Reframing Bilingual Math Learning: Integrating Strategies Based on Translanguaging Principles for a Micro-Curriculum in a 4th-Grade CLIL Math Classroom.

Astrid Carolina Hernández Rodríguez

Martha Yaneth Rodríguez Leiva

Juan Sebastián Quintero Ardila

Mg, Ed. Sandra Milena Rodríguez

Facultad de Educación, Universidad Santo Tomás

Maestría en Ambientes Bilingües

de Aprendizaje

Author Note

Astrid Carolina Hernández Rodríguezhttps://orcid.org/0000-0002-4006-9550
(astrid.hernandez@usantotomas.edu.co)

Martha Yaneth Rodríguez Leiva https://orcid.org/0009-0007-1769-8811
(martharodriguez@usantotomas.edu.co)

Juan Sebastián Quintero Ardila https://orcid.org/0009-0006-6407-5708
(juanquintero@usantotomas.edu.co)

We have no known conflict of interest to disclose.

2024

Table of Contents

Abstract

In Colombian bilingual education, monoglossic tendencies persist, particularly in CLIL contexts, reflecting methodologies, materials, and assessment practices rooted in a narrow, market-oriented agenda (Bettney, 2022; Mosquera, 2022). This study explored the impact of integrating translanguaging principles and strategies into the micro-curriculum of a 4th-grade CLIL math class at a bilingual school in Bogotá, Colombia, with the aim of reframing math learning to embrace students' linguistic and sociocultural diversity. The primary objective was to develop and implement pedagogical strategies based on translanguaging, focusing on designing a more inclusive and contextually relevant learning environment. The research employed an action research methodology, divided into three iterative cycles, to facilitate continuous implementation, analysis, and refinement. Data were collected over three months through qualitative and quantitative methods, including field journals, artifacts, questionnaires, and teacher reflections.

The results indicated that translanguaging principles significantly enhanced collaborative learning, increased metalinguistic awareness in math, and improved language development and student engagement. Additionally, students demonstrated greater self-monitoring and motivation. The findings underscore the necessity of continuous reflection and curriculum adaptation to ensure inclusive and dynamically bilingual CLIL settings, emphasizing the importance of aligning educational practices with the diverse needs of students.

Keywords: Translanguaging principles, micro-curriculum, CLIL, spinning top together, spinning top alone, interlanguage, metalinguistic awareness.

Resumen

En la educación bilingüe en Colombia, persisten tendencias monoglósicas, especialmente en contextos CLIL, reflejando metodologías, materiales y prácticas de evaluación arraigadas en una agenda estrecha y orientada al mercado (Bettney, 2022; Mosquera, 2022). Este estudio exploró el impacto de la integración de principios y estrategias de translenguaje en el microcurrículo de una clase de matemáticas de 4º grado en un contexto CLIL en una escuela bilingüe en Bogotá, Colombia, con el objetivo de replantear el aprendizaje de las matemáticas para abarcar la diversidad lingüística y sociocultural de los estudiantes. El objetivo principal fue desarrollar e implementar estrategias pedagógicas basadas en el translenguaje, enfocándose en diseñar un entorno de aprendizaje más inclusivo y relevante para el contexto. La investigación utilizó una metodología de investigación-acción, dividida en tres ciclos iterativos, para facilitar la implementación continua, el análisis y la refinación. Se recopilaron datos durante tres meses mediante métodos cualitativos y cuantitativos, incluidos diarios de campo, artefactos, cuestionarios y reflexiones de los profesores.

Los resultados indicaron que los principios de translenguaje mejoraron significativamente el aprendizaje colaborativo, aumentaron la conciencia metalingüística en matemáticas y mejoraron el desarrollo del lenguaje y la participación de los estudiantes. Además, los estudiantes demostraron una mayor auto-monitoreo y motivación. Los hallazgos subrayan la necesidad de una reflexión continua y la adaptación del currículo para garantizar entornos CLIL inclusivos y dinámicamente bilingües, enfatizando la importancia de alinear las prácticas educativas con las diversas necesidades de los estudiantes.

Palabras clave: Principios de translenguaje, microcurrículo, CLIL, spinning top together, spinning top alone, interlenguaje, conciencia metalingüística.

Introduction

Nowadays, new trends in bilingual education have highlighted the importance of embracing not only students' linguistic abilities but also their specific needs, and their own sociocultural realities. This emerging trend underscores the integration of multiple languages within the educational context, rejecting the notion of languages and sociocultural phenomena as separate or forbidden entities. Cuartas (2014) observed this phenomenon in Colombia where students and teachers draw upon both the target language and their mother tongue to convey meaning and facilitate effective communication. Similarly, Miranda (2016) highlights how the sociocultural perspective on curriculum, combined with the interplay between the planned and implemented curriculum, allows teachers to exercise autonomy despite the influence of the prescribed curriculum and its constraining discourses. Therefore, it becomes crucial to acknowledge and incorporate this linguistic and sociocultural diversity into the micro-curriculum, with translanguaging emerging as a potential guiding practice for this.

Translanguaging is a powerful tool for challenging monolingual and sociocultural restrictions, allowing students to use their fluid linguistic and cultural resources. However, the exploration of plurilingual pedagogies and translanguaging approaches in Latin America, particularly in Colombia, has been limited in academic literature (Ortega, 2019). Therefore, the research project aims to explore translanguaging as an innovative field that aligns with the goals of the MABA program, integrating bilingualism and learning environments (Acero et al, 2022). Additionally, Ortega (2019) suggests that translanguaging brings benefits to educational

institutions by enhancing students' understanding of bilingual subjects, addressing language weaknesses, and promoting collaborative work among diverse student populations.

Considering the information previously exposed, the present research aims to implement strategies based on translanguaging principles in the micro-curriculum of a math class within a private bilingual school located in Bogotá, Colombia. Despite being a bilingual institution, the school enforces a monoglossic approach, requiring students to use only the target language in the classroom. This study specifically examined a fourth-grade classroom, which was chosen due to the observed reality in which students, despite covering new knowledge in their L2 (second language), consistently rely on their mother tongue to respond to questions and interact with their classmates. Consequently, although students grasp the concepts, they encounter a language barrier not only during the entire process of facing word problems but also during examinations.

To frame this research inquiry, the research question is: How does the integration of translanguaging principles and strategies inside the micro-curriculum influence the learning process in a 4th-grade CLIL Math classroom? In this way, the main objective of this research is to reframe math learning through the development and implementation of pedagogical and didactic strategies based on translanguaging principles reflected in the micro-curriculum of a 4th-grade CLIL Math classroom. Consequently, to achieve this, the specific objectives are:

- To examine pedagogical and didactic strategies based with the glasses of translanguaging principles to implement them in the micro-curriculum of a math content area.
- To explain classroom interactions and the learners' experiences through the pedagogical implementation.
- To evaluate the integration of math and language learning after implementing pedagogical and didactic strategies from the perspective of translanguaging.

