EFL Teachers' Knowledge, Motivations, and Attitudes Towards PBL and STEAM Methodologies in Manta, Ecuador.

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Abstract

Innovations in English language teaching propose the STEAM approach and PBL methodology as new paths. It is necessary to explore how English teachers use these processes. The study aims to determine teachers' perceptions of the STEAM approach and Project-Based Learning (PBL) in English science classes in public and private urban schools in Manta, Ecuador. The research uses a critical-reflective approach and a descriptive design. It applies mixed-methods, using these instruments: (a) a self-perception survey on implementing STEAM for science teachers, (b) a survey on teachers’ perception of project-based learning, and an interview guide. Thirty-five English teachers, aged 24 to 56, participated: 46% female, 54% male. Results show teachers use the STEAM approach frequently in (I) lesson planning, (II) class development, and (III) evaluation. Through PBL, teachers can develop their pedagogical skills and engage students. Teachers need stronger motivation and training to encourage broader use of STEAM and PBL in English-language natural science classes in Ecuador.

Keywords: English as a foreign language, educational innovation, project-based learning, STEAM, teacher training.

INTRODUCTION

Teachers must impart new knowledge, find ways to reach students, and ensure they understand all aspects of the subject, even when they use a second language, such as English. Here, teachers face obstacles, including limited opportunities to expose learners to the foreign language (Villao et al., 2025). The feedback students receive must also be useful and help them use language correctly across all subjects and disciplines. Learning promotes the growth of knowledge, skills, and competencies from a comprehensive, dynamic, and motivating perspective. However, the problem addressed here is the study of teachers' perceptions of STEAM and PBL methods for teaching scientific content in English as a foreign language. Educational strategies can produce beneficial results through the advantages of teacher-student collaboration.

Thus, Santillán Aguirre et al. (2020) argue that teaching strategies make a significant contribution to education by promoting and clarifying understanding in the development of student activities, and conclude that they are essential in both primary and higher education. Besides, Irmina Hernández et al. (2021); Slavit et al. (2021), and Park et al. (2022) argue that these strategies promote the development of scientific research skills and improve interaction and teamwork in diverse contexts. Teachers strive to identify topics and projects that allow students to explore scientific concepts, apply mathematical principles, develop engineering skills, express artistic creativity, and use technology meaningfully in an interdisciplinary context. In addition, it can take the form of research projects that address real-world problems, problem-solving activities that integrate multiple disciplines, or collaboration with professionals from different fields to enrich learning and improve skills (Guijarro et al., 2022; Salcido et al., 2024). The research questions are:

1. What self-perceptions do natural science teachers have about the use of STEAM in classroom practice?

2. What is the teachers' perception of the implementation of PBL?

3. What are teachers' opinions, preferences, and motivations regarding the use of the STEAM approach and the PBL methodology?

The study aims to determine English teachers' perceptions of the STEAM approach and the Project-Based Learning (PBL) methodology in English science classes.

1. LITERATURE REVIEW

1.1. Curriculum Integration in the context of the STEAM and PBL approach

An educator dedicated to curriculum integration strives to break down traditional barriers between disciplines, recognizing that reality is not divided into separate domains (Santillán et al., 2020). Rather than teaching subjects individually, STEAM and PBL encourage the exploration of complex issues that encompass multiple fields of knowledge.

STEAM equips students to face real-world challenges through interdisciplinary work, where collaborating with individuals from varied disciplines and cultures is essential for achievement (Donoso, 2018). It describes fostering collaboration across academic domains to confront complex, multifaceted challenges from multiple perspectives. Students learn to articulate ideas, value others' opinions, and pursue joint objectives (Calisto, 2020; Katz-Buonincontro et al., 2020).

Interdisciplinarity is vital to lesson effectiveness, as it acknowledges that solving contemporary problems requires transcending conventional boundaries. Educators who emphasize interdisciplinarity create opportunities for students to explore connections between various fields and grasp the complexity of modern challenges (Margot and Kettler, 2020; Santos et al., 2021). Students collaborate with peers and educators across disciplines, deepening their understanding of the problem and enabling comprehensive, creative solutions. Rather than teach subjects separately, educators merge knowledge and skills from diverse domains to enhance learning and solve current challenges (Oviedo, 2022; Thibaut et al., 2020). This approach also boosts critical thinking by prompting students to examine issues from different angles and generate innovative solutions (Bhasin & Rajesh, 2022). As a result, students are prepared to become global citizens and inventive leaders in the 21st century.

The Project-Based Learning (PBL) aspect within STEAM emphasizes giving students opportunities to investigate, design, construct, and present real-world solutions. Classroom projects encompass diverse subjects, from scientific models and interactive art to technological designs and engineering experiments, through collaboration, independent inquiry, problem solving, and sharing outcomes (Santillán et al., 2020).

PBL supports deeper, lasting conceptual comprehension by enabling students to conduct thorough research and integrate knowledge across fields, such as Chemistry (Vergara-Castañeda et al., 2021). It also promotes essential skills such as communication, teamwork, critical thinking, and problem-solving, which are vital for addressing mechanical issues (Cioc et al., 2022). Furthermore, Romani-Pillpe (2023) asserts that PBL refines learners' soft skills, including collaboration and communication.

