

# Collaborative learning in Lima's public universities: perspectives from higher education

*Aprendizaje colaborativo en universidades públicas de Lima: perspectivas desde la educación superior*

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## Abstract

This qualitative research analyzes the practices and perceptions of collaborative learning among undergraduate students at a public university in Lima, Peru. A multiple case study design with a hermeneutic-phenomenological approach was used to understand the meanings and experiences that students attribute to collaborative learning within their academic context. Fourteen students from seven faculties participated and were interviewed using a semi-structured guide organized into four dimensions: social, cognitive, emotional, and organizational. The findings show that collaboration is conceived as a process based on reciprocity, shared responsibility, and mutual support. In the social dimension, empathic communication and cooperation are revealed as essential elements for maintaining group cohesion. In the cognitive sphere, knowledge is constructed collectively through dialogue, feedback, and peer explanation. The emotional dimension highlights motivation, trust, and a sense of belonging as factors that strengthen participation and reduce academic stress. Finally, in the organizational dimension, advance planning, role distribution, and continuous feedback are consolidated as key aspects for effective group work. In conclusion, the study shows that collaborative learning transcends the academic sphere, promoting students' social, emotional, and cognitive development, as well as providing valuable guidance for strengthening educational practices in higher education.

**Keywords:** collaborative learning, higher education, social skills.

## Resumen

La presente investigación cualitativa analiza las prácticas y percepciones del aprendizaje colaborativo en estudiantes de pregrado de una universidad pública de Lima, Perú. Se empleó un diseño de estudio de casos múltiples con enfoque hermenéutico-fenomenológico, orientado a comprender los significados y experiencias que los estudiantes atribuyen al aprendizaje colaborativo dentro de su contexto académico. Participaron catorce estudiantes pertenecientes a siete facultades, quienes fueron entrevistados mediante una guía semiestructurada organizada en cuatro dimensiones: social, cognitiva, emocional y organizativa. Los hallazgos muestran que la colaboración se concibe como un proceso basado en la reciprocidad, la responsabilidad compartida y el apoyo mutuo. En la dimensión social, la comunicación empática y la cooperación se revelan como elementos esenciales para mantener la cohesión grupal. En el ámbito cognitivo, el conocimiento se construye colectivamente a través del diálogo, la retroalimentación y la explicación entre pares. La dimensión emocional resalta la motivación, la confianza y el sentido de pertenencia como factores que fortalecen la participación y reducen el estrés académico. Finalmente, en la dimensión organizativa, la planificación anticipada, la distribución de roles y la retroalimentación continua se consolidan como aspectos clave para la eficacia del trabajo grupal. En conclusión, el estudio evidencia que el aprendizaje colaborativo trasciende el ámbito académico, promoviendo el desarrollo social, emocional y cognitivo de los estudiantes, además de aportar orientaciones valiosas para fortalecer las prácticas educativas en la educación superior.

**Palabras clave:** aprendizaje colaborativo, educación superior, competencias sociales.

## Introduction

Collaborative learning has emerged as a key pedagogical strategy in contemporary education, particularly in higher education, where the aim is to cultivate not only cognitive competencies but also social and emotional skills. In this context, it is recognized as a tool that encourages the joint construction of knowledge, peer interaction, and collective problem-solving (Johnson & Johnson, 1999). However, in the Peruvian university landscape, especially within public universities, the implementation of collaborative learning faces challenges associated with both structural limitations and traditional conceptions of teacher-centered learning.

For undergraduate students in public universities in Lima, collaborative learning practices are often influenced by factors such as class size, limited access to technological resources, and students' prior abilities to work in teams. According to Slavin (1995), collaborative learning requires a carefully designed educational framework that promotes positive interdependence, supportive interaction, and individual accountability, elements that are frequently lacking in these educational contexts.

Despite the widely documented benefits of collaborative learning, such as the development of interpersonal skills, increased motivation, and improved academic performance (Gillies, 2007; Kagan, 1994), there are relatively few studies that qualitatively analyze how undergraduate students in public universities in Lima experience and perceive this pedagogical strategy. This gap in the literature is significant, as understanding the experiences and meanings assigned by students can provide valuable insights for optimizing the implementation of collaborative learning in similar contexts.

