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Promoting Intercultural Competence Through SDGs-Integrated PBL Curriculum: A Virtual Exhibition Peer Feedback Approach



WEN-CHI HU 

*Language Center,
Chaoyang University of Technology, Taichung, Taiwan
whu@cyut.edu.tw*

Abstract

Intercultural competence (IC) is a vital capability in higher education, yet limited opportunities for authentic intercultural interaction in many Asian EFL contexts constrain its development. This study examined the effectiveness of a Sustainable Development Goals (SDGs)-integrated Problem-Based Learning (PBL) curriculum in enhancing IC among Taiwanese university students. The intervention combined global problem-solving activities with virtual peer feedback on Virsody, a web-based 3D exhibition platform that supports intercultural exchange. Using a mixed-methods design, 107 participants completed the Intercultural Competence Scale (ICS) at three time points, and 23 students participated in semi-structured interviews. Repeated-measures ANOVA results revealed significant improvements in students' IC scores, while qualitative findings indicated that anonymous virtual peer feedback promoted reflection, empathy, and openness to diverse perspectives. The integration of SDGs (content), PBL (process), and Virsody (medium) operationalized IC development through collaborative, experiential, and technology-enhanced learning. The study contributed to intercultural education theory by demonstrating how sustainability-oriented and digitally mediated pedagogies can foster measurable intercultural growth. Practically, it offers a replicable model for incorporating global citizenship education into EFL curricula through authentic, reflective, and collaborative learning experiences.

Keywords: Intercultural competence, virtual exhibition, sustainable development goals (SDGs), integrated problem-based learning (PBL), mixed-methods

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Introduction

Intercultural competence (IC) is increasingly recognized as an essential skill in today's globalized world, enabling individuals to communicate effectively and appropriately across cultural boundaries (López-Rocha, 2021). IC includes navigating new cultural norms, values, and communication styles (D'Orazzi & Marangell, 2025; Rohani et al., 2025). Developing IC has become a central objective in higher education (Gutiérrez-Santiuste & Ritacco-Real, 2023; Zhang et al., 2025), where universities seek to prepare students for international collaboration and culturally diverse environments. Despite this recognition, many Asian EFL contexts, including Taiwan, offer limited opportunities for authentic intercultural interaction. Taiwanese students often rely on textbooks or digital materials rather than direct intercultural engagement, which may constrain the development of intercultural awareness and sensitivity (Hsu & Beasley, 2019; Wang, 2023; Yashima et al., 2004).

EFL curricula therefore serve as vital platforms for promoting intercultural learning. Prior research indicates that meaningful pedagogical design can create intercultural experiences even in domestic classrooms (Liu, 2016). Integrating the United Nations Sustainable Development Goals (SDGs) into English learning provides authentic, globally relevant contexts that expose students to multiple cultural perspectives and values (Bekteshi & Xhaferi, 2020; Mambu, 2023). When combined with Problem-Based Learning (PBL), learners collaboratively address real-world problems, negotiate meaning, and engage in reflection, which nurtures empathy, intercultural understanding, and perspective-taking (Carrió Llach & Llerena Bastida, 2023; Guo et al., 2024). Within this framework, SDG themes provide the intercultural content, while PBL offers the experiential process through which IC is developed via inquiry and collaboration.

To enhance this learning process, the present study incorporates Virsody, a web-based virtual exhibition platform that enables peer feedback and intercultural communication. Virtual peer feedback allows students to observe, critique, and discuss global issues from multiple perspectives, thereby strengthening intercultural awareness and communicative competence. The virtual exhibition itself does not constitute IC development but serves as a reflective and dialogic space where students exchange feedback, negotiate meaning, and refine their understanding of global issues. This approach positions IC development as the outcome of integrating SDGs (content), PBL (process), and Virsody (medium)—a triadic framework that extends existing models of intercultural learning (Byram, 1997; Deardorff, 2006).

This study was conducted within a 12-week general English course at a Taiwanese university that implemented an SDGs-integrated PBL curriculum. The course aimed to enhance students' IC through collaborative exploration of global challenges and peer interaction in a virtual environment. Working in small groups, students selected specific SDG themes, conducted research, and presented their solutions on Virsody, where they provided and received peer feedback. The purpose of this study is to examine how engaging with global problems through SDG-based PBL activities fosters IC and how virtual peer feedback further strengthens reflection, empathy, and intercultural communication among EFL learners.

Although IC is widely recognized as essential for global communication, particularly in EFL education, empirical research on how to effectively foster IC in classroom contexts remains limited. To date, studies have primarily examined IC development through virtual exchanges and telecollaboration (Heymans, 2024), short-term study abroad programs (Mahapatra et al., 2025), or curriculum internationalization initiatives (Goh, 2025). However, few investigations have explored how virtual platforms can be integrated with PBL to create authentic intercultural learning opportunities through collaborative problem-solving, solution sharing, and peer feedback.

Addressing this gap, the present study employs Virsody, a web-based virtual exhibition platform, as a digital space where students present SDG-related projects and engage in intercultural dialogue through peer feedback. This process enables learners to articulate their understanding of global challenges while reflecting on diverse perspectives and cultural values expressed in their peers' solutions. Such engagement is expected to cultivate the affective dimension of IC (openness and empathy), the cognitive dimension (cultural understanding), and the behavioral dimension (communication strategies). By situating IC development within the integration of SDGs (content), PBL (process), and Virsody (medium), this study extends existing frameworks of intercultural learning (Byram, 1997; Deardorff, 2006) to digitally mediated and sustainability-oriented contexts.

Accordingly, this study investigates how an SDGs-integrated PBL curriculum, supported by virtual peer feedback, contributes to IC development among EFL learners in Taiwan. The research questions guiding this study are:

1. To what extent do students exhibit changes in IC after engaging with an SDGs-integrated PBL curriculum?
2. How do students perceive the role of virtual peer feedback on Virsody in supporting reflection, intercultural learning, and SDGs awareness?
3. How do students' engagements with different SDGs topics reflect their intercultural awareness and global perspectives?

Literature Review

Importance of IC in EFL Context

IC refers to the ability to communicate and interact effectively with individuals from diverse cultural backgrounds. It involves not only recognizing and valuing cultural differences but also adapting one's behavior appropriately in intercultural situations. Bennett and Bennett (2004) described IC as the capacity to act appropriately across cultural contexts, emphasizing the need to overcome ethnocentrism and manage misunderstandings arising from cultural bias. Recent scholarship reinforces that IC extends beyond linguistic proficiency to encompass the ability to navigate unfamiliar cultural norms, values, and communicative behaviors (D'Orazzi & Marangell, 2025; Rohani et al., 2025). Deardorff and Jones (2012) conceptualized IC as comprising three interrelated dimensions: attitudes, knowledge, and skills that together enable effective and appropriate communication across cultures. Similarly, Liao and Li (2023) highlighted openness, curiosity, and willingness to engage with diverse perspectives as central to meaning-making in intercultural encounters. Byram (1997) argued that language learners develop IC as they become aware of how culture shapes meaning and interpretation in communication, thereby moving beyond linguistic competence toward reflective and empathetic engagement with cultural diversity.