1.2. Critical thinking of students and Flexibility and Adaptability in the STEAM and PBL approach

Critical thinking refers to students' ability to objectively analyze and evaluate information or arguments to form their own reasoned judgments. Flexibility in education means adapting teaching strategies to changing circumstances, while adaptability is the readiness to modify approaches when needs shift. Although related, flexibility involves the willingness to try new teaching methods, and adaptability is the capacity to sustain these changes over time. These skills are central in the STEAM (Science, Technology, Engineering, Arts, Mathematics) and Project-Based Learning (PBL) educational approaches.

Flexibility and adaptability refer to teachers' ability to adjust their teaching methods and pedagogical approaches according to students' needs and interests, as well as the demands of the educational environment and context. Recognizing that each group of students is unique and that the world is constantly changing, teachers who prioritize this dimension adopt a flexible, responsive approach that enables personalized and differentiated learning (Falla et al., 2022).

Teachers demonstrate flexibility by modifying curricula, integrating new technologies, and adapting strategies for individual learning differences. They stay open to change and experiment with new approaches (Rodríguez Torres et al., 2022).

In PBL and STEAM, integrating multiple disciplines requires teachers to be flexible and adaptable. These skills help teachers respond to classroom situations and advances in knowledge and technology (Perlaza, 2022).

The Flexibility and Adaptability dimension of the STEAM approach enables teachers to respond effectively to changing needs in learning and teaching (Fernández et al., 2022). Teachers create dynamic environments promoting exploration and meaningful learning. The Creativity and Critical Thinking dimension focuses on developing students' innovative problem-solving in science, encouraging exploration, experimentation, and reflection (Buendía et al., 2018).

The use of technological resources in PBL and STEAM involves deliberately and effectively integrating educational technologies in teaching projects. Teachers seek to leverage these technological tools to enrich students' learning experiences, providing access to resources and materials that would otherwise be unavailable and facilitating the exploration of abstract concepts in tangible, practical ways (Bravo & Alves, 2019). Technology is also recognized as a powerful tool for enhancing exploration, experimentation, and creation across all areas of knowledge, from science and engineering to art and the humanities (Machado et al., 2020). Thus, the use of technological resources can manifest in various ways, from mobile devices and educational applications to design and simulation software, 3D printers, robotics kits, and virtual reality equipment (Reinoso, 2023).

Scholars such as Guerra et al. (2020) and Sanz and Sánchez (2021) found that PBL offers learners practical scenarios in which they can improve their autonomy and critical thinking while seeking solutions to science problems. Besides, PBL supports students' problem-solving abilities and improves their critical thinking through questions and projects that engage with their local context (Zambrano Briones et al., 2022).

Salcido et al. (2024) argue that PBL centers on learners' interests to foster critical thinking, among other communication skills. Meanwhile, Abad & Villafuerte (2025) confirm that PBL is a methodology for teaching EFL that offers learners experiences related to science, aiming to improve their academic achievement.

According to Toledo et al. (2023), by meaningfully integrating technology into the classroom, teachers equip students with the tools and skills necessary to thrive in an increasingly digital, technologically advanced world. However, Cioc et al. (2022) note that PBL can be implemented with or without educational technology, as learners can use contextual materials to create projects. Creativity enables learners to imagine and develop innovative solutions to complex problems, while Critical Thinking equips them to analyze and evaluate those solutions, identify potential implications, and make informed, responsible decisions (George & Salado, 2019).

1.3. Collaboration and teamwork in learning processes and knowledge assessment using technology in STEAM and PBL

Educators who consider communication an essential aspect of learners' development establish a classroom environment where students feel accepted and respected (López et al., 2022). Cooperation in a STEAM environment can take many forms, such as working on group projects, participating in class discussions, collaborating with experts, and networking with other students and professionals in the field. Teachers should define norms for project execution, provide ongoing support, and offer feedback among group members (Patarroyo et al., 2022). It promotes a sense of community and belonging in the classroom, where students feel part of something larger and inspire each other to achieve shared goals (Lizana & Burgos, 2022). The Authentic Assessment model refers to the implementation of diver assessment methods that allow students to demonstrate their understanding and skills through practical problem-solving, the creation of concrete products, and the presentation of projects. Instead of simply memorizing facts and answering multiplechoice questions, students' ability to apply their knowledge meaningfully in real-world and relevant situations is assessed (Walter et al., 2022). Teachers diversify evaluation formats, such as projects, essays, presentations, and other learning products. They can also encompass the assessment of individual or group projects in which students design, implement, and analyze solutions to real-world problems (Walter et al., 2022).

Activities that can help teachers in class collect evidence through written records, video recordings, or student testimonies (Podesta et al., 2022). Thus, Authentic Assessment fosters a more inclusive and equitable evaluation method, giving all students the opportunity to succeed and reveal their potential (Balladares & Valverde, 2022). In addition, Cahyana et al. (2022) affirm that PBL is a valid option for teaching speaking in EFL because of its implications for communication, collaboration, and student-centered characteristics, as well as its role in developing practical projects.

Among previous studies, Margot and Kettler (2020) found that educators who apply STEAM prioritize competency-based learning and interdisciplinary objectives, emphasizing the need to foster required abilities. The work of Liao (2020) concerning STEAM helps educators to use alternative assessment methods, such as project-based assessment, peer assessment, and final product presentations. In addition, Katz-Buonincontro et al. (2020) found that educators generally value the relevance of integrating diverse disciplines in STEAM; however, they also observed that technological integration remains a challenge, particularly due to limited training and a scarcity of resources. Thibaut et al. (2020) demonstrated that educators who implement STEAM tend to promote student autonomy, inquiry-based learning, and collaborative knowledge development. Additionally, Slavit et al. (2021) found that teachers who implement STEAM tend to foster collaborative learning environments and projects. Education also fosters students' critical thinking and interdisciplinary problem-solving skills (Colucci-Gray et al., 2021); however, Park et al. (2022) found that teachers face obstacles in applying organized engineering design processes, primarily due to a lack of training and curricular time.