Furthermore, the sociocultural and economic backgrounds of public university students introduce an additional layer of complexity that warrants investigation. Previous research has indicated that cultural barriers, inadequate infrastructure, and the competitive nature of the Peruvian educational system can hinder the transition to more collaborative models (Paredes & Rodríguez, 2018). Thus, it is essential to elucidate how collaborative learning manifests among undergraduate students at the Universidad Nacional de Educación Enrique Guzmán y Valle (UNE EGYV).

### General research question

How does collaborative learning manifest among undergraduate students at a public university in Lima?

### Specific research questions

- How does the social dimension of collaborative learning present itself among undergraduate students at a public university in Lima?
- How does the cognitive dimension of collaborative learning present itself among undergraduate students at a public university in Lima?

- How does the emotional dimension of collaborative learning present itself among undergraduate students at a public university in Lima?
- How does the organizational dimension of collaborative learning present itself among undergraduate students at a public university in Lima?

### General objective

To describe how collaborative learning manifests among undergraduate students at a public university in Lima.

### Specific objectives

- To describe the social dimension of collaborative learning among undergraduate students at a public university in Lima.
- To describe the cognitive dimension of collaborative learning among undergraduate students at a public university in Lima.
- To describe the emotional dimension of collaborative learning among undergraduate students at a public university in Lima.
- To describe the organizational dimension of collaborative learning among undergraduate students at a public university in Lima.

This research on collaborative learning holds theoretical, practical, methodological, and social relevance. Theoretically, it expands the existing conceptual framework by contextualizing collaborative dynamics and providing a basis for future studies. Practically, the findings will benefit educators, students, and institutions by proposing strategies to enhance pedagogical practices and inform academic policies at UNE EGYV. Its methodological significance lies in employing case studies to explore student experiences in depth, thereby reinforcing a qualitative design adaptable to real-world contexts. Finally, its social justification is grounded in the necessity to promote values such as cooperation, empathy, and shared responsibility, all of which are essential for the holistic development of the educational community and the enhancement of the teaching-learning process.

International literature demonstrates consensus on the effectiveness of collaborative learning in improving participation, inclusion, and performance. Adebola and Tsetetsi (2022) found in South African universities that collaborative strategies reduce anxiety and bolster confidence, particularly among students with low participation. Yuan et al. (2024) and Xu et al. (2024) in Chinese universities noted that collaboration fosters intercultural interaction and joint knowledge construction, although it requires better evaluation mechanisms and communication between international and local students. Thus, collaboration not only facilitates disciplinary learning but also develops intercultural and cognitive competencies relevant in higher education.

Similarly, studies in Europe and Latin America reinforce the value of collaborative learning as an inclusive and transformative practice. Sanahuja et al. (2024) demonstrated that teacher coordination enhances the inclusion of students who face participation challenges. Guerra Santana et al. (2019) confirmed that teamwork increases commitment and strengthens both autonomous and social learning. These studies converge on the idea that collaborative learning promotes participatory, empathetic, and cognitively integrated academic communities.

In the Peruvian context, collaborative learning has established itself as a key strategy for enhancing academic and socio-emotional competencies. Peralta et al. (2025) highlighted its impact on the development of digital competencies within teacher education; Castagnola et al. (2021) emphasized its application in graduate programs; and Rojas Chahua et al. (2024) underscored the importance of assertive communication, empathy, and conflict resolution through group dynamics and technological resources. Additionally, Reyes Rodríguez et al. (2024) demonstrated its role in fostering research competencies, while Alva and Rodríguez (2023) reported significant improvements in academic performance in quantitative fields. Collectively, these studies affirm the effectiveness of collaborative learning in promoting innovation, participation, and holistic development within Peruvian higher education.

Collaborative learning is defined as a process in which students work together to achieve common goals by sharing ideas and constructing knowledge (Slavin, 1995). Its primary characteristics include: (a) positive interdependence; (b) individual and collective accountability; (c) supportive interaction; (d) interpersonal skills, such as communication and conflict resolution; and (e) group reflection aimed at enhancing the collaborative process.

## Dimensions of collaborative learning

### Social dimension

The social dimension of collaborative learning focuses on how group interactions cultivate interpersonal skills, collective efforts towards common goals, and conflict resolution.

**(a) Positive interdependence:** Collaborative learning fosters positive interdependence, whereby students work together to achieve common objectives, understanding that individual success is contingent upon group success (Johnson, Johnson, & Holubec, 2013).

**(b) Social skills:** Group work enhances social skills such as communication, active listening, and empathy, which are fundamental for effective collaboration (Gillies, 2016).