IC is therefore understood as a dynamic, evolving competence that integrates cultural knowledge, interpretive and relational skills, attitudes, and critical awareness (Xu et al., 2025; Zhang et al., 2025). Chao (2014) expanded this framework by identifying five components: knowledge, affective orientation, self-efficacy, behavioral performance, and intercultural consciousness, emphasizing that successful language learners require both emotional readiness and behavioral adaptability to manage intercultural interactions effectively. In the context of globalization, EFL education plays a pivotal role in cultivating these competencies, as learners must navigate increasingly diverse academic, professional, and social environments. Nikiforova and Skvortsova (2021) emphasized that IC should be fostered across disciplines to prepare students as active global citizens, while Arslan and Curle (2021)

suggested that education for sustainable development (ESD), particularly through the framework of the United Nations Sustainable Development Goals (SDGs), provides meaningful contexts for advancing intercultural understanding and global responsibility.

To create authentic and transformative learning experiences, EFL educators are encouraged to integrate real-world global issues into instruction (Astawa et al., 2017; Astawa et al., 2024). Embedding SDG-related content enables students to examine complex global challenges from multiple cultural and ethical perspectives, thereby linking language learning with intercultural awareness. This approach aligns with evidence that intercultural learning is most effective when students collaborate on globally relevant tasks and exchange perspectives across cultures (Davies-Vollum et al., 2023). Consequently, the development of IC should be regarded not as a peripheral linguistic goal but as a central outcome of globally oriented EFL instruction that prepares learners to participate responsibly and empathetically in an interconnected world. Building on Byram's (1997) model of intercultural communicative competence and Deardorff's (2006) process model, this study investigates how IC can be cultivated through sustainability-driven, digitally mediated learning experiences.

SDGs-Integrated PBL in Education

Integrating SDGs into EFL instruction broadens its scope beyond linguistic development to include competencies essential for global engagement, encouraging learners to adopt a wider perspective and to participate actively in sustainability-oriented discourse (Ludwig, 2021). Incorporating SDGs as authentic and meaningful content enables teachers to enhance student engagement, strengthen language proficiency, and introduce real-world problem-solving challenges (Nanni & Allan, 2020). A growing body of research also highlights the effectiveness of PBL in improving EFL learning outcomes. PBL has been shown to reduce English language anxiety and to increase learners' self-efficacy and willingness to communicate (Zarei, 2024). These benefits stem from the collaborative and student-centered nature of PBL, which fosters supportive and interactive learning environments. Furthermore, PBL encourages learners to take ownership of their learning process and to develop life-long learning skills (Hmelo-Silver, 2004). Carrió Llach and Llerena Bastida (2023) demonstrated that PBL engages students in diverse contexts, enhancing their critical, social, and ethical competencies. Through this approach, learners deepen their understanding, explore areas of personal and academic interest, draw on collective experiences, and articulate their reasoning and learning processes more explicitly (Sudarya et al., 2023). Likewise, empirical findings confirm that PBL enhances EFL students' language proficiency, critical thinking, and motivation (Koçoğlu & Kanadlı, 2025). By engaging students in authentic problem-based scenarios, PBL encourages them to investigate alternatives, evaluate options, and propose feasible solutions (Kosow & Gaßner, 2008). Supported by authentic problem design, PBL effectively promotes learner engagement, language development, and higher-order thinking (Guo et al., 2024). Accordingly, this study adopted a concept map of SDGs-integrated PBL stages developed from insights gathered through the literature review (see Figure 1).

Virtual Exhibition for Better Learning

Researchers have discovered that online exhibitions act as educational tools, encouraging learners to engage in the planning, interaction, and execution of their creativities. VR exhibitions present numerous benefits for EFL learning, such as heightened interaction, creativity, and autonomous learning (Suprayogi & Eko, 2020). VR in EFL settings can create a near-authentic, contextualized environment. The methods of language engagement and learner-centered approaches are meaningful (Yang et al., 2020). VR tools have improved EFL learners' understanding, interests, enthusiasm, cultural sensitivity, and confidence (Ebadi & Ebadijalal, 2022). Also, VR exhibition in EFL learning allows for flexible learning, real-life application, and improved language skills (Yeh et al., 2022).

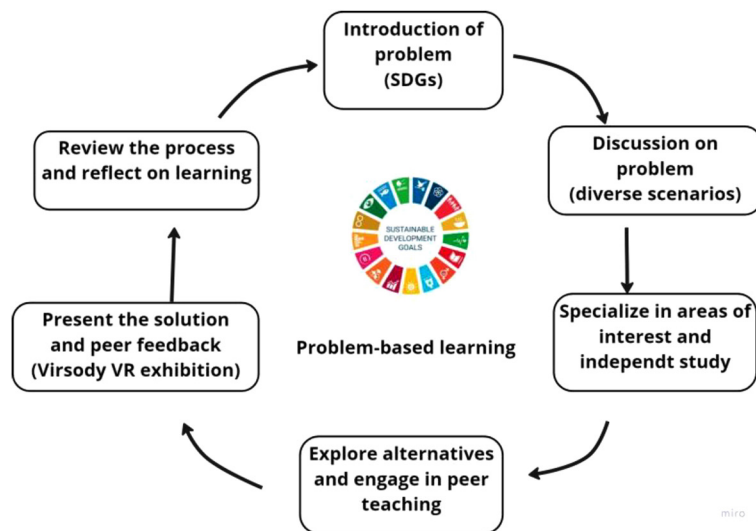


Figure 1 *SDGs-Integrated PBL Cycle*

Through collaborative efforts in designing online exhibitions, students enhance their English skills and acquire multimodal competencies, becoming more effective in roles like coordinators, planners, and evaluators (Lin, 2024). Furthermore, VR technology has been found to boost learning motivation, while peer feedback within VR settings encourages students to engage in reflective learning by examining their peers' work and evaluating their own (Chien et al., 2020; Makransky & Lilleholt, 2018). Topping (1998) highlighted the role of peer assessment in motivating students to evaluate their peers' work through ratings or feedback, thereby promoting critical thinking skills. Online peer assessment supports anonymous feedback, increases student participation in peer feedback activities (Liu et al., 2019), and provides flexibility in timing and location. Seifert and Feliks (2019) advocate for online peer feedback to enhance student evaluation skills, noting anonymity as a key benefit. In VR environments, experiences like receiving praise, criticism, and opinions encourage students to reflect on their performance (Chien et al., 2020). This VR experience facilitates the acquisition of collaborative advantages and skills relevant to students' future careers and promotes solutions or approaches to real-world challenges (Lin, 2024; Saiki et al., 2012). The immersive features of VR exhibitions can provide better learning experiences, showcasing their potential to encourage SDGs awareness, promote accessibility in education, and enable cooperation (Rane et al., 2023). Virsoy and similar virtual reality platforms, such as Spatial and Farvel, can serve as virtual galleries in the metaverse (Wu et al., 2024). Hence, in this study, Virsoy, a VR exhibition platform, served as a space for sharing SDG solutions, conducting peer assessment, and facilitating learning reflection.