2. METHODOLOGY

The research adopts a critical-reflective approach and a descriptive research design. They used a mixed-methods approach to scientific research. Thirty-five English teachers, aged 24-56, participated; 46% were female, and 54% were male. All participants reside in the canton of Manta, Ecuador.

Table 1. The sample

English Teachers	Public schools	Private schools	Total
Female	13	7	20
Male	6	9	15
Total	**19**	**16**	**35**

2.1. Instruments. - The research uses the following instruments

2.1.1. Survey. – The instrument titled "Self-Perception of the Implementation of the STEAM Approach in Teaching for Natural Science Educators" was developed by Camacho-Tamayo and Bernal-Ballen in 2023. Its purpose is to describe how natural science teachers perceive the use of STEAM in their educational practice. This instrument is organized into three parts: lesson planning, lesson delivery, and evaluation. In its original form, it includes 28 questions. Responses can be selected from five frequency options, ranging from Very Frequently to Never. The reliability coefficient (Cronbach's Alpha) is 0.920. The instrument was administered via Google Forms. It is estimated that completing the form takes 4 to 6 minutes.

2.1.2. Likert questionnaire. – The questionnaire entitled "Teachers' Perceptions of Project-Based Learning Implementation" was developed by Basilotta Gomez-Pablo and colleagues in 2017 and validated by Siti Aisyah and Dian Novita in 2025. The reliability of the complete questionnaire (Cronbach's alpha) is 0.978. This instrument examines educators' perceptions of the relevance and impact of implementing Project-Based Learning (PBL). The first section of the questionnaire addresses questions about both personal and professional characteristics. The second section contains 48 items. There are seven options on a Likert scale, ranging from Strongly Disagree to Strongly Agree. The dimensions analyzed include: (a) School context and administrative support for PBL, (b) Project characteristics: design of PBL activities, (c) Tools used: effectiveness of teaching materials, communication tools, and assessment tools for PBL, (d) Teacher's role and participation in the planning, implementation, monitoring, and feedback of the project, (e) Student responsibility, autonomy, collaboration, and use of ICT tools in PBL, (f) Parents' role and involvement in supporting PBL, (g) Student outcomes in relation to learning objectives, creativity, and skills development due to PBL, (h) Outcomes that affect teachers' technological, pedagogical, and social skills. This instrument was also administered via a Google Form. Completing the form is estimated to take between 4 and 6 minutes.

2.1.3. Interview guide. - The instrument, developed ad hoc by the research team, aims to gather information on educators' (1) perceptions, (2) motivations, and (3) preferences regarding PBL and STEAM. The initial interview guide was structured around seven relevant questions. A panel of Specialists in teaching English as a foreign language, psychology, and educational administration evaluated the instrument; all of them were affiliated with a public university in Ecuador. They suggested reducing the number of questions from seven to four and checking the syntax to guarantee interviewers understand the questions widely. The interviews were conducted at the educational institutions where the teachers work. The total duration of the interview recordings was 110 minutes.

2.2. Data Processing. - The information was collected via an online Google form, transferred into SPSS, where it was organized and annotated. The data was then used to formulate the research presentation. Only the approval of the Rector of the Academic Unit was required, as no students were included in the study.

3. RESULTS

The results are presented in accordance with the research questions.

3.1. Self-Perception about Implementing the STEAM Approach in Pedagogical Practices for Natural Science Teachers

In response to the research question 1: What self-perceptions do natural science teachers have about the use of STEAM in classroom practice? Table 2 presents the results of the questionnaire Self-Perception about Implementing STEAM Approach in Pedagogical Practices for Natural Science Teachers (Camacho-Tamayo y Bernal-Ballen, 2023).

Table 2. Self-Perception about Implementing STEAM Approach in Pedagogical Practices for Natural Science Teachers

SECTION I: LESSON PLANING	**Never**	**Seldom**	**Occasionally**	**Frequently**	**Very Frequently**
1. I search for information by necessary topic, considering the quality of the information sources, to deepen the knowledge of current scientific content.	0	0	5 14.29%	10 28.57%	20 57.14%
2. I formulate objectives that are relevant and seek to promote the development of skills and transversal knowledge.	0	0	2 5.71%	3 8.57%	**30** **85.71%**
3. I design material to get to know my students' context and talents to plan the class's topic (e.g., based on a previous knowledge activity, diagnostic test, or entrance ticket).	0	0	5 14.29%	8 22.86%	22 62.85%
4. I include pedagogical strategies that can be used in an interdisciplinary way.	0	0	2 5.71%	10 28.57%	23 65.71%
5. I propose learning activities where information and communication technologies, scientific knowledge, and mathematics are integrated.	0	0	10 28.57%	10 28.57%	15 42.86%