Literature Review

Monoglossic vs heteroglossic perspectives

Since its inception, bilingual education in Colombia, much like in many other developing countries, has been predominantly influenced by monoglossic perspectives (Mosquera, 2022). Consequently, bilingualism is often reduced to the sole mastery of English, with standard practice often banning the use of languages other than English (Guerrero, 2008; Miranda-Nieves, 2018; Usma, 2009, 2015; Usma & Peláez, 2017). This perspective also entails the implementation of foreign methodologies without sufficient contextualization, thereby neglecting the multicultural reality of the country (Usma, 2009; Le Gal, 2018; Galindo & Moreno, 2008 as cited by Bastidas & Jiménez, 2021). These prevalent perceptions within bilingualism policies have significantly influenced the curriculum and, subsequently, the micro-curriculum, creating an importation philosophy in which foreign methodologies, materials, and assessment strategies are perceived as inherently superior (Le Gal, 2018).

In contrast, a critical perspective in language studies advocates for viewing language as dynamic and fluid. This approach challenges the traditional view of language as a static code (Bettney, 2022). Instead, it posits that bilingualism should not be confined to a cognitive system with separate linguistic compartments, but rather should be seen as an integrated whole that individuals actively engage with to communicate across various contexts in their lives (Canagarajah, 2013). A heteroglossic view further emphasizes the fluidity of plurilinguals' linguistic practices and identities, challenging hegemonic ideologies that prioritize certain languages (García, 2013). This perspective highlights the need for schools to move beyond focusing solely on languages of power and to embrace linguistic diversity (Spiro & Crisfield, 2018). While monoglossic ideology treats languages as static and distinct entities (Hamel, 2008),

bilingual education in Colombia has expanded in response to national and international developments, positioning English as crucial for commerce (De Mejía et al., 2012). However, Bettney (2022) points out that doubts persist about the effectiveness of bilingual programs due to ongoing monoglossic and hegemonic language ideologies, which suppress linguistic diversity.

Therefore, critical scholarship calls for decolonizing approaches that embrace a heteroglossic understanding of language, urging a shift towards equitable practices in bilingual education. This requires further research to explore how a more inclusive and dynamic approach can better accommodate the diverse linguistic realities of students and foster a more holistic and effective learning environment. One way to analyze this is by examining the elements that directly influence the micro-curriculum, such as teaching strategies and methodologies, educational materials, and assessment methods.

Strategies & methodologies

In recent years, Colombia's approach to English language education has evolved to incorporate both monoglossic and heteroglossic perspectives, reflecting a complex interplay between local educational needs and external influences. The National Bilingualism Program and the Colombia Bilingüe initiative, as highlighted by Cárdenas and Miranda (2014), underscore the government's commitment to improving English proficiency through standardized methods and assessments. This national framework predominantly draws on methodologies like the grammar-translation approach, audiolingual approach, direct method, communicative approach, and task-based learning, which have been largely influenced by external entities such as the British Council and have origins in the United States or Europe (Granados, 2022; Le Gal, 2018).

While these methodologies have been effective in standardizing language instruction and assessment, they often overlook the unique cultural and linguistic context of Colombian students.

De Mejía (2011) discusses the opportunities and challenges within the national bilingual framework, noting that while monoglossic strategies focus on the four key language skills, there is a growing recognition of the need for more inclusive pedagogical approaches that account for the diverse linguistic realities of students. Guerrero (2008) critiques the imposition of a monoglossic model, emphasizing the importance of incorporating students' native languages to foster a more holistic educational environment.

Despite these advancements, the effective implementation of heteroglossic strategies remains a challenge. There is a pressing need for ongoing support and training for educators to fully embrace these inclusive methodologies that not only adhere to external standards but also resonate with the lived experiences of Colombian students. This calls for a curriculum framework that measures language proficiency while also being sensitive to the diverse realities of students, thereby fostering a more comprehensive and contextually relevant bilingual education system.

Materials

English Language Teaching (ELT) textbooks are fundamental in second language classrooms worldwide, as highlighted by Harwood (2014) and Richards (2005). Freeman (2014) classifies these textbooks into two categories: global and local. Global textbooks are produced in large quantities and are intended for use across various countries, often neglecting the unique contextual differences of learners. In contrast, local textbooks are tailored for specific audiences, taking into account their unique cultural and educational contexts.

In Colombia, there is a noticeable preference for global ELT materials, which needs to be critically examined (Le Gal, 2018). These English textbooks frequently reflect and perpetuate values, behaviors, cultural patterns, traditions, and dominant ideologies that are largely external

and unfamiliar to Colombian students (Nuñez, 2018). Furthermore, these materials often overlook important aspects of linguistic diversity and interlanguage development, leaving students without adequate support when they encounter new and unfamiliar content (Le Gal, 2018).Therefore, by identifying and addressing the gaps in traditional ELT materials, educators can incorporate cross-cultural and cross-linguistic elements that provide more comprehensive and contextually relevant options, potentially enhancing the students' learning process.

Assessment strategies

In line with this trend, the Colombian bilingual national program has also adopted a foreign assessment model originally designed for a European context, namely the Common European Framework of Reference for Languages (Usma, 2009; Valencia, 2013). However, this framework fails to address the specific needs of a context where Spanish is the dominant language (Granados, 2022). Consequently, assessment practices within this framework aim to attain a particular level of linguistic proficiency, often that of a native speaker, which presents considerable challenges given the limited articulation of the foundations for such progression (Leung, & Scarino, 2016). Therefore, there is a pressing necessity for the development of innovative and diverse approaches to multilingualism and multiculturalism that surpass the confines of conventional monolingual contexts and language usage inside our micro-curriculum.

CLIL methodology

The monoglossic perspective in language education not only impacts language learning practices but also influences bilingual content area learning. This traditional approach often emphasizes proficiency in a single foreign language, particularly English, which is highly valued for its academic and professional advantages (Lethaby, 2015, p. 4). As many young Colombians aspire to study and work abroad, proficiency in English becomes crucial (López, 2012).

Consequently, educational institutions must prioritize not only language instruction but also its integration into various subject contents (Perez, 2016). To address these evolving needs, numerous bilingual schools and universities in Colombia have adopted the CLIL methodology, which originated in Europe in the mid-1990s and was designed to promote multilingualism for economic cohesion within the European Union (Ruiz de Zarobe, 2017). CLIL has since been adapted globally, including in Colombia, where it is utilized to teach both disciplinary content and language skills simultaneously (Hemmi & Banegas, 2021).

Despite contextual adaptations of CLIL to suit local educational environments, there remain significant concerns regarding social justice within English language education. Underpinned by Vygotsky's sociocultural theory, CLIL emphasizes collaborative learning and integrates Halliday's systemic functional linguistics to align content learning with language use in real-world contexts (Hemmi & Banegas, 2022). Effective CLIL implementation requires careful planning to address both content and language needs, ensuring that lessons are comprehensive and linguistically supportive (Perez, 2016). To connect both the necessity to suit local educational environments and address content and language needs, translanguaging offers a transformative solution by shifting from a monoglossic to a dynamic approach that nurtures multiple linguistic identities, fostering equity, efficiency, and integration to meet both local and global needs (Calvet, 1987; Fettes, 2003; Muhlhausler, 2002 as cited by García, 2009, p. 119). By incorporating translanguaging within CLIL frameworks, educational institutions can enhance social justice, support multiple linguistic identities, and provide a more holistic and inclusive educational experience that prepares students for a globalized world.