Methodology

This investigation uses a mixed-methods approach that integrates quantitative and qualitative data to examine how the SDGs-integrated PBL curriculum and the Virsoy exhibition enhance participants' IC. Virsoy is a web-based virtual 3D exhibition platform designed for educational use, developed by the company Black Hole Creative in Taiwan. It allows students to display digital projects in immersive virtual spaces and engage in peer feedback through interactive features such as commenting and discussion boards. By simulating an authentic exhibition environment, Virsoy promotes collaboration, reflection, and intercultural exchange among learners, regardless of physical location. The study specifically utilizes a one-group repeated-measures design, wherein the same group of participants is assessed three times under the same conditions to observe changes over time. This design allows the examination of how participants' IC evolved following the SDGs-integrated PBL interventions.

By analyzing quantitative and qualitative data, the study aims to understand participants' IC development and their experiences with virtual peer assessment, providing insights for improving pedagogical practices. Quantitative data were collected via the Intercultural Competence Scale (ICS), and qualitative data were obtained via semi-structured interviews. Combining qualitative and quantitative approaches enables a more comprehensive understanding of the research questions (Creswell, 2002). Quantitative analysis was applied to evaluate the students' ICS outcomes. Participant interviews were conducted to examine how students perceived the SDG-integrated PBL instruction, and this qualitative data strengthened the study's credibility (Merriam, 2002). To enhance the credibility of the findings, this study employed a complementary mixed-methods strategy (Greene et al., 1989). Quantitative and qualitative data were integrated at the interpretation stage to offer a fuller understanding of the SDGs-integrated PBL approach and the role of virtual peer feedback in shaping intercultural learning outcomes.

Procedure

The aim of this study is to explore the effectiveness of an SDGs-integrated PBL curriculum, supported by virtual peer feedback on Virsody, in enhancing IC among EFL learners. A repeated measures Analysis of Variance (ANOVA) was used to analyze the changes in IC, as measured by the ICS questionnaire administered at three different points. The research uses a three-phase assessment approach with the ICS questionnaire for data collection. Initially, participants completed the questionnaire to set a baseline of IC. Following the implementation of an educational intervention integrating SDGs with PBL activities, the second administration of the ICS questionnaire measured immediate changes in participants' IC. After participating in the VR exhibition, where they shared solutions and received peer feedback, students completed the ICS questionnaire a third time to assess the sustained effects of the intervention (see Figure 2). Then, semi-structured interviews were carried out to complement the quantitative data for the research questions.

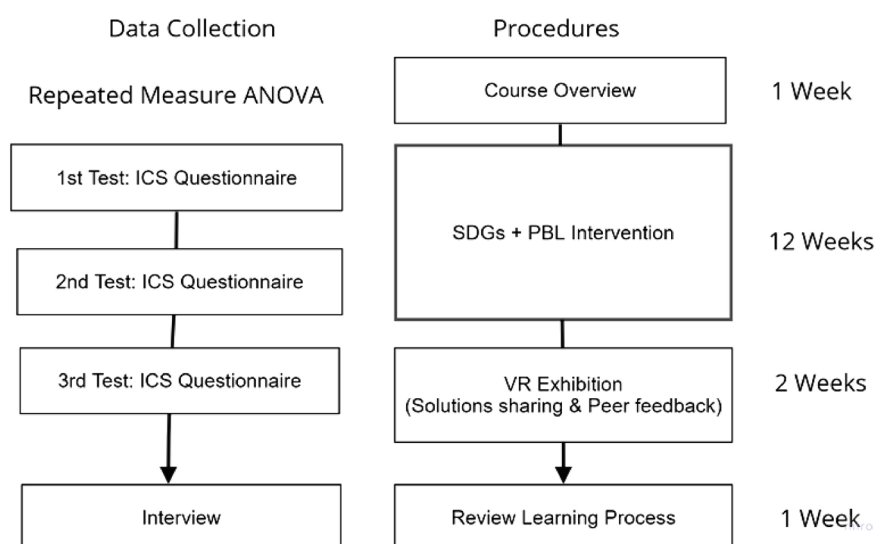


Figure 2 *Research Design*

Participants

The study involved 107 Taiwanese university EFL learners enrolled in a compulsory Freshman English course taught by the same instructor over one semester. The participants were assigned to the researcher's classes by the university's administration office. From these assigned students, a random selection

process was used to invite participants to join the study. The final sample included students from four departments: Science (38.32%), Humanities (13.08%), Education (39.25%), and Management (9.35%). These proportions reflect the natural composition of the assigned classes. For the qualitative phase, 23 students volunteered to participate in semi-structured interviews. This approach allowed for the inclusion of diverse perspectives while maintaining voluntary participation ethics.

Instrument

The ICS was employed to measure participants' competence across five factors: knowledge of intercultural interaction, affective orientation, self-efficacy, behavioral performance, and display of intercultural consciousness. The 29 items were drawn from validated survey items from Chao's (2014) instrument, and Cronbach's alpha is .961. The choice of survey items was informed by the study's research questions and objectives and feedback obtained from two experts' reviews. Each item underwent evaluation through a six-point Likert scale (Appendix). Moreover, a total of 23 volunteers participated in semi-structured interviews, with each session lasting approximately 25 minutes. Participants engaged in discussions centered around questions designed to explore their experiences and perspectives on the solutions displayed on Virsody and conduct peer feedback. The questions aimed to delve into various aspects of the study's focus, allowing participants to share detailed insights and reflections on their engagement with the online exhibition format. These conversations provided valuable qualitative data, enhancing the comprehension of the research questions. Interview questions 1-3 investigated how intercultural interaction and peer feedback within Virsody support the development of IC dimensions, including openness, empathy, and perspective-taking, whereas Questions 4-5 addressed how engagement with the SDGs promotes intercultural awareness and global-mindedness. The interview questions are:

1. How do you describe your overall experience using Virsody for peer feedback in your learning process?
2. Can you share specific instances where Virsody helped improve your SDGs solutions in drawing, writing, or speaking?
3. In what ways has receiving or giving peer feedback on Virsody influenced your learning outcomes?
4. Which SDG did you choose to focus on, and what motivated this choice?
5. How has working on this SDGs solution influenced your understanding or perspective on global issues?