6. I propose activities that the student can broaden his knowledge from other sources of information. (for example, documentary research, interviews, projects, exhibitions, among others).	0	0	2 5.71%	13 37.14%	20 57.14%
7. I relate situations of daily life with scientific concepts that can favor the understanding and prediction of natural phenomena.	0	0	5 14.29%	5 14.29%	25 71.42%
SECTION II: DEVELOPMENT OF THE CLASS	**Never**	**Seldom**	**Occasionally**	**Frequently**	**Very Frequently**
8. I consider the student's previous knowledge and explanatory model they, not only in the area that I direct but in the different areas of knowledge.	5 14.29%	2 5.71%	5 14.29%	23 65.71%	0
9. I motivate students to be active participants in scientific learning in order to strengthen their autonomy and integral development.	0	0	0	5 14.29%	**30** **85.71%**
10. I mediate the possible knowledge construction between teachers and students through constant communication.	0	0	0	5 14.29%	**30** **85.71%**

11. I propose relevant activities to strengthen the student's creativity through the production, dissemination and application of their interdisciplinary knowledge.	0	0	28 80%	5 14.29%	2 5.71%
12. I make use mistakes as a learning opportunity.	0	0	4 11.43%	28 80%	3 8.57%
13. I integrally develop scientific knowledge's conceptual, procedural, and attitudinal content in reaction to other knowledge in practice.	0	0	5 14.29%	5 14.29%	25 71.42%
14. I encourage critical reflection processes in students favoring their learning between science, technology, engineering, mathematics, arts, and humanities are created through problem-solving activities.	0	0	7 20%	6 17.14%	22 62.86%
15. I position a problem, I carry out an activity to obtain solutions, I define the logical solution and I implement the solution.	0	0	10 28.57%	10 28.57%	15 42.86%
16. I guide the student to be a researcher of his reality, learning to structure, to give	0	0	2 5.71%	3 8.57%	**30** **85.71%**

meaning and sense to what he / she learns.					
SECTION III: CLASS EVALUATION	**Never**	**Seldom**	**Occasionally**	**Frequently**	**Very Frequently**
17. I close the class considering a strategy that allows observing if the proposed objectives were met.	0	0	5 14.29%	5 14.29%	25 71.42%%
18. I generate spaces for feedback where the student's reflection and creativity are privileged.	0	0	7 20%	8 22.86%	20 57.14%
19. I communicate the results obtained clearly and assertively.	0	0	15 42.86%	5 14.29%	15 42.86%
20. I use diverse evaluation strategies in class which I share with my peers.	0	0	2 5.71%	3 8.57%	**30** **85.71%**
21. I regularly analyze with my peers from other areas the results of the evaluation instruments that I use in class to take decisions regarding future classroom practices.	0	0	3 8.57%	5 14.29%	27 71.14%
22. I propose a regular systematization in items of planning; the effectiveness of the design and the operationalization of the strategies used in my own classes.	5 14.29%	0	0	25 71.42%	5 14.29%

23. I enhance collaborative participation, with product presentations of the students, in transversal school spaces (for example, through science day, conferences, Olympics, contests, forums, among others).	0	0	2 5.71%	3 8.57%	**30** **85.71%**

Source: Research participants' answers (2026)

For section I: Lesson planning. – The item reaching highest score in VF (Very Frequently) is 2.

For section II: Development of the class. – The items reaching the highest scores in VF (Very Frequently) are 9, 10, and 16.

For section III: Class evaluation. – The items reaching highest scores are 20 and 23.

3.2. Teachers' perception of the implementation of project-based learning

In response to research question 2. What is Teachers' perception of the implementation of project-based learning? See table 3 showing the results of the questionnaire on teachers' perceptions of the implementation of project-based learning (Basilotta Gomez-Pablo et al., 2017; Siti Aisyah & Dian Novita, 2025).

Table 3. Teachers' perception of the implementation of project-based learning

ITEMS	TD	VD	D	ND/NA	A	VA	TA
1. Adequate infrastructure and facilities for PBL and pedagogical learning.	0	5 14.29%	5 14.29%	0	25 71.42%	0	0
2. Parent involvement programs to accompany students playing at home.	0	0	0	0	28 80%	5 14.29%	2 5.71%

3. Adequate coordination between teachers involved in project development.	0	0	0	0	0	5 14.29%	**30** **85.71%**
4. Teachers are supportive of collaborative projects (PBL).	0	0	0	0	5 14.29%	7 20%	23 65.71%
5. School management supports and encourages the development of PBL	0	0	0	0	0	5 14.29%	**30** **85.71%**
6. Learning objectives are clearly defined.	0	0	0	0	0	0	**35** **100%**
7. Project content aligns with curriculum and standards.	0	0	3 8.57%	5 14.29%	27 77.14%	0	0
8. Activities motivate and stimulate curiosity.	0	0	0	0	2 5.71%	3 8.57%	**30** **85.71%**
9. Tasks are distributed, structured, and organized adequately.	0	0	0	5 14.29%	3 8.57%	3 8.57%	24 68.57%
10. Technology facilitates adequate implementation.	0	0	0	0	2 5.71%	3 8.57%	**30** **85.71%**
11. Project allows for greater teacher-student interaction.	0	0	0	0	25 71.42%	5 14.29%	5 14.29%
12. Project encourages active student engagement in learning.	0	0	0	0	28 80%	5 14.29%	3 8.57%
13. Teachers develop teaching materials that are tailored to the needs of students.	0	0	0	0	2 5.71%	5 14.29%	28 80%
14. Teachers use a variety of communication tools to stay	0	0	0	0	25 71.42%	5 14.29%	5 14.29%