Translanguaging

Translanguaging is the dynamic utilization of multiple languages in both discourse and pedagogical contexts, encompassing the fluid interplay between linguistic repertoires among bilingual individuals (García, 2014). Translanguaging encompasses diverse and strategic discursive practices that allow effective communication (Anwaruddin, 2018). Creese & Blackledge, (2015, p.23) highlight that translanguaging involves extending and adapting semiotic practices within specific sociolinguistic contexts and expanding linguistic repertoires. Multilingual individuals, as is mentioned by Li (2018, p. 6) utilize their language resources creatively, blending languages and creating innovative forms. However, translanguaging is not simply about allowing the use of the first language; it requires pedagogical value and additional resources for effectiveness (Galante, 2020).

As a practical theory, translanguaging describes the linguistic practices of multilinguals, deploying their full linguistic repertoire without strictly adhering to the social and political boundaries of languages (Otheguy et al., 2015). Rather than considering switching between languages as deficient, translanguaging legitimizes these practices as dynamic. Garcia (2009) emphasizes that this approach allows for the authentic expression of children's linguistic identity. Garcia et al. (2017) define the goals of pedagogical translanguaging: to enable students to use their full linguistic repertoire, to provide opportunities to incorporate new academic language practices, and to support the development of their multilingual identities. Translanguaging fosters a collaborative environment through strategic groupings and projects that require the use of different languages and skills.

Translanguaging strategies facilitate academic content learning, metalinguistic skills development, and positive growth in language understanding and usage (Padilla. *et al*, 2016). It

supports bilingualism, and teachers' use of translanguaging strategies enhances students' language systems, their creativity and self-esteem (Garcia; 2018).

Translanguaging enables teachers to adjust task complexity, bridge connections between languages, and validate students' first language (García, 2014). Additionally, both García and Wei (2014) as well as García and Kano (2014) emphasized that translanguaging deepens understanding, fosters critical thinking, and allows flexibility in language use.

It is effective at elementary levels and serves as scaffolding in early language acquisition (Ramirez & Ortiz, 2022). Incorporating translanguaging in instruction creates inclusive and effective multilingual classrooms, honoring students' languages and promoting academic success.

Following García & Wei (2014) proposal, translanguaging is used by teachers not only to achieve different goals but also, to ensure that bilingual students learn both content and language, in consequence, the principles and strategies under this new pedagogical approach are:

- Differentiate students' levels and adapt instructions according to these levels being a possible strategy translation.
- Build background knowledge through collaborative dialogue, grouping, and use of multilingual teaching materials, visual aids, projects, research, etc.
- Deepen understanding, develop, and extend new knowledge and critical thinking integrating into the previous one's strategies such as inner speech and multilingual writing.

- Achieve cross-linguistic transfer and metalinguistic awareness using some strategies word walls, sentence starters, comparing multilingual texts, multilingual vocabulary inquiry, and multilingual syntax/morphology inquiry.
- Promote cross-linguistic flexibility utilizing alternating languages and media, translating, translanguaging in writing and speaking.
- Using all the previous strategies and principles, engage students empowering them in their identity and positionality, and finally to achieve interrogate linguistic inequality and disrupt linguistic hierarchies and social structures.

Finally, as teachers, it is important to have in mind some important considerations of Translanguaging based teaching suggested by Sangsok & Minjung (2021). These considerations include: knowing their own students, creating multilingual environments, preparing multilingual resources, designing translanguaging units, including spinning top activities, evaluating students' learning from different assessment angles (student's self-evaluation, peer/group assessment, family assessment, teacher's assessment, and teacher's integrative assessment), and reflecting on their own teaching. Consequently, these considerations, in conjunction with the principles, present an ideal approach to facilitate the transformation of the micro-curriculum by incorporating translanguaging strategies that challenge the prevailing monoglossic perspective in bilingual education.

Design

Research design

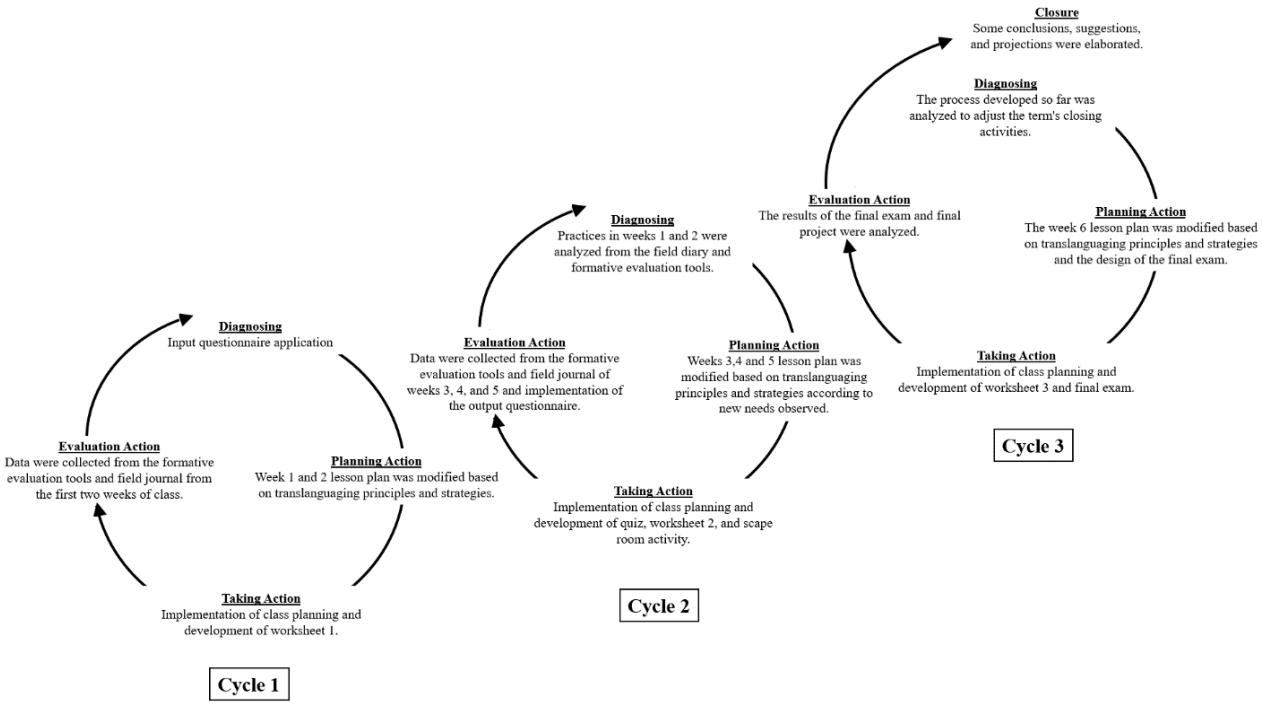
To address the identified need within the chosen context and to enact strategies for modifying the micro-curriculum, the decision was made to employ action research. This approach enables ongoing evaluation of the implementation process of these new strategies as

they are being put into action. Additionally, one of the researchers was the direct teacher of the class under analysis in the current study, action research was selected as a methodology for developing the research design. According to McNiff (2013), action research is a method of systematic enquiry that allows teachers to undertake as researchers of their own practice by reflecting, planning, evaluating and reconsidering what they are doing in reflection cycles.

The following scheme outlines a recurring sequence: identifying a societal issue, formulating action, observing outcomes, and evaluating effects. This process informs knowledge, guides subsequent cycles, and allows flexibility for adjustments. Building relationships remains central. Overall, it highlights the interconnectedness of participation, action, and research, emphasizing iterative experiential learning.

Figure 1

Present investigation action research cycles.