SDGs-Integrated PBL Curriculum

The SDGs-integrated PBL curriculum is action-oriented and encourages learners to engage in creating sustainable solutions. The PBL component was implemented through a series of inquiry-based tasks centered on the SDGs. Students worked in groups to identify real-world problems related to their chosen SDG, research possible solutions, and collaboratively design a visual and written presentation using Virsody. The process followed key stages of PBL, including problem identification, information gathering, solution development, peer evaluation, and reflection. This structure encouraged intercultural negotiation, empathy, and perspective-taking, thereby supporting the development of IC alongside language and content learning objectives. This active engagement can facilitate experiential learning opportunities where students apply intercultural communication skills in diverse settings, further enhancing their competence. A total of 107 students were enrolled in a compulsory Freshman English course taught by the same instructor during one semester. The course aims to familiarize students with the SDGs, engage them in problem-solving real-world challenges related to these goals,

develop practical and reasonable solutions using virtual reality (VR) exhibition, and enhance collaborative skills through peer feedback. For the SDGs lesson, various materials were utilized to ensure an interactive and comprehensive learning experience. The resources included informational reading materials, diverse case studies, and scenarios related to SDGs for group discussions (see Table 1). The lesson commenced with an overview of the SDGs. They included selected goals and a discussion on their global significance, setting the PBL stages for the focus of the course. Students worked in groups, and each received a different SDG-related scenario to examine and stimulate conversation

Table 1 *SDGs-Integrated PBL Curriculum Design*

Weeks	Topics and issues taught in class	Examples	Activities
1.	Global Goals	Overview of 17 goals	Introduction to the course; group formation; discussion on the meaning and relevance of the SDGs; short reflective writing on personal connections to global issues.
2.	Kindness	Are humans born good or bad	Reading comprehension and discussion; brainstorming how kindness and empathy relate to intercultural communication; mini task on kindness across cultures.
3.	Culture Shock	Foreign culture conflicts	Watch video clips on culture shock; analyze real-life cases; group sharing on personal or second-hand intercultural experiences; vocabulary and expression building; decide one SDG goal to investigate.
4.	Stereotypes Awareness	Why does national identity matter, types of discrimination	Reading and group discussion on stereotypes and bias; role-play activities to challenge assumptions; linking the topic to SDG 10 (Reduced Inequalities).
5.	Respect Difference	Putting labels on people, gender roles and stereotypes	Debate on equality and respect; group mind-mapping of discrimination types; reflection writing on cultural tolerance and identity; linking the topic to SDG 5 (Gender Equality).
6.	Cultural Competence	Cross-cultural communication	Discussion on IC components; case reading; practice scenarios in cross-cultural communication.
7.	How to Change the World	Human rights and responsibilities	Reading on global citizenship; group brainstorming for potential project topics related to specific SDGs; proposal draft for PBL project; linking the topic to SDG 17 (Partnerships for the goals).
8.	Climate Change	Innovative ways of environmental protections	Group research on chosen SDG topics; develop project outlines and proposed solutions; teacher feedback sessions; linking the topic to SDG 13 (Climate Action).
9.	Religious Awareness	Religious beliefs and diversity	Reading and discussion on religious tolerance; connecting faith and traditions, examples of foreign superstitions and taboos; revision of project drafts; integration of intercultural perspectives.
10.	Model Citizens	Ways to save leftovers, food waste	Peers shared ideas on how to use leftovers for good; linking the topic to SDG 2 (Zero Hunger).
11.	Humanitarian Assistance	Foreign aid and rescue	Group work on finalizing written and visual project materials; peer feedback exchange on project drafts; rehearsal for presentations; linking the topic to SDG 1 (No Poverty).
12.	Technology and Human	How to use technology for good	Students record and refine oral presentations; upload final projects to Virsody platform; peer feedback practice using evaluation criteria.

on the multifaceted nature of these challenges. Following this, students delved deeper into the SDGs problems, causes, and solutions. During this session, they conducted independent research on their assigned goal, exploring personal or academic interest areas. Building on this, students spent time investigating various solutions individually, then engaging in peer discussion and sharing their findings.

Through the SDGs-integrated PBL process, students were required to research global issues, consider differing cultural perspectives, and collaboratively negotiate feasible solutions. This engagement aimed to foster the affective, cognitive, and behavioral dimensions of IC such as openness, empathy, and adaptability outlined by Chao (2014). The final stage of displaying these solutions on Virsody provided a reflective and communicative space where students could observe peers' ideas, offer constructive feedback, and compare cultural viewpoints represented in their projects. Thus, the virtual exhibition functioned as a mediating environment that extended intercultural learning rather than serving as the end goal.

The culmination of this investigative work was a final session where participants used a VR exhibition to create and present immersive presentations of their proposed solutions. After all presentations and peer feedback, students reflected on what they had learned as the final review of learning. They discussed the problem-solving process and how peer feedback could enhance understanding and solution modelling. Each student wrote a brief reflection on what they had learned and how it could be applied outside the classroom.

Virtual Exhibition and Peer Feedback

Integrating SDG themes within a PBL framework provides authentic, globally relevant contexts that encourage collaboration, empathy, and perspective-taking. The Virsody virtual exhibition extends this process by creating a space for peer feedback and reflection. Through exchanging feedback on SDG-related projects, students engage with diverse viewpoints, negotiate meaning, and refine their understanding of global issues. These processes collectively support the development of IC. For instance, peer assessment fosters interaction and engagement among students (Ion et al., 2018). In this study, Virsody was used as the VR exhibition platform. Students used it to showcase their SDGs solutions both drawings and writings. During the process, students first submitted, evaluated peers' work, provided feedback, and received feedback on their own submissions, including strengths, weaknesses, and improvement suggestions (Chien et al., 2020). This creates an interactive learning environment (see Figure 3). Here, students engage in peer assessment, share feedback anonymously, and reflect on their learning experiences related to the SDGs.

The development of IC in this study results from the integration of three components: SDGs as globally relevant and interculturally rich content, PBL as a collaborative and reflective learning process, and Virsody as the medium facilitating peer feedback and communication. These interconnections show how SDGs, PBL, and Virsody work together to support IC development. Each group presented their VR solution, including drawings and writings, to the class in a 5-minute oral presentation, and peers posted their feedback in the Virsody comments using structured feedback forms (see Table 2). The peer feedback criteria include the creativity of the SDGs solutions (30%), the effectiveness of the VR presentations (30%), the aesthetic performance of the drawings (20%), and the meaning of the solutions (20%).