connected with students and parents.							
15. Teachers use a variety of learning tools and media to support student learning.	0	0	0	3 8.57%	3 8.57%	22 62.86%	7 20%
16. Teachers use a variety of assessment strategies to track student progress.	0	0	0	5 14.29%	15 42.86%	10 28.57%	5 14.29%
17. Teachers contribute significantly to project planning and design.	0	0	0	0	5 14.29%	5 14.29%	25 71.42%
18. Teachers are actively involved in all aspects of project development.	0	0	5 14.29%	5 14.29%	15 42.86%	5 14.29%	5 14.29%
19. Teachers are committed to completing the project.	0	0	0	0	20 57.14%	10 28.57%	5 14.29%
20. Teachers have time to coordinate with colleagues.	0	0	0	0	20 57.14%	10 28.57%	5 14.29%
21. Teachers provide constructive feedback to students.	0	0	0	0	5 14.29%	2 5.71%	28 80%
22. Students are accountable for assigned tasks and complete them on time and to the best of their ability.	0	0	3 8.57%	2 5.71%	10 28.57%	10 28.57%	10 28.57%
23. Students are able to locate appropriate learning resources.	0	5 14.29%	5 14.29%	5 14.29%	10 28.57%	10 28.57%	0
24. Students are able to take on varying roles in the project,	0	0	0	0	2 5.71%	7 20%	26 74.29%

such as leader, team member, or facilitator.							
25. Students take time to reflect on their progress and learning together during the project.	0	0	0	0	20 57.14%	10 28.57%	5 14.29%
26. Students interact and collaborate effectively with their peers and teachers during the project.	0	0	0	0	20 57.14%	12 34.29%	3 8.57%
27. Students support and assist each other during the project.	0	0	0	0	5 14.29%	5 14.29%	25 71.42%
28. Students use ICT tools effectively to support their learning projects.	0	0	5 14.29%	5 14.29%	20 57.14%	5 14.29%	0
29. Students actively participate in all aspects of the project, from planning to evaluation.	0	0	0	3 8.57%	5 14.29%	5 14.29%	22 62.85%
30. Students maintain a positive attitude throughout the process of completing the project and their learning.	0	0	0	0	20 57.14%	5 14.29%	10 28.57%
31. Parents provide a supportive and encouraging learning environment for their children.	0	**25** **71.43%**	0	10 28.57%	0	0	0
32. Parents show interest in and support their children's projects.	0	15 42.86%	5 14.29%	5 14.29%	10 28.57%	0	0

33. Parents motivate their children to complete their projects.	0	0	10 28.57%	10 28.57%	15 42.86%	0	0
34. Parents provide the resources their children need to complete their projects.	0	15 42.86%	12 34.29%	2 5.71%	6 17.14%	0	0
35. Parents help their children communicate with others about their projects.	0	15 42.86%	10 28.57%	5 14.29%	5 14.29%	0	0
36. Students achieve the planned learning objectives.	0	0	5 14.29%	5 14.29%	10 28.57%	15 42.86%	0
37. Students are able to focus on tasks and complete them.	0	0	5 14.29%	5 14.29%	10 28.57%	15 42.86%	0
38. Students develop their imagination, creativity, and innovation skills.	0	0	5 14.29%	5 14.29%	20 57.14%	5 14.29%	0
39. Students to be more connected with each other and with their community.	0	0	0	5 14.29%	27 77.14%	3 8.57%	0
40. Students to develop their metacognitive skills, such as the ability to monitor and evaluate their own learning.	0	0	10 28.57%	5 14.29%	15 42.86%	5 14.29%	0
41. Students to develop their digital skills, such as the ability to use technology to learn and complete tasks.	0	0	0	3 8.57%	20 57.14%	8 22.86%	4 11.43%
42. Students acquire the emotional and social skills, such as the ability to	0	0	0	0	25 71.42%	5 14.29%	5 14.29%

collaborate, problem- solve, and resolve conflict.							
43. Teachers develop their technological skills, so that they can use technology to support student learning.	0	0	0	0	5 14.29%	5 14.29%	25 71.42%
44. Teachers develop their pedagogical skills, so that they can design and implement more effective and engaging learning experiences for their students.	0	0	0	0	0	3 8.57%	32 91.42%
45. Teachers develop their social skills (friendship, teamwork, respect, etc.), so that they can work more effectively with colleagues and students.	0	0	0	0	2 5.71%	5 14.29%	28 80%
46. Encourage teachers to participate actively in networks and learning communities to share experiences and learn from other colleagues.	0	0	0	0	3 8.57%	2 5.71%	**30** **85.71%**
47. Help teachers engage in meaningful and challenging learning, so that they can increase their motivation and job satisfaction.	0	0	0	0	7 20%	8 22.86%	20 57.14%
48. Create and promote a more positive and supportive	0	0	0	0	2 5.71%	5 14.29%	28 80%

school learning culture, so that students and teachers can learn and grow better.							

Source: Research participants' answers (2026)

The items with the reaching highest scores in TA (Total Agreed) are 6, 3, 5, 8, 10, 46.
The item reaching highest score in VD (Very Disagreed) is 31.

3.3. Teachers' opinions, preferences, and motivations regarding the use of the STEAM approach and the PBL methodology

In response to research question 3, What are teachers' opinions, preferences, and motivations regarding the use of the STEAM approach and the PBL methodology? see Table 3.