**(c) Conflict resolution:** Collaborative work also includes conflict management. According to Deutsch (1973), conflicts within the classroom can become learning opportunities if addressed constructively.

### Cognitive dimension

The cognitive dimension examines how students construct knowledge together, support one another in overcoming challenges, and employ teaching strategies.

**(a) Joint knowledge construction:** Collaborative learning enables the sharing and co-creation of knowledge within a team, facilitating a deeper understanding of concepts (Slavin, 1995).

**(b) Zone of Proximal Development (ZPD):** Building on the theory by Vygotsky (1978), collaborative work capitalizes on the ZPD, allowing students to benefit from peer support and advance beyond their individual capabilities.

**(c) Scaffolding:** The teacher plays a crucial role in providing scaffolding, guiding students through strategies that promote autonomous learning (Wood, Bruner, & Ross, 1976).

### Emotional dimension

This dimension focuses on how collaborative learning impacts students' emotional aspects, including motivation, confidence, and group cohesion.

**(a) Intrinsic motivation:** Collaborative learning enhances intrinsic motivation by providing a supportive environment where students feel valued (Deci & Ryan, 1985).

**(b) Trust within the group:** Mutual trust among group members is essential for the success of collaborative activities, fostering a safe learning environment (Tschannen-Moran & Hoy, 2000).

**(c) Group cohesion:** A sense of unity and belonging within the group strengthens cohesion, facilitating collaboration and productivity (Forsyth, 2014).

### Organizational dimension

The organizational dimension emphasizes how collaborative activities are structured through roles, planning, and assessment.

**(a) Roles and responsibilities:** Assigning roles within the group is crucial for ensuring equity and active participation from all members (Bennett, 1993).

**(b) Planning and organization:** Prior planning enables collaborative activities to unfold effectively, ensuring the achievement of set objectives (Cohen, 1994).

**(c) Performance assessment:** Assessment strategies, such as rubrics and self-evaluation, are fundamental for appraising individual and group performance in collaborative learning (Panitz, 1999).

### Definition of terms

**Collaborative learning:** An educational methodology in which students work together in small groups towards a common goal, sharing ideas, knowledge, and responsibilities to enhance both individual and collective learning (Johnson, Johnson, & Holubec, 2013).

**Social dimension:** A set of interactions and interpersonal relationships developed within the context of collaborative learning, including positive interdependence, social skills, and conflict resolution (Gillies, 2016).

**Cognitive dimension:** Focused on how students acquire and construct knowledge in a collaborative environment, leveraging peer contributions and scaffolding provided by the instructor (Vygotsky, 1978).

**Emotional dimension:** Refers to the impact of collaborative learning on students' emotional aspects, encompassing motivation, confidence, and group cohesion (Deci & Ryan, 1985).

**Organizational dimension:** Relates to planning, role assignment, and performance evaluation within the context of collaborative learning (Cohen, 1994).

## Hypothetical assumptions and system of categories

### Hypothetical assumptions

**HA1:** The social dimension of collaborative learning is crucial for the development of social skills, problem-solving abilities, and teamwork among undergraduate students at UNE EGYV.

**HA2:** The cognitive dimension of collaborative learning promotes the joint construction of knowledge, fostering unity and participation within teams, which is essential for meaningful learning among UNE students.

**HA3:** The emotional dimension of collaborative learning motivates UNE students to engage in academic activities, solidifying cohesion and trust for effective teamwork.

**HA4:** The organizational dimension of collaborative learning addresses the distribution of roles and responsibilities assigned to different work teams across various specialties at UNE.

### Methodology

This research is framed within a qualitative approach aimed at thoroughly understanding the meanings and experiences of students in their natural context, following the interpretative perspective proposed by Hernández and Mendoza (2018), where reality is understood from the viewpoint of those who live it. With a hermeneutic character, the study seeks to interpret the significance that students attribute to collaborative learning within their university environment, addressing both group interactions and the sociocultural conditions of the academic context.

The study is classified as applied and descriptive, utilizing a qualitative design of multiple case studies, as indicated by Stake (1995), who argues that this approach allows for the examination of complex phenomena in their real context to achieve a comprehensive understanding of their particularities. The adopted phenomenological-hermeneutic design enables the exploration of subjective experiences of collaborative learning through inductive and reflective interpretation of participants' discourse.

The unit of analysis consisted of fourteen undergraduate students from seven faculties at a public university in Lima, with each student representing an individual case of collaborative learning within their respective academic environments.