Data Analysis

First, a repeated-measures ANOVA was performed to assess participants' variance in IC over time. Table 3 presents the descriptive statistics for the ICS questionnaire results collected at three different

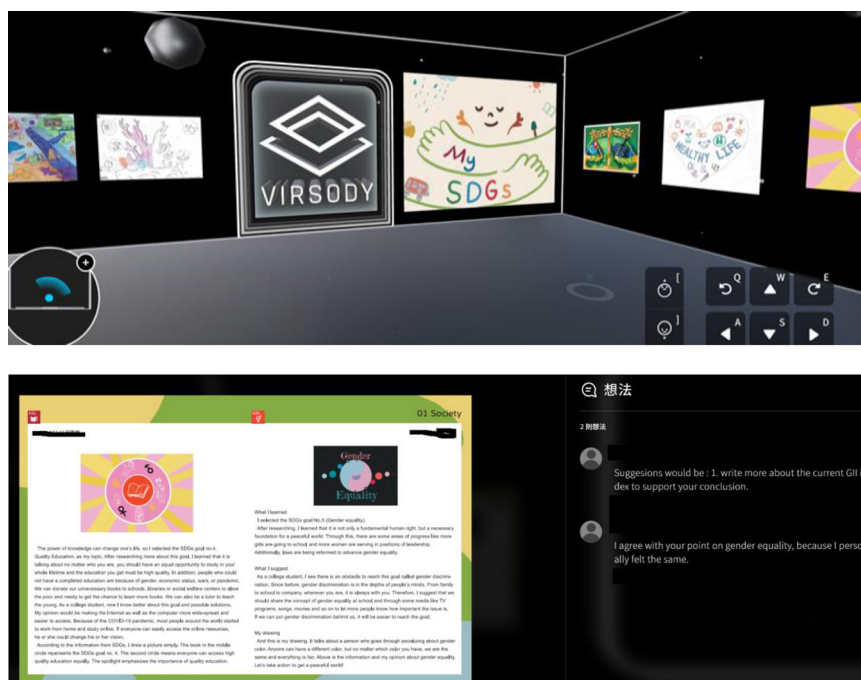


Figure 3 Examples of Virsody Exhibition and Peer Feedback

Table 2 Peer Feedback Criteria

Criteria	Excellent	Good	Satisfactory	Needs improvement
1. Creativity of SDGs Solutions 30%	Highly original and innovative approach to SDGs solutions.	Original approach with good innovation in SDGs solutions.	Adequate approach with some innovation in SDGs solutions.	Limited originality and innovation in SDGs solutions.
2. Effectiveness of VR Presentations 30%	The presentation effectively communicates the concept with high engagement.	The presentation communicates the concept well with good engagement.	The presentation communicates the concept with a satisfactory level of engagement.	The presentation communicates the concept but lacks engagement.
3. Aesthetic Performance of Drawings 20%	Drawings are exceptionally well-designed with attention to detail and composition.	Drawings are well-designed with good attention to detail and composition.	Drawings are satisfactory with some attention to detail and composition.	Drawings lack attention to detail and composition.
4. Meaning of the Solutions 20%	Solution provides profound insights and a strong, relevant message aligned with SDGs.	Solution provides clear insights and a relevant message aligned with SDGs.	Solution provides an adequate message aligned with SDGs.	Solution provides a vague or weakly relevant message to SDGs.

Table 3 Descriptive Statistics for ICS Results

	M	SD	N
Time1	4.33	.76	107
Time2	4.58	.52	107
Time3	4.70	.78	107

time points. The results reveal an upward trend in the ICS results among 107 participants. The mean score increased from 4.33 before the course (Time 1) to 4.58 after the intervention (Time 2), and then to 4.70 after students displayed their SDGs solutions on Virsody (Time 3). This progression suggests an improvement in participants' IC throughout the study.

Table 4 demonstrates that the data meet the assumption of sphericity, indicated by a p -value of .165, which is greater than .05. Therefore, the assumption of sphericity was confirmed, meaning that the repeated-measures ANOVA results are valid under this assumption.

Table 4 *Assumption of Sphericity*

Mauchly's test of sphericity							
Measure: MEASURE_1							
Within subjects effect	Mauchly's W	Approx. chi-square	df	sig.	Epsilon		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
time	.97	3.60	2	.17	.97	.99	.50

In Table 5, the F-value is 10.168, indicating significance with a p -value $< .001$, which is below the accepted alpha threshold of .05. This result indicates a statistically meaningful discrepancy among the mean values across the various stages of the time-based, within-subjects variable.

Table 5 *Tests of Within-Subjects Effects*

Tests of within-subjects effects							
Measure: MEASURE_1							
Source		Type III sum of squares	df	Mean square	F	Sig.	Partial eta squared
Time	Sphericity Assumed	7.86	2	3.93	10.17	.000	.09
	Greenhouse-Geisser	7.86	1.94	4.06	10.17	.000	.09
	Huynh-Feldt	7.86	1.97	3.99	10.17	.000	.09
	Lower-bound	7.86	1.00	7.86	10.17	.002	.09
Error (factor1)	Sphericity Assumed	81.91	212	.39			
	Greenhouse-Geisser	81.91	205.09	.40			
	Huynh-Feldt	81.91	208.84	.39			
	Lower-bound	81.91	106.00	.77			

Furthermore, Table 6 provides a detailed breakdown of pairwise comparisons for a variable over time. Between Time 1 and Time 2, there is a mean difference of -0.252 , which is statistically significant ($p = .007$). Comparing Time 1 with Time 3, there is a more considerable mean difference of -0.376 , which is also significant ($p < .001$). Looking at Time 2 compared with Time 1, the mean difference is 0.252 (the same value but positive, as this is the reverse comparison of the first row),

with the same significance level ($p = .007$). Time 2 compared to Time 3 shows a mean difference of -0.124 , which is not statistically significant ($p = .153$). Hence, the IC results of participants showed a significant increase from Time 1 to Time 3 and from Time 1 to Time 2; however, the increase from Time 2 to Time 3 was not statistically significant.

Table 6 *Pairwise Comparisons*

Pairwise comparisons						
Measure: MEASURE_1						
(I) Time	(J) Time	Mean difference (I-J)	Std error	Sig.	95% Confidence interval for difference	
					Lower bound	Upper bound
1	2	-.25*	.09	.007	-.43	-.07
	3	-.38*	.08	.000	-.53	-.22
2	1	.252*	.09	.007	.07	.43
	3	-.12	.09	.153	-.30	.05
3	1	.38*	.08	.000	.22	.53
	2	.12	.09	.153	-.05	.30

Additionally, analysis of the semi-structured interviews indicated distinct themes and patterns related to participants' views on the Virsody exhibition and their preferences regarding SDGs topics. Based on the 23 volunteers' interview feedback, using Virsody provided several advantages, notably reducing stress associated with presenting SDGs solutions. Additionally, receiving peer feedback enhanced their depth of learning, while the virtual exhibition allowed for greater flexibility in appreciating their peers' drawings and essays (see Table 7). Participants' reflections on the Virsody exhibition revealed how the virtual platform supported the development of IC. Anonymous peer feedback encouraged openness to diverse perspectives and reduced affective barriers to intercultural exchange. The virtual exhibition featured provided a low-anxiety environment for expressing ideas, fostering confidence and empathy in communication. In addition, participants' emphasis on reflection and critical thinking indicated deeper awareness of multiple viewpoints and self-evaluation, both of which are essential components of IC development.