Table 3. Instructors' perceptions, preferences, and motivations regarding the use of the STEAM approach and the PBL methodology

Evidence	**Subcategory 1**	**Subcategory 2**
Category 1: Perceptions regarding the STEAM approach	**Self-conviction**	**Mastery of the approach**
Teacher 1 (Physics): I wouldn't know how to answer well because when I studied to be a teacher none of that existed, only that over the years we are trained with certain tools to work in something that one as a teacher does not know.	Low	Low
Teacher 2 (Chemistry): I think it is an alternative form of teaching and learning, since by using a method that the children enjoy, a teacher can achieve good results; although it does not apply to all students.	Moderate	Moderate
Teacher 3 (Cultural and Artistic Education): I believe it is a fast-learning method for students, as they can learn in a different way than usual; the downside is that it	High	Moderate

focuses on certain specific topics and not on the entire curriculum.		
Teacher 4 (English): It is an optional way to learn specific topics in the subject, but we encounter strong barriers, such as: learning basic vocabulary, practicing speaking and writing, not to mention listening.	Moderate	Moderate
Category 2: Opinions regarding the PBL method	**Self-conviction**	**Mastery of the approach**
Teacher 1 (Physics): I must point out that, as time has passed and all the new methods have been applied, we as teachers have also been learning along with the students.	Moderate	Moderate
Teacher 2 (Chemistry): I can say that in PBL I can form work groups with better participation.	Moderate	High
Teacher 3 (Cultural and Artistic Education): Here students can better demonstrate the learning processes and results by showcasing the different skills of each student.	High	High
Teacher 4 (English): Although the students lack a strong foundation in the foreign language, they struggle to participate effectively in teams. However, they demonstrate that they view the language not as an obligation but as a tool for earning money.	Low	Moderate
Category 3: Teacher preference for STEAM or PBL	**Preference**	**Advantage**
Teacher 1 (Physics): As a teacher, I prefer PBL. Because the students teach me things I hadn't learned before.	PBL	Greater collective learning
Teacher 2 (Chemistry): Personally, I don't have a problem with any method, since my subject is not only theory, it also involves a lot of practice, and that makes the students more interested in learning.	INDIFFERENT	Student motivation for learning

Teacher 3 (Cultural and Artistic Education): I prefer STEAM, because it is the one, we have worked with the most and I master it much better, even though they are similar.	STEAM	Greater student participation
Teacher 4 (English): I think I prefer PBL, because that way I could better develop the different foreign language skills and the students could see their own achievement with something they saw as difficult or impossible.	PBL	Practice English communication skills
Category 4: Motivation to use STEAM or PBL	**Preference**	**Motivation**
Teacher 1 (Physics): As a teacher, I'm motivated by students learning, even if it's in a different way, but that they learn. Because it's necessary and relevant for them to learn how to apply Physics in different fields.	PBL	Student learning
Teacher 2 (Chemistry): I am motivated by students understanding and learning where everything comes from, why and what for.	INDIFFERENT	Student Understanding
Teacher 3 (Cultural and Artistic Education): I am motivated to make them work on something that I consider my passion and that they also understand why I make them work on each thing.	STEAM	Student work
Teacher 4 (English): If we talk about motivation, I think that just trying to speak in another language is enough, because they realize how relevant it is to learn a foreign language, not just English.	PBL	Assessment of foreign language learning

Source: Instructors' interview (2026)

4. DISCUSSION

Findings show that science educators have a high self-assessment regarding the use of the STEAM approach, especially in sections: (1) lesson planning, (2) school environment development, and (3) assessment methods. Regarding lesson planning, the highest rating was obtained in point 2, which addresses the definition of goals focused on transversal skills (85.71%, very frequently). It aligns with the work of Margot and Kettler (2020) when argue that STEAM prioritize competency-based learning and interdisciplinary objectives, emphasizing the need to foster 21st-century skills.

The results in item 5 concerning the integration of ICT, mathematics, and scientific knowledge, showed moderate-to-high agreement. It aligns with Katz-Buonincontro et al. (2020), who noted the relevance of disciplines integration alongside technological education.

Regarding the classroom environment, the highest ratings were given for items 9, 10, and 16, which highlight student participation, communication between teachers and students' research skills. These results are consistent with those of Thibaut et al. (2020), who demonstrated that STEAM tends to promote student autonomy and collaborative learning in classrooms.

In the item 14 concerning stimulation of critical reflection through problem-solving activities, aligns with Colucci-Gray et al.'s (2021) findings on critical thinking and interdisciplinary problem-solving skills. However, item 15 showed the highest score in "Never," suggesting a limited use of organized problem-solving processes. It is comparable to the results of Park et al. (2022), who observed that teachers face obstacles in applying organized engineering design processes and curricular time.

Detailed results with STEAM

Regarding classroom assessment, the highest scores were recorded for items 20 and 23, which address different assessment tactics and collaborative work. These results are consistent with those of Liao (2020), who indicated that STEAM educators often use alternative assessment methods, such as project-based assessment, peer assessment, and final product presentations. Results about the high frequency of collaborative participation aligns with the findings of Slavit et al. (2021), when affirm that teachers implementing STEAM tend to foster collaborative learning environments.

Overall, the findings of this research support the idea that educators have a positive perception of STEAM implementation, which is consistent with recent studies suggesting that teachers view it as an effective methodology for fostering interdisciplinary skills, facilitating active learning, and increasing student engagement (Margot & Kettler, 2020; Quigley et al., 2020).