Note: Own elaboration based on "the continuous cycles of Action Research". **Retrieved from:** Zikos D, Thiel A. Action Research's Potential to Foster Institutional Change for Urban Water Management. *Water*. 2013; 5(2):356-378. https://doi.org/10.3390/w5020356

In the context of our research, we have structured three cycles and a closing stage, which are aligned with the six weeks established in the institution where the research was carried out, for the development of the fourth academic term.

In the first cycle, we started with the diagnostic phase using an input questionnaire completed by the students through an online form. Then, we advanced to the planning action stage, where modifications were made in the mathematics class planning, according to the principles of translanguaging. Subsequently, in the taking action stage, the modified planning was applied for week one and two, and the students developed the first worksheet, which

included translanguaging strategies. Finally, in the evaluation action stage, data were collected through a field journal and the formative assessment tools completed by the students.

In the second cycle, we began by analyzing the data collected in the field journal and the formative evaluation tools, which allowed us to establish criteria to make the necessary adjustments and improve teaching practice. These modifications were carried out in the planning action stage, where the principles and strategies of translanguaging were applied during weeks 3, 4, and 5 of class. Then, we moved on to the taking action stage, where the modified class planning was executed, and the students developed the quiz and worksheet 2. Finally, the cycle was closed with the evaluation action stage, in which data were collected through the field journal, the formative evaluation tools, and the students completed an output questionnaire, which, like the first questionnaire, was managed by means of an online form.

In the third cycle, in the diagnostic stage, an analysis of the process developed so far was carried out, based on the data, collection of the field journal, the two questionnaires and the formative evaluation tools, to guide the planning action stage. In the second stage (planning action), the planning of week 6 was modified and the final evaluation was designed, which allowed the development of the taking action stage, where the students developed worksheet 3 and presented their final evaluation of a standardized test (PRUEBA SABER) during the last week of the school year. In the evaluation stage, the students' results obtained in the final evaluation and in the final presentation of their project on the application of fractions in a real context, specifically in the areas of their place of residence, were analyzed. In this way, the research culminates in a final closing stage, in which conclusions, suggestions and projections are drawn based on the process carried out.

Additionally, for the purposes of this study, individual teacher research was implemented as a type of action research study. In accordance with Ferrance (2000) & Tomal (2010) individual teacher research primarily centers on specific classroom concerns in which a teacher can be in quest of solutions for challenges related to student issues, teacher issues, school-centered issues and instrumental development issues. In consequence, this research aims at reframing 4th-grade CLIL math learning by having the teacher applying pedagogical and didactic strategies rooted in translanguaging principles within the micro-curriculum. In this sense, the type of research study allowed the researchers to take action, plan, reflect and reconsider aspects within the micro-curriculum mainly related to strategies, materials and assessment practices.

Finally, in terms of data analysis, this research encompassed both quantitative and qualitative approaches. According to Hanson et al (2005) when a study incorporates both quantitative and qualitative data, it enables simultaneous testing of theoretical models and allows for their modification based on participant feedback, thus leading to a more comprehensive grasp.

In summary, it was decided to implement both qualitative and quantitative data analysis. Qualitative data will be used to analyze student interactions and perceptions regarding the implementation of these strategies. Additionally, quantitative data analysis will allow for an examination of student academic performance throughout the three cycles of implementation, aligning with the objective of determining the influence of these strategies on student learning processes.

Participants: CLIL Math Class Students

The insights obtained by participants through the first instrument applied provided a valuable foundation for gaining a comprehensive understanding and relevance of the present study. The participants are 22 students from a bilingual school located in the rural zone of Mosquera, Cundinamarca. According to the open online questionnaire, data showed that the class is made up of 12 girls and 10 boys between 9 and 11 years old. Eighty-two percent of the students have been in the school for more than 4 years, where from an early age they have been in a bilingual learning environment, specifically the use of Spanish and English. A high proportion of this population finds the mathematics class interesting because it provides them with tools to understand events in their daily lives, and they also find it fun. On the other hand, one of the researchers is the titular teacher of the mathematics subject and homeroom teacher, which facilitated the application of the micro-curriculum based on the principles of translanguaging and data collection.

Instruments & Techniques to Collect Information

In order to keep up with the research stages and meet the objectives of the research, the following instruments and techniques to collect information were implemented: input and output questionnaire, and field diary.

Table 1

Instruments to collect information

INSTRUMENT	DESCRIPTION	RESOURCE
1. Field Journal	Teaching diaries are a useful tool for collecting information about what takes place in the teaching and learning processes. This information can be the emotions and participation of students and teachers, interpretations, reflections, progress and difficulties, etc. (Quintana, 2008). Since part of the specific objectives of this study is to analyze students' interactions and perceptions based on their experiences within the classroom, it was	Field Journal file

	decided to use a field diary as the first instrument. In this way, the present study was able to collect detailed information about what happened in each class with the implementation of these translanguaging strategies, thus allowing for a more rigorous analysis of student interactions and perceptions during classes that implemented these new strategies.	
2. Perception Questionnaires.	A second instrument utilized in this research was the questionnaire, which is a structured set of questions presented to participants to elicit written or verbal responses (Creswell, 2014). Questionnaires serve various purposes, including diagnostics (Sampieri, 2018). In this study, two questionnaires were developed in written form. The first questionnaire served as a diagnostic tool for assessing the mathematics class and gauging the perceived relevance of using Spanish within the classroom context. This initial questionnaire aimed to provide insights into students' perspectives on their math class in general and the integration of their mother tongue within the mathematics learning environment. The second questionnaire was administered at the conclusion of the academic semester and focused on capturing again students' perceptions in general of their match class after the use of translanguaging principle and their conclusions about using their mother tongue. These questionnaires aimed to support the field journal when analyzing students' perceptions focused on their experience before and after implementing translanguaging strategies in the micro curriculum.	Initial perception questionnaire. Final perception questionnaire.
3. Artifacts	The artifact "is an educational tool that seeks to strengthen the formative process of the population" (Rodríguez & Camacho, 2019, p.01). In the context of this research, an artifact, is understood as a product or document that is used to monitor, analyze and evaluate the learning process through the production of students, which in turn allows us to make a reflection on the practice, improve the teaching and learning process and allows us to comply with the third specific objective focused on determine the influence of the translanguaging strategies utilized in the learning process of students. In this sense, the artifacts used in this research are subdivided into 3 worksheets, a quiz, an evaluation,	Worksheet 01 Worksheet 02 Worksheet 03 Quiz Final Exam Self-Assessment Peer Assessment

	self and peer assessment. These artifacts were distributed throughout the research cycles, and articulated the mathematical contents, the target language, the principles and strategies of translanguaging.

Note: click on each resource's name – column 3. Own elaboration

Finally, the current research was carried out by answering not only the project stages but also, the achievements of the objectives proposed by the investigators, as it is possible to observe in APPENDIX F_RESEARCH PLAN.

Implementation

Educational context. Gimnasio Bilingüe Campestre Marie Curie is a private educational institution located in the savannah of Bogotá, specifically in the municipality of Mosquera, Cundinamarca. This institution offers formal and inclusive education for children and youth from preschool to high school. Its educational approach focuses on the development of 21st-century skills, such as critical thinking, curiosity, creativity, collaborative work, communication, and social-emotional competences, with the purpose of contributing to the scientific and technological advancement of Colombia.