Table 7 *Participants' Views of Virsody Exhibition (N = 23)*

Themes	Examples	N	%
Anonymous Peer Feedback	• Learning enhancement through diverse perspectives	18	78%
	• Focusing attention on the content of feedback	20	86%
	• Minimizing bias and negative emotions	15	65%
Stress Reduction	• Lowered stress or anxiety relative to typical public speaking	22	97%
	• More confident to present solutions	17	74%
Online Virtual Exhibition Features	• Flexibility ways to engage with SDGs solutions	20	86%
	• Offering sufficient time to review drawings and written content	22	97%
Critical Thinking	• Promotion of deeper reflection	17	74%
	• Be more objective when looking at their own work	19	83%

As shown in Table 8, participants in the study demonstrated interest in addressing economic, societal, and environmental challenges through problem-solving and solution-oriented thinking related to the SDGs. Their proposals include enhancing economic equity, promoting social well-being through education and health initiatives, and protecting the environment by conserving natural resources. This diverse approach underscores a comprehensive understanding of sustainability, emphasizing the interconnectedness of economic stability, social equity, and environmental preservation. Participants proposed practical, local actions to contribute to the SDGs, emphasizing that individual efforts and community initiatives are crucial to sustainable development alongside systemic changes.

Table 8 *Preferences of SDGs from Semi-Structured Interviews*

Categories	Goal no.	Practical solutions from participants
Economy	No. 8: Decent Work and Economic Growth	Gain more knowledge about fair trade issue
		Learn about current employment policies and situations
		Be mindful of labor rights and work ethics
	No. 10: Reduced Inequalities	Share facts with our family and friends to encourage equitable actions
		Buy fair trade products
		Express our voices on social media
	No. 12: Responsible Consumption and Production	Reduce impulsive consumption
		Use environmentally friendly products
		Make more local purchases
Society	No. 2: Zero Hunger	Reduce waste and trash daily
		Study about agricultural technology and maintaining the genetic diversity of seeds
		Don't waste food
		Buy food in bulk
		Be grateful for daily meals
	No. 3: Good Health and Well-Being	Learn about the food system and shop wisely
		Pay attention to our mental health rather than just physical health
		Take care of our health by using technology
		Don't waste medical resources
		Learn more about young people's mental health
	No. 4: Quality Education	Donate books to local schools, library, or Social Welfare Center
		Serve as a tutor to teach others
	No. 5: Gender Equality	Respect different genders
		Share house chores
		Use the power of social media
		Remove the shame from menstruation
		Have more confidence in my gender

(continue)

Table 8 (continued)

Categories	Goal no.	Practical solutions from participants
Society	No. 11: Sustainable Cities and Communities	Reduce people's impact on the environment
		Protect cultural and natural heritage
		Learn more about our cities
Biosphere	No. 16: Peace, Justice, and Strong Institutions	Join peace parades or write a letter to the government to show our voices
		Show respect and love
		Have a willingness to help others
	No. 6: Clean Water and Sanitation	Use more water-saving devices
		Take showers instead of baths
		Start making daily changes
	No. 13: Climate Action	Limited use of air conditioning
		Bring our own shopping bags
		Support green energy
		Reduce the use of fossil fuels
		Use public transportation to reduce carbon emissions
		Have meat-free days
		Use applications to track my carbon footprint
	No. 14: Life Below Water	Reduce all types of marine pollution
		Avoid eating endangered species
		Never use sunscreen while in the water
		Use less plastic products to avoid ocean pollution
		Beach cleanup, reduce single-use plastics
	No. 15: Life on Land	Avoid products containing microbeads
		Support non-government organizations
		Study about wildlife
		Conserve natural resources
		Support animal rights

Discussion

Students' IC Development after Engaging with an SDGs-Integrated PBL Curriculum

The significant increases in IC scores suggest that the SDGs-integrated PBL curriculum effectively enhances intercultural awareness among EFL learners. The study underscores the importance of structured intercultural education in developing critical global competencies in a university setting. The result of the repeated-measures ANOVA analysis revealed a statistically significant difference in the mean results over these periods ($F(2, 212) = 10.168, p < .001$). Subsequent post hoc pairwise comparisons, adjusted by the Bonferroni correction, identified a statistically significant increase in the mean score from the initial questionnaire to the follow-up questionnaires (Time 1 to Time 2, $p = .007$; Time 1 to Time 3, $p = .000$). However, the difference between the Time 3 and Time 2 questionnaire was not

statistically significant ($p = .153$). These findings indicate a significant time effect on IC development, suggesting that the curriculum contributed to the improvement measured by the ICS. Between Time 1 and Time 2, there was an observed enhancement in the IC performance of the participants, likely attributable to the instruction and activities related to SDGs and PBL. Moving from Time 1 to Time 3, students demonstrated further improvements, surpassing the baseline, potentially as a result of receiving peer feedback. Between Time 2 and Time 3, improvements were also found among the students, although these were not statistically significant. This may suggest that their level of learning was already quite high, indicating a plateau effect where additional gains become harder to achieve due to the initial substantial improvements. These results indicated that IC development emerged through the combined influence of SDG-related content, collaborative problem-solving in PBL, and reflective peer engagement in Virsody. The integration of these elements created authentic, globally relevant learning contexts that encouraged empathy, openness, and perspective-taking, which are central to intercultural learning.

These study findings add value to the existing literature by empirically validating the positive impact of incorporating SDGs and PBL approaches in EFL classrooms on enhancing IC. The findings from the repeated-measures ANOVA not only align with prior studies that underscore the significance of targeted activities and supportive guidance for intercultural learning (Liu, 2016; Wang, 2023) but also extend the understanding of how SDGs can act as catalysts for fostering global citizenship among EFL learners, as suggested by Mambu (2023). Moreover, this study illuminates the role of PBL in stimulating collaboration and innovation, enabling students to integrate their personal experiences with diverse cultural, economic, and environmental realities in an ethically conscious way (Carrió Llech & Llerena Bastida, 2023). In doing so, it reaffirms and builds upon the work of Bekteshi and Xhaferi (2020) and Davies-Vollum et al. (2023), who argue for the immense benefits of integrating discussions on global goals within EFL education to advance IC. Thus, this study offers concrete evidence supporting innovative pedagogical strategies that prepare learners for a globalized world, contributing novel insights into effective practices for cultivating intercultural understanding and international citizenship in the field of language education. Theoretically, these findings contributed to models of intercultural learning by demonstrating how experiential, problem-oriented, and sustainability-focused instruction can foster measurable growth in IC. Practically, the curriculum design provided a replicable framework for integrating global issues into EFL teaching, offering educators a concrete strategy to promote intercultural awareness and global citizenship through structured reflection and collaboration.