Regarding the Lesson Planning section, the item that received the highest score was item 2: “I establish relevant objectives that seek to foster the development of transversal skills and knowledge.” This could be explained by the fact that English language-teaching objectives in

Ecuadorian schools define achievement levels aligned with the Common European Framework of Reference for Languages (CEFR), which assesses the four communicative skills. For this reason, educators must ensure clear direction, starting with planning. Furthermore, knowledge is interdisciplinary; therefore, students need to learn about diverse areas of study through other languages, such as English.

A meticulously planned teaching process considers educational standards, methodologies, and strategies appropriate for the students' ages and knowledge levels. All of this must be consistent with the learning environments, available class time, teaching resources, access to educational technology, and other factors.

Elements 9, 10, and 16 show the clearest trend. Element 9, "I motivate students to actively engage in the scientific learning process to enhance their independence and holistic growth," fosters each student's autonomous development, which is fundamental, given that they must generate their own responses to the academic challenges they encounter. Furthermore, initiative and the ability to take action are attributes that will distinguish them from other professionals.

Item 10. "I facilitate knowledge creation between teachers and students through continuous communication." is linked to the need for effective communication among teachers and students for transferring foreign languages.

Item 16. "I guide students in exploring their own reality, learning to organize, give meaning to, and understand what they study." This is because educators recognize that students show interest in certain topics and not others. This is a result of the transformation of the educational model, where teachers strive to teach content aligned with students' interests.

For the Class evaluation section, the items reaching the highest scores are 20 and 23

20. I use diverse evaluation strategies in class, which I share with my peers.

23. I enhance collaborative participation, with product presentations of the students, in transversal school spaces (for example, through science day, conferences, Olympics, contests, forums, among others).

Both items 20 and 23 show that teachers try to offer students novel and interesting assessment alternatives to evaluate subject knowledge in scenarios that strengthen soft skills, such as teamwork, leadership, and technology use.

Detailed results with PBL

The items reaching highest scores in TA (Total Agreed) are 6, 3, 5, 8, 10, 46.

6. Learning objectives are clearly defined.

3. Adequate coordination between teachers involved in project development.

5. School management supports and encourages the development of PBL

8. Activities motivate and stimulate curiosity.

10. Technology facilitates adequate implementation.

46. Encourage teachers to participate actively in networks and learning communities to share experiences and learn from other colleagues.

It can be seen that the first items 6, 3, 5, 8 define the work in the classroom, where the most personalized activities can be evidenced with a view to achieving better academic results; while the last items 10 and 46 refer to the work done by the educational institution in collaboration with the network of educational institutions to respond appropriately to national educational policies.

The item reaching highest score in VD (Very Disagreed) is 31. Parents provide a supportive and encouraging learning environment for their children. Teachers believe that parents support their children in dynamic and innovative learning using PBL.

Regarding the instructors' perceptions, preferences, and motivations regarding the use of the STEAM approach and the PBL methodology, for the category 1: Opinions regarding the STEAM approach the subcategory Self-conviction the most relevant evidence is Teacher 3 (Cultural and Artistic Education): I believe it is a fast-learning method for students, as they can learn in a different way than usual; the downside is that it focuses on certain specific topics and not on the entire curriculum.

The evidence shows that teacher 3 of the Cultural and Artistic Education subject is self-convinced that good results have been achieved by working in STEAM and with a PBL approach on specific topics focused on the context and interests of the students; furthermore, in the

Category 2: Opinions regarding the PBL method the same teacher demonstrates their achievements through good learning processes, reaching the objectives of their classes.

For Category 2: Opinions regarding the PBL method with the subcategory Mastery of the approach, the evidence shows that Teacher 2 (Chemistry): I can say that in PBL I can form work groups with better participation; achieves greater participation in groups while, Teacher 3 (Cultural and Artistic Education): demonstrate better results depending on the learning processes in different skills of each student.

According to teachers who indicated a preference for PBL, the advantages are greater collective learning and practice of English communication skills. Meanwhile, teachers who prefer STEAM indicated that its advantage is greater student participation.

Regarding Category 4: Motivation to use STEAM or PBL, teachers who prefer PBL indicate Student learning and Assessment of foreign language learning. Meanwhile, teachers who prefer STEAM indicate Student work.

In addition, authors present the following suggestions for improving teaching with STEAM and PBL in several classes:

Community Solutions Design (PBL + Engineering/Technology):

Project: "Safe Routes to School." Students identify an infrastructure or safety problem near the school.

Sustainable Snacks Lab (STEAM + Science/Mathematics):

Project: Body functions at the Gym

Environmental Awareness Campaign (STEAM + Art/Science):

Project: "Eco-Art: Plastic Transformation." Transforming school plastic waste into art pieces or useful prototypes.

Investigating Local Phenomena:

Project: Analyzing the local biodiversity. For example, picture varieties of lemons produced in the region.

Simulating Technological Entrepreneurship (STEAM + Mathematics/Technology):

Project: Creating a prototype of an application or service that addresses a need in the neighborhood.

In every proposal, learners can design an "Elevator Pitch" to sell their idea.