**Table 1.** System of categories and subcategories

Thematic Unit	Categories	Subcategories	Index
Collaborative Learning	<b>C1: Social dimension</b>	<b>SC1C1:</b> Positive Interdependence	Group work fosters goal achievement.
		<b>SC2C1:</b> Social Skills	Skills develop through collaborative work.
		<b>SC3C1:</b> Conflict Resolution	Types of conflicts
	<b>C2: Cognitive dimension</b>	<b>SC1C2:</b> Joint Knowledge Construction	Knowledge is shared and constructed.
		<b>SC2C2:</b> Zone of Proximal Development (ZPD)	Collaborative work helps overcome academic challenges.
		<b>SC3C2:</b> Use of Scaffolding	The teacher facilitates the use of strategies.
	<b>C3: Emotional dimension</b>	<b>SC1C3:</b> Intrinsic Motivation	Influence of collaborative learning on academic participation.
		<b>SC2C3:</b> Trust in the Group	Trust is essential for the success of collaborative activities.
		<b>SC3C3:</b> Group Cohesion	Sense of unity and belonging within the group.
	<b>C4: Organizational dimension</b>	<b>SC1C4:</b> Roles and Responsibilities	Distribution of roles and responsibilities within the group.
		<b>SC2C4:</b> Planning and Organization	Prior planning for the success of collaborative work.

Source: Authors' own elaboration (2025).

The presented categorical structure indicates that collaborative learning is based on four integrated dimensions encompassing social, cognitive, emotional, and organizational aspects. In the social realm, positive interdependence, the development of interpersonal skills, and constructive conflict management stand out as elements that strengthen group dynamics. The cognitive dimension emphasizes the shared construction of knowledge, the importance of the Zone of Proximal Development (ZPD), and the strategic use of scaffolding to overcome academic challenges. Furthermore, the emotional sphere highlights the role of intrinsic motivation, mutual trust, and group cohesion as essential conditions for participation. Finally, the organizational dimension considers the clear assignment of roles, joint planning, and performance assessment as key components to ensure effective collaborative processes. Collectively, these categories facilitate an understanding of the complexity of collaborative learning in university contexts.

**Table 2** Identification of interviewees (initials only)

Faculty	Interviewee 1	Interviewee 2
Faculty of Technology	JMHB	RTLK
Faculty of Business Sciences	HGVS	LCRD
Faculty of Initial Education	MLRM	VGPR
Faculty of Social Sciences	EMAC	CVTG
Faculty of Agricultural Sciences	PVZS	MLZR
Faculty of Pedagogy and Physical Culture	KAHO	OBLA
Faculty of Science	DSMR	VPRL

Source: Authors' own elaboration (2025).

It is noteworthy that the alphanumeric codes assigned to each participant ensure the confidentiality and anonymity of interviewees, in accordance with ethical standards in qualitative research (APA, 2020). The population consisted of students enrolled in the faculties of Technology, Administration, Early Education, Social Sciences, Agricultural Sciences, Pedagogy and Physical Culture, and Science. The sample was intentional and convenient, comprising 14 students who voluntarily participated, selected based on their prior experience with collaborative learning activities and their willingness to reflect on this process.

The diversity of faculties ensures qualitative representativeness, aiming not to generalize results but to understand the plurality of experiences and collaborative practices within the university.

Three main qualitative techniques were employed:

1. **In-depth interviews:** This technique explored students' perceptions, experiences, and attitudes towards collaborative learning. A semi-structured guide with questions distributed across the social, cognitive, emotional, and organizational dimensions was utilized.
2. **Non-participant observation:** This method recorded behaviors, interactions, and group dynamics during collaborative academic activities.
3. **Document analysis:** Materials produced by the groups (papers, reports, presentations) were reviewed to contrast findings from interviews.

The instruments used included the interview guide, observation checklist, and documentary matrix, developed according to the specific objectives of the study and validated through expert judgement.

The methodological process unfolded in four phases:

- a) **Preparation:** This phase involved the design of the study protocol, validation of instruments, and obtaining informed consent.
- b) **Data collection:** This included conducting in-person and virtual interviews, observing academic sessions, and collecting relevant documents.
- c) **Transcription and coding:** Interviews were transcribed verbatim and analyzed through thematic coding (open, axial, and selective), identifying patterns of meaning.
- d) **Triangulation and interpretative analysis:** Data from interviews, observations, and documents were integrated into a comparative matrix, allowing for a contrast of the four dimensions of collaborative learning.

