard deviations, and reliability by dimension. The means reflect students' positive perceptions of their experiences in COIL courses regarding interacting with peers in digital environments, the collaboration among multicultural teams, and the differences and similarities among peers during collaboration. The reliability values of the McDonald's Omega and Cronbach's Alpha coefficients are excellent, suggesting that measures to evaluate the variables in each study dimension are adequate.

Table 5

Means, Standard Deviation, McDonald's Omega and Cronbach's Alpha by Dimension of the Scale "Perceptions of Experiences in Collaborative Online International Learning."

Items	M	SD	ω	α
Interaction among students in digital environments.	5.57	1.07	.89	.87
Collaborative work in multicultural teams to achieve objectives.	5.82	1.00	.86	.89
Reflection on differences and similarities with peers during collaboration.	5.83	1.00	.89	.88

Discussion

Developing instruments with robust validity to measure COIL course experiences is essential for a deeper understanding of learning, interaction, and collaboration processes in international virtual environments. The present study aimed to develop a measurement scale for university students' Collaborative Online International Learning experiences and analyze the construct validity and reliability of the scale. In Figure 1, we reported the results of the construct validity performed through Confirmatory Factor Analysis; the findings confirmed the excellent fit of the data to the measurement model proposed in three dimensions: interaction among students in digital environments, collaborative work in multicultural teams to achieve goals, and reflection on the differences and similarities among peers during collaboration. Our findings complement those of instruments used in other COIL courses (Davis et al., 2023; Mestre-Segarra & Ruiz-Garrido, 2022; Naicker et al., 2022) that do not report the evidence of validity and reliability of their scales.

In theory, these results confirm the viability of a model with three dimensions to evaluate the COIL experiences of students. In educational practice, this represents a contribution for teachers and researchers who develop educational practices and studies on the subject; they will now have a valid and reliable measure for the construct.

The reliability of the proposed scale was calculated using McDonald's Omega coefficient and Cronbach's Alpha. The exploration of item reliability allowed for knowing precisely the scores of each for more specific decision-making considering the item's behavior with the rest of the scale. Similarly, we calculated the reliability of the dimensions to know the global behavior of those values. Tables 2, 3, and 4 report the reliabilities of the dimensional items, indicating good values, as suggested in the literature (Green & Yang, 2015). This demonstrates the consistency of each scale item. Similarly, the reliability calculated by dimensions showed values that reflect good internal consistency and the excellent fit of the items to measure the Collaborative Online International Learning experiences.

Limitations

This study is a valuable contribution to knowledge about Collaborative Online International Learning, specifically in the methodological and instrumental aspects. Like every study, the findings presented here must be taken cautiously due to its limitations. In this case, although we sought to reduce them as much as possible, some limitations were beyond our ability to resolve. First, the study sample size was small, so we suggest forming a larger sample for future studies. Second, although we sought a sample with cultural variants, these can be expanded to permit generalizations. Finally, although we used a robust measure such as Confirmatory Factor Analysis to determine construct validity, it is necessary to include other evidence of validity, including concurrent, predictive, and discriminant validity, to strengthen the evidence of the scale's validity.

Conclusion

This study focused on developing a scale to measure experiences in COIL courses, obtaining evidence of validity and reliability. The confirmatory factor analysis results supported a three-dimensional model: interaction among students in digital environments, collaborative work in multicultural teams, and reflection during collaboration. Reliability coefficients by items and dimensions were also obtained, demonstrating adequate internal consistency and validating the robustness of the proposed scale. These findings represent a significant advance in the field and provide a valid and reliable tool to evaluate COIL experiences theoretically and practically.

Declarations

Conflict of interest. The authors have no conflict of interest in the publication of this manuscript.

Data Availability. Data will be available only if there is justification for the request.

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