Students' Perceptions of Virtual Peer Feedback on Virsody in Supporting Reflection, Intercultural Learning, and SDGs Awareness

Based on semi-structured interviews with 23 participants, it was observed that anonymous peer feedback through Virsody facilitates enhanced learning from diverse perspectives. Participants indicated that providing feedback encouraged deeper reflection about solutions. They experienced reduced stress compared to traditional public speaking scenarios, which often induce higher levels of anxiety. The online virtual exhibition format with peer feedback provided greater flexibility and ample time for participants to consider their classmates' SDGs solutions thoroughly, appreciate drawings, and engage with written content.

The findings aligned with prior research on peer assessment; technology-enhanced peer evaluation has been recognized for its role in enhancing students' academic performance, motivation, critical thinking, and reflective abilities (Chang et al., 2020; Chen et al., 2023; Demiraslan Çevik et al., 2015; Dickson et al., 2019; Fu et al., 2019; Zumba et al., 2025). Using anonymous online feedback mechanisms can shift students' attention to the substance of assessments over the assessors' identities, thus minimizing bias and mitigating adverse emotions (Gao, 2025; Panadero & Alqassab, 2019). Also, Dağdelen (2025)

stated that EFL learners generally viewed digital peer feedback positively, as it reduced anxiety, and boosted motivation and confidence. Thus, digital peer feedback promoted metacognitive reflection, helping learners think critically about feedback and use it to revise their work. The peer feedback process within Virsody not only enhanced reflection and reduced anxiety but also supported intercultural learning by exposing students to diverse perspectives and communication styles. Such interaction aligns with key IC dimensions, including empathy, tolerance of ambiguity, and respect for difference, highlighting the pedagogical potential of technology-mediated collaboration in fostering intercultural understanding.

Students' SDGs Engagements Reflect their Intercultural Awareness and Global Perspectives

From the semi-structured interviews, participants identified some patterns and overlapping SDGs. In the Economic category, participants showed a keen interest in SDGs focused on economic issues, such as Decent Work and Economic Growth, Reduced Inequalities, and Responsible Consumption and Production. Their solutions emphasize learning about fair trade, labor rights, and responsible consumption practices, suggesting a conscious effort to understand and mitigate the negative impacts of economic activities on society and the environment. The emphasis on sharing knowledge and altering personal consumption habits indicates a grassroots approach to fostering economic sustainability and equity. Moreover, participants expressed concerns about societal solutions, including Zero Hunger, Good Health and Well-being, Quality Education, Gender Equality, Sustainable Cities and Communities, and Peace, Justice, and Strong Institutions. Solutions range from advocating for mental health awareness to promoting gender equality and enhancing the sustainability of cities. The focus on education, health, and societal well-being reflects a holistic view of social sustainability, where equitable access to resources and opportunities is essential for sustainable development. Finally, in the Biosphere category, participants addressed the critical need to build environmental awareness and take action. Participants gravitated towards goals related to Clean Water and Sanitation, Climate Action, Life Below Water, and Life on Land. Proposed solutions include using water-saving devices, advocating for reduced use of fossil fuels, participating in beach cleanups, and supporting wildlife conservation. This focus underscores the critical importance of preserving natural resources and ecosystems as foundational elements of sustainable development. The following figure summarizes the concerns and specific goals that garnered the most participant interest (see Figure 4). Thus, students may select specific SDGs they feel a personal connection to or align with their educational and career aspirations, seeing these goals as more pertinent and accessible. Familiarity with specific goals plays a role, as does the visibility of clear and achievable pathways to make an impact, which can guide their preferences towards particular SDGs over others. The students' strong engagement with the "Society" category goals, such as SDG 5 (Gender Equality) and SDG 10 (Reduced Inequalities), reflected a developing intercultural awareness that extends beyond surface culture (for example, food and festivals) to a deeper understanding of systemic global issues. This engagement aligned with the knowledge and affective dimensions of IC, demonstrating both a cognitive grasp of complex problems and an affective orientation characterized by empathy and concern for equity, which are essential foundations for global citizenship.

Hence, the findings confirmed that IC in EFL learning develops through the dynamic interaction of content (SDGs), pedagogy (PBL), and digital medium (Virsody). This triadic integration advances current frameworks by illustrating how global themes, experiential learning, and virtual collaboration collectively enhance intercultural engagement. In practical terms, the approach provided a sustainable and transferable model for language educators aiming to embed global citizenship and intercultural dialogue within their curricula.

The results of the study align with what is documented in existing literature. Usman et al. (2025) found that students viewed sustainability-themed EFL tasks as more meaningful than purely linguistic

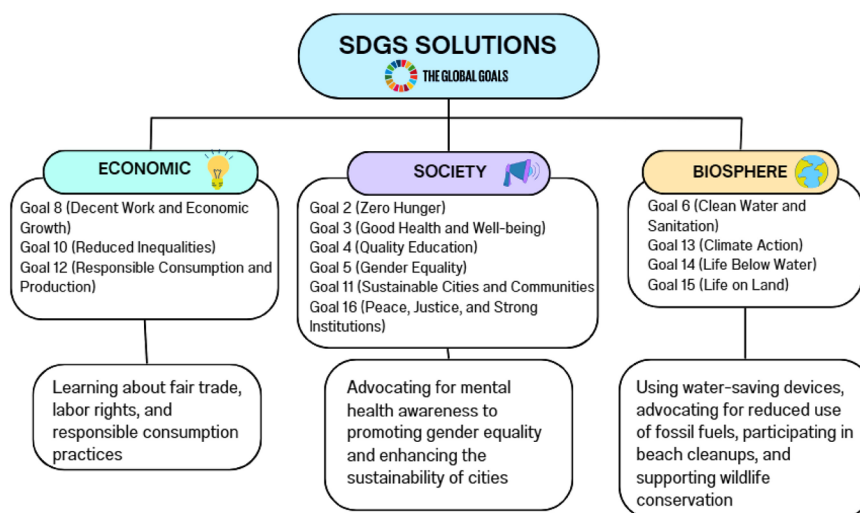


Figure 4 Participants' SDGs Preferences

ones. Integration was most effective when language skills were combined with critical thinking and reflection on SDG issues. Bektashi and Xhaferi (2020) argue that incorporating SDGs into EFL teaching provides students with an intercultural lens, equipping them for the demands of a dynamic global landscape. Nanni and Allan (2020) further advocate integrating SDGs into EFL classrooms, suggesting that such content can elevate student engagement and problem-solving abilities. Azizah et al. (2025) found that integrating SDGs into EFL fostered students' critical thinking, empathy, and engagement while enhancing language skills and promoting global citizenship. Koçoğlu and Kanadlı (2025) and Carrió Llach and Llerena Bastida (2023) have demonstrated how PBL immerses students in varied contexts, fostering their critical thinking and ethical reasoning. Kosow and Gaßner (2008) emphasize that PBL encourages students to find solutions by exploring options, considering potential outcomes, and making informed decisions to resolve issues, thereby fostering global citizenship among EFL learners (Mambu, 2023).