The analysis followed the inductive logic proposed by Miles et al. (2014), deriving emerging categories and constructing interpretations that reflect participants' understandings.

The principles of research ethics with human subjects were upheld, including informed consent, confidentiality, and respect for participants' autonomy. Interviewees were informed about the study's objectives, the voluntary nature of their participation, and the possibility of withdrawal at any time without consequences.

To ensure credibility and scientific rigor, strategies for source and method triangulation, peer validation, and documented evidence chains were employed. Transferability was assured through a detailed description of the context; dependability through systematic documentation of the process; and confirmability via analytical transparency and researcher neutrality.

### Techniques and instruments

The techniques employed included observation, in-depth interviews, and document analysis. The specific instruments were the observation checklist, interview guide, and documentary matrix.

### Procedures

For data collection, the indicated instruments were applied. The recorded data were transcribed for subsequent interpretation, qualitative analysis, and method triangulation.

### Ethical considerations

Throughout the study process, the intellectual rights of the authors were respected. Informed consent was obtained, explaining the benefits of the research to participants. Strict confidentiality was maintained, ensuring anonymity and adherence to protocols to guarantee academic rigor.

### Results and discussion

This chapter presents the results and discussion synthesized from fourteen interviews with undergraduate students from seven faculties. Interpretation was conducted through thematic coding and hermeneutic triangulation, organizing findings into the social, cognitive, emotional, and organizational dimensions of collaborative learning.

**Table 3** Categorization of results by dimension, categories, and subcategories

Dimension	Category	Subcategory	Textual evidence (quotes)	Researcher interpretation
Social	Positive Interdependence	Role Distribution and Mutual Support	"We rotate roles to avoid overburdening anyone." (Interviewee JMHB, Faculty of Technology) / "Each person takes on a part according to their strengths." (Interviewee	Cooperation is built on shared responsibility and balanced functions.

			AGLP, Faculty of Technology)	
	Social Skills	Empathetic Communication	“We discuss before making any important decisions.” (Interviewee HGVS, Faculty of Administration) / “We listen first and then vote to decide.” (Interviewee TCRR, Faculty of Administration)	Respectful and assertive communication prevents conflicts and strengthens group cohesion.
Cognitive	Joint Knowledge Construction	Exchange of Ideas and Experiences	“If one doesn’t understand, another explains with examples.” (Interviewee MLRM, Faculty of Early Education) / “We share readings and reflections before writing.” (Interviewee LCPV, Faculty of Early Education)	Understanding emerges from reflective dialogue and co-construction of knowledge.
	Teacher Scaffolding	Continuous Guidance, Rubrics	“Rubrics guide our progress.” (Interviewee DSMR, Faculty of Science) / “The teacher reviews and provides feedback to help us improve.” (Interviewee TBLC, Faculty of Science)	Teacher mediation regulates the learning process, structuring student autonomy.
Emotional	Intrinsic Motivation	Trust and Support	“I feel more secure when my peers support me.” (Interviewee KAHO, Faculty of Pedagogy and Physical Culture) / “Working together motivates us because we understand each other.” (Interviewee BNTG, Faculty of Pedagogy and Physical Culture)	Collaborative work strengthens self-efficacy, security, and academic commitment.
	Cohesion and Sense of Belonging	Group Identity	“When there's unity, everyone gives their best.” (Interviewee PVZS, Faculty of Agricultural Sciences) / “We already know each other, and that makes us trust more.” (Interviewee RQMM, Faculty of Agricultural Sciences)	Stability and a sense of belonging consolidate emotional bonds and collective commitment.
Organizational	Strategic Planning	Task and Time Assignment	“Defining objectives from the start avoids chaos.” (Interviewee EMAC, Faculty of Social Sciences) / “We create schedules to avoid leaving everything until the end.”	Anticipatory planning increases group efficiency and optimizes results.

			(Interviewee VRPG, Faculty of Social Sciences)	
	Collaborative Feedback	Continuous Evaluation and Improvement	“We review and correct before submission.” (Interviewee PVZS, Faculty of Agricultural Sciences) / “We give each other suggestions to improve our work.” (Interviewee RQMM, Faculty of Agricultural Sciences)	Systematic feedback promotes self-regulation and collective improvement.

Source: Authors' own elaboration (2025).

Dimensions: social, cognitive, emotional, and organizational.

Quotes are presented in the agreed-upon format to preserve anonymity.