The school's mission is focused on providing quality education, fostering a scientific culture in its educational community, and promoting the development of essential skills. Its vision is to be recognized nationally as a leading institution in scientific culture, with publications, participation in scientific events, and successful academic tests at the national level. In addition, they seek to form bilingual baccalaureate graduates with strong ethics and an entrepreneurial attitude based on principles of social solidarity, research, exigency, and reflective thinking.

The philosophy of the institution is based on the motto "Everything that man has created is generated in thought if you cultivate it well, its production will be invaluable". This reflects the belief that education and the stimulation of thought are fundamental to the development of individuals and the improvement of society. Research is considered an essential component of this philosophy and is considered a fundamental pillar of the institution.

Bilingualism program. On the other hand, the school is recognized as an institution of National Bilingualism in the domain of the English Language by the Secretary of Education of Mosquera. They have had a bilingualism plan in place since 2014, creating a learning community involving families, students, and teachers. By 2023, they plan to have two cultural agents from the YMCA, among other partnerships, to create bilingual environments for the entire community, to raise the language proficiency of all educational stakeholders.

The school's bilingualism project is characterized by its integration with other areas of knowledge, where English serves as the language of instruction and the foundation for other bilingual subjects using Content and Language Integrated Learning (CLIL) (Gimnasio Bilingüe Campestre Marie Curie and English area, 2022).

In this way, the institution's bilingualism program focuses on strengthening both the linguistic and cognitive skills of the students through the reading and writing process. This approach allows not only to strengthen grammatical, orthographic and semiotic concepts, but also to relate them to different contexts and areas of knowledge and in turn facilitating the construction of more argued and effectively expressed messages.

In relation to the area of mathematics, the English Department has developed a detailed plan that describes the communicative competencies, terms, themes of the year, communicative skills and the themes implemented in other areas of knowledge, such as social studies and science. This plan includes strategies to foster a bilingual environment within the institution, such as the use of English commands in all areas, bilingual signage of spaces, the use of badges to invite speaking in English, and the implementation of bilingual conversation clubs. In addition, the institution establishes as a goal the increase of English language proficiency among students and teachers, and to achieve this, the presentation of international exams by the Common European Framework, such as the Cambridge English Assessment exams, is promoted. This allows certifying the English level of students according to internationally recognized standards (Gimnasio Bilingüe Campestre Marie Curie and English area,2022).

Math methodology. The primary goal of the mathematics program at Marie Curie School is to promote mathematics as the universal language of the natural sciences among its students. This is achieved by applying numerical, variational, metric, spatial, and statistical concepts to solve problems that connect them with the scientific realities of their surroundings. The program emphasizes problem-solving methods that systematically develop effective thought processes for solving real-world problems. Various strategies, including the use of tools like abacuses, Soma Cube, mathematical calendars, riddles, modeling problems, and participation in mathematics competitions, are employed to encourage students' creativity and ingenuity while applying mathematical concepts (Gimnasio Bilingüe Campestre Marie Curie and Mathematics and physics area, 2024).

The basic standards of mathematical competencies (Ministry of National Education, 2006) and the Basic Learning Rights (DBA) (Ministry of National Education, 2016), where mathematics for the development of science and technology is presented as a fundamental axis, which in turn directly supports the cross-cutting axis of the GBCMC.

The assessment of the area is regulated by the Institutional Assessment System, where superior performance is established in the range of 25 to 23.6, high performance with 23.5 to 21.6, basic performance with 21.5 to 19.6 and low performance from 19.5 to 0. Activities such as work guides, quizzes, mini-projects, use of virtual platforms, self-assessment and peer-assessment are used. For the development of this academic period studying, the following assessment matrix is established, according to Plan General de Temas Math & Physics 2024.

Table ***2***

Matrix Assessment to 4th term

ASSESSMENT TASK 25 POINTS	WEEK	SCORE TO ACHIEVE
BIMONTHLY PROJECT: Make a blueprint of your house and work with basic fraction operations using the area of each place.	5 and 6	5 points
FINAL EXAM	7	5 points
QUIZ: Multiplication using fractions	3	4 points
WORK USING TABLETS: Addition and subtraction of fractions	2	3 points
WORKSHEETS IN CLASS: Fractional operators.	1 - 6	3 points
SELF-ASSESSMENT Process developing through the term, the student evaluates your work in an academic and coexistent way.	2 and 5	2 points
PEER- ASSESSMENT Developing through the term, the students check your cooperative work.	2 and 5	3 points

Teaching Approach Guiding & Instructional Design

Pedagogical proposal

In this bilingual CLIL classroom, despite students' enrollment in a bilingual program, instructional methods predominantly adhere to a monoglossic approach. To redefine the learning experience and foster a more heteroglossic environment, translanguaging principles were introduced into the micro-curriculum. This entailed a multifaceted approach. Initially, efforts were made to develop pedagogical and didactic strategies based on the framework outlined by Sangsok and Minjung (2021). Their model provides a comprehensive cycle, guiding educators through pivotal stages, including understanding students' linguistic backgrounds, creating a multilingual classroom environment, and crafting units that seamlessly integrate translanguaging principles. To enact this, modifications were made to the micro-curriculum in terms of materials, activity implementation, and assessment practices.

Regarding materials and activities, they were tailored to align with the objectives of translanguaging principles. As outlined by Ofelia and Wei in 2014, these principles encompass seven key aspects, and for the purpose of this proposal, we focused on the first fourth:

1. Differentiate and adapt materials and/or activities that allowed the teacher to adapt instruction in both English (target language) and Spanish (home language).
2. Build background knowledge: materials and/or activities that enable students to grasp the content being taught and understand the various linguistic elements of the lesson.
3. Cross-linguistic metalinguistic awareness: materials and/or activities that allowed students to strengthen their ability to meet the communicative exigences of the situation.

4. Cross-linguistic flexibility: materials and/or activities that allowed students to use language practices competently.

This adjustment also ensured that problem information presented in worksheets, slide materials, and quizzes resonated with students' contextual experiences, minimizing foreignness. As advocated by Le gal (2008), language learning practices should prioritize a sociocritical orientation over marketization, emphasizing local practices, materials, and culture.

Furthermore, the design and execution of activities were restructured by integrating the "translanguaging top" concept, as articulated by Sansok and Minjung. This metaphor draws a parallel between translanguaging and a spinning top, in which students are encouraged to freely utilize their full linguistic repertoire, transcending language boundaries. In this context, activities can be categorized as follows:

- Spinning Activities: These involve students making full use of their linguistic resources without limitations, freely blending their home language and the target language as needed.
- Static Activities: In these activities, students predominantly use only one language, either their home language or the target language.
- Together Activities: These activities entail collaborative group work, where students work collectively and engage in language blending.
- Alone Activities: Here, students work individually, focusing on language usage within the context of the spinning top concept.

During the implementation of the micro-curriculum, the teacher introduced both Spinning and Static Top strategies. However, only spinning strategies were considered for using them with translanguaging principles. These strategies allowed students to naturally employ their linguistic

resources. For instance, students were encouraged to share ideas with their peers in their home language while interacting with the teacher in the target language, and vice versa. They also had the opportunity to complete exercises and provide answers in both languages, fostering a seamless integration of linguistic repertoires. For further insight, please refer to the accompanying table 3.