Limitation of the Study

One area of concern for this study is its focus on a specific educational setting and a relatively homogeneous group of EFL learners, which could restrict the broader applicability of the findings. Also, future research could include control groups not exposed to the curriculum to attribute changes more accurately in IC to the intervention. Likewise, future research could incorporate a broader demographic, including nationality or cultural background variations, employing various assessment methods and comparing multiple platforms. This approach would enrich our understanding of intercultural learning processes in diverse educational contexts. Additionally, examining the role of technology, like Virsody, in facilitating intercultural learning could provide insights into optimizing virtual platforms for educational purposes.

Conclusion

This research significantly contributes to the literature by empirically validating the efficacy of integrating SDGs and PBL in enhancing IC among EFL learners. It extends the current understanding of how SDGs can serve as a stimulant for promoting global citizenship. It underscores the potential of PBL to stimulate critical thinking, collaboration, and ethical reasoning. By highlighting the beneficial role of anonymous peer feedback in reducing presentation stress and encouraging deep reflection, this

study also enriches discussions around the use of digital platforms in education. The findings advanced theoretical understanding by demonstrating how the integration of SDGs and PBL within a digital peer feedback environment operationalizes IC development in measurable ways. This framework clarified the interdependence between global content, experiential learning processes, and reflective communication in promoting intercultural awareness.

This study confirms the effectiveness of an SDGs-integrated PBL curriculum in elevating IC among EFL students. With significant gains in IC scores verified by repeated-measures ANOVA, the findings endorse a pedagogical shift towards incorporating structured intercultural content within authentic global issues and problem-solving to cultivate essential global competencies. The observed progression in students' intercultural development, from before the intervention to after the Virsody exhibition and peer feedback sessions, highlights the impact of SDGs-related instruction and the peer feedback process. These results suggested practical directions for EFL educators seeking to cultivate IC through curriculum design. Incorporating authentic, globally focused problems and peer feedback within virtual learning spaces can create a sustainable model for integrating global citizenship education into language instruction.

In terms of students' reception of the virtual exhibition platform Virsody, the study reveals that anonymity in peer feedback facilitates a more profound engagement with diverse perspectives, enabling a stress-reduced learning environment compared to conventional presentation methods. This method aligns with recent scholarship recognizing technology-mediated peer evaluation as beneficial for academic growth, motivation, and reflective thinking.

Regarding SDGs preferences, participants predominantly selected goals within the Economic, Society, and Biosphere categories, resonating with a grassroots drive towards understanding and acting upon economic sustainability, social equity, and environmental stewardship issues. These preferences underscore a trend where students prioritize SDGs with personal significance or perceived practicality in effecting change.

Collectively, these insights demonstrate the multifaceted benefits of SDGs-focused PBL in fostering global citizenship, ethical awareness, and collaborative problem-solving among EFL students. This research substantiates the transformative potential of SDGs as educational content, reinforcing the work of seminal authors in the field and offering a compelling argument for the continued integration of global goals into higher education. By highlighting how such pedagogical approaches prepare students for a globalized society, this study contributes to the broader dialogue on reasonable practices for promoting intercultural understanding and global responsibility. In practical terms, this study provided educators with a replicable model for combining SDGs-based inquiry, problem-solving, and digital peer reflection to promote intercultural learning. Future research may explore how this triadic framework can be adapted across disciplines or cultural contexts to further enhance global competence in higher education.

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Appendix

Intercultural Competence Scale (ICS) for Taiwanese University EFL learners

6 = strongly agree, 5 = agree, 4 = slightly agree, 3 = slightly disagree, 2 = disagree, 1 = strongly disagree

Factor 1: Knowledge of intercultural interaction	
1. I know the routine aspects of life in other cultures (e.g., cuisine and customs).	6 5 4 3 2 1
2. I know the rules of non-verbal behaviors in other cultures.	6 5 4 3 2 1
3. I know the visible achievement cultures, related to the facts and knowledge of world civilizations (e.g., arts, literature).	6 5 4 3 2 1
4. I know the rules of verbal behaviors in other cultures.	6 5 4 3 2 1
5. I know the signs of cultural stress and strategies for overcoming culture shock.	6 5 4 3 2 1
6. I know how historical and socio-political factors influence the attitudes and behavior of people from different cultures.	6 5 4 3 2 1
7. I know how to appropriately negotiate with people from different cultures in intercultural contexts.	6 5 4 3 2 1
8. I know the interactive behaviors common among people of different cultures in professional areas.	6 5 4 3 2 1
Factor 2: Affective orientation to intercultural interaction	
9. I enjoy communicating with people from different cultures.	6 5 4 3 2 1
10. I am willing to acquire knowledge regarding different world cultures.	6 5 4 3 2 1
11. I am willing to manage emotions and frustrations when interacting with people from different cultures.	6 5 4 3 2 1
12. I am willing to demonstrate my interest in understanding people of other cultures that are unfamiliar to me.	6 5 4 3 2 1
13. I am willing to modify my attitude and behavior for interacting appropriately with people of other cultures.	6 5 4 3 2 1
14. I am willing to communicate with people of other cultures to broaden my worldview.	6 5 4 3 2 1
Factor 3: Self-efficacy in intercultural situations	
15. I am confident that I can interact with people of other cultures appropriately and effectively.	6 5 4 3 2 1
16. I am confident that I can adjust to living in different cultural contexts.	6 5 4 3 2 1
17. I am confident that I can adjust to the stress of culture shock.	6 5 4 3 2 1
Factor 4: Behavioral performance in intercultural interaction	
18. I can effectively use English to communicate with other people of different cultural backgrounds.	6 5 4 3 2 1
19. I can eat what others eat in culturally diverse situations.	6 5 4 3 2 1
20. I can use functional languages (e.g., invitation, refusal, and apology) flexibly for achieving appropriate intercultural communication.	6 5 4 3 2 1
21. I can develop appropriate interactive strategies (e.g., directness and face-saving) to adjust to the diverse styles of intercultural communication.	6 5 4 3 2 1
22. I can modify the way I dress when it is necessary in intercultural situations.	6 5 4 3 2 1

(continue)

(continued)

23. I can change my verbal behavior (e.g., speed, accent) when it is necessary in intercultural situations.	654321
24. I can change my non-verbal behavior (e.g., gestures, facial expressions) when it is necessary in intercultural situations.	654321
Factor 5: Display of intercultural consciousness	
25. I do not generalize a person's behaviors as representative of a particular culture.	654321
26. I am well prepared before any intercultural contact.	654321
27. I can realize the cultural knowledge I apply to intercultural interaction.	654321
28. I can sense how my cultural background influences my attitudes and approaches to managing emerging problems during intercultural communication.	654321
29. I can sense that the responses other people provide during intercultural communication often reflect their own values and beliefs.	654321