The results reveal that the social dimension of collaborative learning is grounded in reciprocity, empathetic communication, and shared responsibility. Participants emphasized that role rotation and dialogue prevent conflicts and foster group cohesion, confirming the assertions made by Johnson and Johnson (1999) and Deutsch (1973) about positive interdependence as the foundation of cooperation. However, differences among faculties were noted, suggesting that collaborative effectiveness depends on the level of commitment and communication skills developed within each group.

Regarding the cognitive dimension, findings evidence that knowledge is constructed through interaction and joint reflection. Peer explanation and academic debate enhance deep understanding, aligning with the views of Vygotsky (1978) and Slavin (1995), who highlight the roles of teacher scaffolding and cognitive elaboration as catalysts for meaningful learning.

In the emotional dimension, students associate collaborative work with enhanced motivation, trust, and a sense of belonging. These perceptions reinforce self-determination theory (Deci & Ryan, 1985), demonstrating that cooperation meets psychological needs and reduces academic anxiety. Group cohesion and open communication, as noted by Forsyth (2014), emerge as key elements for well-being and persistence in learning.

Finally, the organizational dimension solidifies as a pillar for the sustainability of group work. Anticipatory planning, role distribution, and constant feedback are practices that optimize productivity and strengthen collective responsibility, reflecting the findings of Cohen (1994) and Panitz (1999). Overall, the four dimensions illustrate that effective collaboration requires a balance between organizational structure, social interaction, cognitive reflection, and emotional cohesion

**Table 4** Comparison of manifestations by faculty and dimension

Faculty	Social dimension	Cognitive dimension	Emotional dimension	Organizational dimension
Faculty of Technology	Role rotation; technical consensus	Applied exchange; use of guides	High trust	Structured planning
Faculty of Business Sciences	Formal distribution and progress control	Clarity of goals; reports	Moderate trust	Rubrics and schedules
Faculty of Early Education	Empathetic communication	Explanation with examples; ZPD	Strong belonging	Flexible organization
Faculty of Social Sciences	Consensus and critical dialogue	Reflective analysis	High cohesion	Anticipatory planning
Faculty of Agricultural Sciences	Variable cooperation	Situational peer support	Fluctuating motivation	Irregular planning

Faculty of Pedagogy and Physical Culture	Balanced collaboration	Practical and visual learning	High motivation	Continuous tracking and improvement
Faculty of Science	Effective digital communication	Conceptual exchange	Positive climate	Defined roles and feedback

Source: Authors' own elaboration (2025). Narrative synthesis based on the 14 interviews.

The results displayed in **Table 4** summarize the primary manifestations of collaborative learning observed across the seven analyzed faculties. The information is derived from the analysis of the fourteen interviews, categorized according to the social, cognitive, emotional, and organizational dimensions. This comparative analysis allows for the identification of contextual variations and differential levels of collaborative development among the academic units.

## Conclusions

The findings reveal that the four dimensions of collaborative learning interrelate dynamically, forming an integral system of academic and socio-emotional development. The social dimension enhances communication and mutual respect; the cognitive dimension fosters the shared construction of knowledge; the emotional dimension promotes motivation and trust; and the organizational dimension ensures planning and quality of outcomes. Overall, the analyzed cases demonstrate that collaborative learning in a public university in Lima serves as an effective practice, although it still requires teacher training in pedagogical mediation, adequate infrastructure, and institutional policies that promote interdisciplinary cooperation. This study confirms that collaborative learning not only enhances academic performance but also strengthens the social fabric of the university, contributing to the achievement of Sustainable Development Goals related to quality education, equity, and emotional well-being.

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## DECLARATIONS

### CONTRIBUTION OF THE AUTHORS

The authors declare that the conceptualization, data curation, formal analysis, investigation, methodology, project management, resources, validation, and writing—proofreading and editing were conducted to ensure that the research meets the appropriate rigor.

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### CONFLICT OF INTEREST STATEMENT

The authors declare that there are no financial or personal conflicts of interest that could have improperly influenced the preparation, analysis, interpretation, or presentation of the results of this study.

### **DECLARATION ON THE USE OF ARTIFICIAL INTELLIGENCE**

The authors declare that, during the writing process of this manuscript, generative artificial intelligence tools were employed solely as support for linguistic tasks, such as improving style, syntactic organization, and grammatical correction. Under no circumstances were these technologies used to generate original scientific content, interpret results, or substitute the academic and ethical judgment of the author.