Table 3

Instructional design

CYCLE	SCHOOL WEEK	CLIL COMPONENT (MATH)	TARGET LANGUAGE SKILLS	TRANSLANGUAGING PRINCIPLE	TRANSLANGUAGING STRATEGY	PEDAGOGICAL ACTIVITIES /RESOURCES
1	**W. 1 Motivation**	Problem-solving and logical-mathematical reasoning	Reading and speaking	Build background knowledge Cross-linguistic flexibility	Spinning top together (Collaborative grouping) (Alternative languages and media)	Diagnosis (input questionnaire) Math Calendar (students discuss a math problem in their mother tongue and then discuss and share all their ideas in the class using English (target language).
	Final Project Explanation	Model processes and phenomena of reality, formulate, compare, and exercise procedures and algorithms	Writing and Speaking	Build background knowledge Deepen understanding, develop, and extend new knowledge cross-linguistic flexibility	Static Top Alone (Project learning) Spinning Top Alone (Inner speech) (Alternating languages and media) (Translanguaging in speaking)	PPT (The teacher starts talking about the Bimonthly project (See annex) **1. The task should include:** A floor plane of the place where you live with the parts and the measures. (Week 2) **2.** The area of each part and the total area. (Week 3) **3.** The answers to each question must be a complete sentence. (Week 4-6) **e.g.,** How much longer is the area of the living room than the kitchen? **Answer:** The area of the living room is longer than the kitchen. **4.** All operations and processes. (Week 4-6) **5.** Do not forget to use a ruler and colors. (Week 4-6) In the final week of the term, when students present to complete the bimonthly project, the teacher will create a spinning wheel and all the students will have the opportunity to share some answers both in their home language (Spanish) and their target language (English).
	Exploration	Reasoning	Speaking	Build background knowledge Cross-linguistic flexibility	Spinning top together (Collaborative grouping) (Alternative languages and media)	To introduce the topic, the teacher will ask the students how they can add two fractions with different denominators. Students will make groups and discuss their ideas in their home language (Spanish) and they will share their ideas with the teacher in their target language (English). Explanatory annexes.
	Explanation and Deeping	Communicate and exercise procedures and algorithms.	Listening, speaking	Cross-linguistic flexibility	Spinning top alone (Alternative languages and media).	Video Link: https://youtu.be/tDQipFjAoT8. After watching the video, students will socialize with the teacher about their understanding using their home language (Spanish), additionally, it is necessary, for the teacher can explain again how to find the LCM of two numbers using the students' home language.
		Solving problems, reasoning, and exercising procedures and algorithms.	Reading, speaking	Differentiate and adapt Build Background knowledge Cross-linguistic flexibility	Spinning top alone (Using multilingual visual resources) (translation) (Multilingual vocabulary inquiry)	Game https://www.iknowit.com/lessons/d-adding - fractions-unlike-denominators.html Posters with keywords To support students understanding they can look around the classroom and help themselves with the posters placed around with keywords for math problems in their home language (Spanish).

	Diagnostic Test	Problem-solving and formulation	Reading, writing, and speaking	n/a	Static top alone	Students will develop the diagnostic test.
	Elaboration	Problem solving and formulation Reasoning Formulate, compare, and exercise procedures and algorithms	Reading and speaking*	Build background knowledge Differentiate and adapt Cross-linguistic flexibility	Spinning top together (Collaborative grouping) (Alternative languages and media) (Using multilingual visual resources) (translation) (Multilingual vocabulary inquiry)	Situation problems based on students' contexts and realities. The teacher will give some time for students to discuss their ideas in groups using their home language and then they will discuss the solutions in the target language. * A word bank with keywords in both their home language and target language will be given (spinning top alone). Explanatory annexes Board
	Assessment		Speaking	Build Background Knowledge	Spinning Top Together (Collaborative dialogue)	The teacher is going to attend to questions and doubts that students could have, and review the activity solved, paying more attention to insertion students. Questions will be solved both in English and Spanish according to the students' needs.
	Final Project Advance		Speaking		Static Top Alone (Project learning)	Students are going to explore fraction concepts and their operations of heterogeneous fractions through practical activity. The main intention is to strengthen and use not only the new knowledge explored but also their skill to express orally fractions and face some mathematical procedures with them.
	W. 2 Motivation	Problem-solving and logical-mathematical reasoning	Reading and speaking	Build background knowledge Cross-linguistic flexibility	Spinning top together (Collaborative grouping) (Alternative languages and media)	Math Calendar (students discuss a math problem in their mother tongue and then discuss and share all their ideas in the class using English (target language).
		Communicate	Reading & speaking	Promote cross-linguistic flexibility	Spinning top alone (Alternating languages and media)	Fathom Reads/ Platform The teacher talks about the book that will be read in class this term “The History of the Telephones”. Students will read in the target language and the teacher will provide understanding questions to be asked in their home language.
	Exploration	Problem solving and formulation Reasoning Formulate, compare, and exercise procedures and algorithms	Listening and speaking	n/a	Static top together (Collaborative dialogue)	Explain subtraction with fractions. Once the teacher has made the explanation, some exercises will be given to students to practice. They can discuss them in their target language and the teacher can give feedback in their target language. Explanatory Annexes.
		Formulate, compare, and exercise procedures and algorithms.	Listening and reading	Spinning top alone (Alternating languages and media)	Cross-linguistic flexibility	Tablets for each student Links Addition: https://www.sheppardsoftware.com/math/fractions/addition-game/ Subtraction: https://www.sheppardsoftware.com/math/fractions/subtraction-game/ Internet The teacher will start explaining the parts of the platform using the student's home language (Spanish), exercises will be in English.
	Explanation and Deeping	Communicate	Reading	Cross-linguistic transfer	Spinning top alone (Word walls)	Word Walls Image. The teacher gives them some vocabulary about subtraction. The words will be both In Spanish and English.
	Elaboration	Formulate, compare, and exercise procedures and algorithms.	Reading & writing	Build background knowledge	Spinning top alone (Multilingual visual resources) (Word walls)	Worksheet 01 Pictionary. Students will also have a box with keywords they can relate to in both their home language (Spanish) and their target language (English).