5. CONCLUSIONS

The authors report that the objective of this study, to determine English language teachers' perceptions of the STEAM approach and Project-Based Learning (PBL) in English science classes in public and private schools in the Manta area of Ecuador, has been fully achieved. The results show differences in participants' perceptions across all dimensions evaluated, indicating that teachers have varying perspectives on integrating the STEAM approach and PBL methodology into their educational practice. The authors conclude that teachers need greater motivation to increase their implementation in English science education in Ecuador. The weakness of the study is the limited number of cores, which does not allow for generalization; however, the research results can be used for curriculum development and decision-makers to improve EFL instruction in the secondary education system. It concludes that evidence indicates the need for additional training and resources to improve the implementation of the STEAM approach and PBL methodology. They both can promote more effective, meaningful learning of complex concepts in high school students. Researchers invite the scientific community to join the LINE-TEAM and PBL studies, analyzing teacher gender, school location, and parent/guardian involvement. The research team considers that the present paper contributes to improving the Science instruction on using English as a foreign Language in Ecuador and other countries in South America

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APPENDIX

Table 4. Planning an educational intervention using the STEAM approach

Title and Objectives	STEAM Sequences	Assessment	Materials and Resources
1. Climate Change & Sustainable Cities **Objective:** Students analyze climate change and design a sustainable city model	- Science: Analyze climate change causes - Technology: Use online climate simulators - Engineering: Design sustainable city - Art: Build eco-city model - Math: Calculate CO_2 reduction	STEAM Rubric Project Presentation Collaborative Work	Cardboard, recycling, laptops NASA Climate Resources: https://climate.nasa.gov NASA STEM Activities: https://www.nasa.gov/es/recursos-stem/
2. Renewable Energy Project	- Investigate solar, wind, hydro - Build mini	Checklist Functional prototype	Bottles, cardboard, small motors PhET Energy Simulations: https://phet.colorado.edu STEM Library:

Objective: Students explore renewable energy sources	solar oven / wind turbine - Calculate energy efficiency - Present prototypes	Oral presentation	https://www.stem-power.eu/es/biblioteca-virtual-es/
3. Human Body Engineering **Objective:** Understand body systems and create bio-models	- Research body systems - Build lung model / heart pump - Explain biological processes - Draw diagrams	Rubric Functional Model Scientific Explanation	Balloons, bottles, hoses Khan Academy Biology: https://www.khanacademy.org/science/biology
4. Water Purification Challenge **Objective:** Design a water filtration system	- Analyze water contamination - Build water filter - Test water quality - Compare results	Experimental evaluation Scientific report Group work	Sand, charcoal, bottles Water Science School NASA: https://www.usgs.gov/special-topics/water-science-school
5. Ecosystem Biodiversit	- Field observation - Create	Portfolio STEAM Infographic	Cell phones, cardboard National Geographic Education: https://education.nationalgeographic.org

y Project Objective: Study ecosystems and biodiversity	ecosystem model - Calculate biodiversity index - Create infographic	Presentation	
6. Space Exploration & Rocket Design Objective: Learn physics and space science	- Study Newton's laws - Build paper rockets - Test distance & speed - Analyze results	Experiment Presentation STEAM Rubric	Paper, straws, tape NASA Rocket Activities: https://www.nasa.gov/stem

Table 5. Planning an educational intervention using the PBL methodology

Title and Objectives	PBL Sequences	Assessment	Required Resources
1. Climate Change and Ecuador Objective: Students analyze climate change impacts in	**Driving Question:** How is climate change affecting Ecuador? • Students analyze real data (temperature, rainfall)	Rubric: • Research quality • English communication • Problem-solving • Teamwork	NASA Climate Kids https://climatekids.nasa.gov Canva https://www.canva.com NOAA Climate Data https://www.noaa.gov

Title and Objectives	PBL Sequences	Assessment	Required Resources
Ecuador and propose solutions	• Group research about Andes, Coast, Amazon, Galápagos • Create infographic with solutions • Presentation in English		
2. Water Pollution in Local Communities Objective: Students investigate water pollution and propose solutions	**Driving Question:** Is our local water safe? • Students collect local information • Analyze contamination causes • Create awareness campaign • Present solutions to community	Performance-based assessment • Investigation report • Campaign design • Oral presentation	WHO Water Resources https://www.who.int Google Earth https://earth.google.com Local news articles
3. Renewable Energy for Ecuador Objective:	**Driving Question:** Which renewable energy is best for Ecuador?	Project rubric • Prototype design • Scientific	Renewable Energy Info https://www.energy.gov Simple materials (cardboard, motors) YouTube Science Channels

Title and Objectives	PBL Sequences	Assessment	Required Resources
Students design renewable energy solutions	• Students research solar, wind, hydro • Design prototype (model) • Build small model • Pitch project	explanation • Innovation	
4. Biodiversity Conservation in Ecuador **Objective:** Students explore biodiversity and conservation	**Driving Question:** How can we protect Ecuador's biodiversity? • Students investigate endangered species • Research ecosystems • Create conservation plan • Poster presentation	Rubric: • Research accuracy • Creativity • English usage	National Geographic Education https://education.nationalgeographic.org IUCN Red List https://www.iucnredlist.org
5. Human Body and Healthy	**Driving Question:** How can students	Self-assessment Peer	WHO Health Resources https://www.who.int

Title and Objectives	PBL Sequences	Assessment	Required Resources
Lifestyle Objective: Students analyze health and create wellness plans	improve their health? • Students analyze habits • Research nutrition & exercise • Create health plan • Present recommendations	evaluation Teacher rubric	CDC Education https://www.cdc.gov
6. Waste Management and Recycling Objective: Students design recycling solutions	**Driving Question:** How can we reduce waste in our school? • Waste audit in school • Data collection • Design recycling plan • Present proposal to school	Project rubric • Data analysis • Feasibility • Presentation	Recycling Education https://www.epa.gov/recycle Google Sheets School waste materials