						Individually, each student must write the process to solve heterogeneous fractions in their notebook. They will use their target language to write it.
	Assessment		Speaking and writing	Build background knowledge	Spinning Top Together (Collaborative dialogue)	Format Exit Ticket Two stars and a wish The teacher is going to attend with questions and doubts that students could have, and review the activity solved, paying more attention to insertion students.
	Final Project Advance					Checking the first handout of the students' blueprints.
END OF THE CYCLE		**FORMATIVE ASSESSMENT TOOLS APPLICATION**				
2	**W. 3 Motivation**	Problem-solving and logical-mathematical reasoning	Reading and speaking	Build background knowledge Cross-linguistic flexibility	Spinning top together (Collaborative grouping) (Alternative languages and media)	Math Calendar (students discuss a math problem in their mother tongue and then discuss and share all their ideas in the class using English (target language).
	Exploration	Solving problems, reasoning, and exercising procedures and algorithms	Listening and speaking	Cross-linguistic transfer and metalinguistic awareness	Spinning top together (collaborative dialogue, collaborative grouping)	Slides and notebooks. question discussion. Students will make some groups and will discuss these questions in their home language (Spanish) and they will give the answers in English. Explanatory Annexes.
	Explanation and Deeping	Formulation, comparison and exercise of procedures	Listening and speaking	Cross-linguistic flexibility	Spinning Top Alone (Alternating languages and media)	Smart screen. Explanation and exercises can be delivered, and students mother tongue (Spanish) and they will share it in their target language (English).
	Elaboration	Problem formulation, treatment and resolution	Writing	Cross-linguistic flexibility	Spinning Top Alone (Translanguaging in writing, alternating languages and media)	Slides. Teacher will write exercises both in English and Spanish and students will answer them at the same time. Explanatory Annexes.
		Problem formulation, treatment and resolution	Speaking	Build background knowledge	Spinning Top Together (Collaborative dialogue, collaborative grouping)	Once they have finished, students will get in groups and will discuss their ideas in Spanish. Then they will socialize their answer in English with the teacher.
	Assessment	Problem formulation, treatment and resolution, Reasoning Formulation, comparison and exercise of procedures	Writing	Cross-linguistic flexibility	Spinning Top Alone (Alternating language and media)	Quiz Worksheet. To support their process, students will have math problems written both in their home language (Spanish) and the target language (English). They will have to answer in both languages.
	Final Project Advance					Using the blueprint designed before, students will deliver the area of each part of their houses or apartments and the total area of it.
	W. 4 Motivation	Problem-solving and logical-mathematical reasoning	Reading and speaking	Build background knowledge Cross-linguistic flexibility	Spinning top together (Collaborative grouping) (Alternative languages and media)	Math Calendar (students discuss a math problem in their mother tongue and then discuss and share all their ideas in the class using English (target language).
		Communicate	Reading & speaking	Promote cross-linguistic flexibility	Spinning top alone (Alternating languages and media)	Fathom reads/platform The teacher talks about the book that will be read in class this term "The History of the Telephones". Students will read in the target language and the teacher will provide understanding questions to be asked in their home language.
	Exploration	Reasoning, Problem formulation, treatment and resolution,	Listening & Speaking	Build background knowledge	Spinning top together (collaborative dialogue, collaborative grouping)	Division with fractions. Ask questions with situations based on students' contexts - Students will make some groups and will discuss this question in their home language (Spanish) and they will answer their ideas with the teacher using the target language (English).

		Formulation, comparison and exercise of procedures	Speaking	n/a	Static top together (collaborative dialogue, collaborative grouping)	When doing exercises Students can discuss their ideas in groups in their target language and they will give the answers in their target language too. Explanatory annexes.
	Explanation and Deeping	Formulation, comparison and exercise of procedures	Speaking	Cross-linguistic flexibility	Spinning Top Alone (Alternating languages and media)	**Explanation: how to divide two fractions.** The teacher can support their explanation using students mother tongue (Spanish) and students will answer the operations and share it with the class in English. Explanatory annexes.
	Elaboration	Problem formulation, treatment and resolution, Reasoning.	Writing	Cross-linguistic flexibility	Spinning Top Alone (Translanguaging in writing, alternating languages and media)	The teacher will write one of the exercises both in English and Spanish, students will write on their notebooks and will answer them at the same time.
		Problem formulation, treatment and resolution, Reasoning.	Speaking	Build background knowledge	Spinning Top Together (Collaborative dialogue, collaborative grouping)	Once they have finished, students will get in groups and will discuss their ideas in Spanish. Then they will socialize their answer in English with the teacher. Exercises will be based on students' contexts. Explanatory Annexes.
	Assessment	Problem formulation, treatment and resolution, Reasoning Formulation, comparison and exercise procedure.		Cross-linguistic transfer and metalinguistic Awareness	Spinning Top Alone (Multilingual vocabulary inquiry)	Worksheet 02 Format Students start to solve worksheet No.2. (Problems are adjusted to their context). To solve it students can support their process using a key word bank that will be provided by the teacher in the worksheet. It will connect some concepts in English and Spanish with their meaning through drawings.
	Final Project Advance					Start solving some questions related to the fractions that represent each area of the rooms of their houses or apartments' using the blueprint as supporting material. Students should write the answers for the questions with full sentences. **(SEE ANEXE MINI-PROJECT)**
	W. 5 Motivation	Problem-solving and logical-mathematical reasoning	Reading and speaking	Build background knowledge Cross-linguistic flexibility	Spinning top together (Collaborative grouping) (Alternative languages and media)	Math Calendar (students discuss a math problem in their mother tongue and then discuss and share all their ideas in the class using English (target language).
		Communicate	Reading & speaking	Promote cross-linguistic flexibility	Spinning top alone (Alternating languages and media)	Fathom reads/platform The teacher talks about the book that will be read in class this term "The History of the Telephones". Students will read in the target language and the teacher will provide understanding questions to be asked in their home language.
	Exploration	Problem formulation, treatment and resolution, Reasoning Formulation, comparison and exercise of procedures.	Reading & Speaking	Build background knowledge Cross-linguistic flexibility	Spinning top together (Collaborative grouping) (Alternative languages and media)	**Space Room activity. Four groups. Each group receives a problem.** Students can discuss their ideas in groups in their mother tongue and they will give the answers in English. Explanatory Annexes Scape room
		Formulation, comparison and exercise of procedures.	Reading & Writing	Promote cross-linguistic flexibility and metalinguistic awareness	Spinning top alone (Alternating languages and media)	"Metro" activity. Using the measures that students already have the teacher explains how to write a decimal number with those, in the before case the decimal number is 8.6. Students are going to write the measures as a decimal number. Students will make full sentences of the object they see. They will write the sentences both in English and Spanish. Explanatory Annexes "Metro"
	Explanation and Deeping	Problem formulation, treatment and resolution, Reasoning Formulation, comparison and exercise of procedures	Reading and speaking			Scape room game. Questions with fractions based on students' contexts. The teacher gives students the material and students start with the activity. Explanatory Annexes Scape Room.

		Formulation, comparison and exercise of procedures				Introduction to decimal number and its parts. Visual Examples.
	Elaboration	Problem formulation, treatment and resolution, Reasoning Formulation, comparison and exercise of procedures	Listening	Differentiate and adapt	Spinning Top Alone (translation)	Scape Room Game. Teacher explain exercises students could not solve. And meanings of the unknown words found. The teacher will present some slides with key vocabulary and images related to the concepts. Students can discuss in their mother tongue (Spanish) what they did not understand and then share their ideas in the target language (English).
		Communicate	Reading and Speaking	Build background knowledge Cross-linguistic flexibilit Promote cross-linguistic flexibility and metalinguistic awareness	Spinning top together (Collaborative grouping) (Alternative languages and media) Spinning top alone (Alternating languages and media)	Fathom Reads platform The teacher does a reading control of the book "The history of the telephones". Students will read in the target language and the teacher will provide understanding questions to be asked in their home language.
	Assessment					Exit Ticket Two stars and a wish The teacher is going to attend to questions and doubts that students could have, and review the activity solved, paying more attention to insertion students. Additionally, two formative assessment worksheets will be delivered to the students. The first one (exit ticket) will ask students about their personal learning process and how they felt about it, including the implementation of translanguaging principles. The second one (two starts and a wish) will ask students to provide feedback to each other on their learning process, highlighting two strengths and one improvement opportunity. (SEE ANNEXES)
	Final Project Advance					Continue solving some questions related to the fractions that represent each area of the rooms of their houses or apartments' using the blueprint as supporting material. Students should write the answers for the questions with full sentences. (SEE ANEXE MINI-PROJECT)
END OF THE CYCLE		**FORMATIVE ASSESSMENT TOOLS – OUTPUT QUESTIONAIRE APPLICATION**				
3	**W. 6 Motivation**	Problem-solving and logical-mathematical reasoning	Reading and speaking	Build background knowledge Cross-linguistic flexibility	Spinning top together (Collaborative grouping) (Alternative languages and media)	Diagnosis (output questionnaire) Math Calendar (students discuss a math problem in their mother tongue and then discuss and share all their ideas in the class using English (target language).
	Exploration	Problem-solving and logical-mathematical reasoning	Reading and speaking	Promote cross-linguistic flexibility and metalinguistic awareness	Spinning top alone (Alternating languages and media)	The teacher will ask students how to solve some exercises in which they need to divide the numerator and denominator in order to find the decimal number that represents the fraction. Students will come to the board and will write the process and the answer and will explain their procedure both in Spanish and English.
	Explanation and Deeping	Formulation, comparison and exercise of procedures.				Reminder about how to divide two numbers. Explanation of the steps and the processes. Introduction to the two cases: exact and inexact division. Explanatory Annexes
	Elaboration	Problem formulation, treatment and resolution, Reasoning Formulation, comparison and exercise of procedures.	Reading and writing	Cross-linguistic transfer and metalinguistic Awareness	Spinning Top Alone (Multilingual vocabulary inquiry)	Worksheet 03 Students solve worksheet No. 3. The teacher could check the bimonthly project. (Problems are adjusted to their context) To solve it students can support their process using a key word bank that will be provided by the teacher in the worksheet. It will connect some concepts in English and Spanish with their meaning through drawings.

	Assessment					The teacher is going to attend to questions and doubts that students could have, and see if the activity solved, paying more attention to the insecure students.
	Final Project Advance					Students will present the final document with the blueprint of all the areas in their houses or apartments and worksheets with the process and the questions answered.
CLOSURE	**W. 7 Final Exam**	Problem-solving and logical-mathematical Reasoning Problem formulation, treatment and resolution,	Reading	Build background knowledge Differentiate and adapt Cross-linguistic flexibility	Spinning Top Alone (Multilingual vocabulary inquiry)	Final exam, standardized ICFES type test with 10 questions. It includes a Pictionary word bank with the definition in both English and Spanish.
END OF THE CYCLE		FINAL EXAM APPLICATION				

Lastly, assessment strategies were employed throughout the proposal's implementation. Both summative assessments (required by the institution) and formative assessments (advocated by researchers under the translanguaging approach) were utilized. Summative assessment measures learning outcomes for certification or progression, while formative assessment fosters frequent, interactive assessments to tailor teaching to diverse student needs, promoting equity (Économiques, D. E. D., s/f).

Within the realm of formative assessment, an exit ticket (self-assessment) was implemented to enhance student achievement and motivation (Paz-Albo & Escobar, 2016), along with the "two stars and a wish" approach (peer-assessment). This facilitated specific and constructive feedback for students (Flórez & Sammons, 2013). Students engaged in the "two stars and a wish" activity twice during the six-week term. The implementation of the exit ticket strategy in week two also served as a means to gauge students' perceptions of the translanguaging strategies employed thus far, while the "two stars and a wish" approach enabled students to assess each other and their progress.

In this sense, the presented proposal aims to create culturally relevant materials and activities that incorporate examples and contexts reflecting the diverse backgrounds of the students. Additionally, it seeks to establish an inclusive learning environment, where students are

encouraged to view their linguistic backgrounds as valuable assets rather than obstacles. The proposed techniques will also enable the assessment of students' understanding, allowing for adjustments in instruction as needed. As this is an action research project, the teacher's role in this proposal is that of a learner.

They are engaged in self-reflection, not only in terms of creating supportive environments for students, but also in evaluating and refining their own teaching practices. Additionally, students play an active role as learners. They engage with mathematical concepts, participate in activities, and also engage in individual and collaborative reflection.

In the following teaching-learning term plan document*, you will delve into the core elements of effective teaching: syllabus design, lesson planning, artifacts* (including content assessment*), and formative assessment tools*.[1] This lesson plan seeks to refine teaching strategies, providing knowledge and tools to create engaging and meaningful learning experiences for the focus group of students selected. Our intention is to include principles and strategies of translanguaging overcoming the monoglossic perspective.

Researchers' roles

According to the methodology implemented (action research), researchers' roles are characterized by two types of approaches. The first one is the researcher who is immersed in the educational process of the participants, where it is possible to have an approach to the participants' reality and gain their confidence; nevertheless, the researcher must keep in mind how his/her own personal values would influence in his/her perceptions and interpretations

[1] * Click on the words pointed with an asterisk, in this way, you can check the documents mentioned in their full version.

(Efron & Ravid, 2013). The second one is the researcher who takes “a neutral and objective stance to ensure scientifically accurate findings” (Efron & Ravid, 2013, p.48).

In the context of this research, the delineation of researchers' roles was inspired by the conceptual framework explained above. Consequently, the research team comprised three educators, each assuming distinct roles. One team member actively participated as the immersed teacher, playing a direct and participatory role in executing the pedagogical implementation within the educational context. On the other hand, Researcher 1 and Researcher 2 assumed non-contextual roles, maintaining a neutral and objective stance throughout the study. This division of roles facilitated a comprehensive examination of the research subject, ensuring diverse perspectives and insights from both immersed and external viewpoints.

Analysis and Findings

The summarized findings in this section show the outcomes of the research methodology outlined in the previous section. It's essential to underscore that the primary aim of this study was to transform the approach to learning math and language by developing and integrating pedagogical and didactic strategies rooted in translanguaging principles within the micro-curriculum of a 4th grade CLIL Math classroom. To achieve this objective, employing action research was essential, aligning seamlessly with the ongoing investigation. This approach allowed for the systematic consideration of various stages, enabling researchers to adapt their learning based on the practical implementation of their strategies. Four main stages - diagnosis, action planning, implementation, and evaluation - played a crucial role in shaping the findings across three cycles, ultimately contributing to the transformative process of Math learning through the application of translanguaging strategies.

In that way, this research involved the analysis of three distinct cycles, connected to a field journey that enabled continuous examination of results. The initial cycle spanned from week one to week two, starting with an input questionnaire and culminating in the integration of the formative assessment tool called "two stars and a wish." Subsequently, the second cycle initiated by appraising the preceding cycle for necessary adjustments and concluded with the utilization of the assessment tool "two stars and a wish." Finally, the third cycle began with an evaluation of tools implemented in prior cycles and concluded with the execution of the output questionnaire and the final exam. This structured approach facilitated a comprehensive and progressive assessment of the applied methodologies and tools across the research's phases.

In terms of the duration of data collection, the initial entry in the field journal started on September 7th, coinciding with the application of artifacts previously modified under translanguaging principles and strategies. The administration of the input questionnaire occurred on September 18th, and the development of both the output questionnaire and the final class took place on November 8th. To finish the data collection stage, the final exam was applied on November 16th.

Beyond this, the analysis process started on September 25th analyzing the results of the input questionnaire. Consequently, we defined the main analysis categories and we started with the field journal analysis focusing our attention on CLIL methodology and its connections with translanguaging principles and strategies, then we analyzed not only artifacts results but also students' perception about the process through formative assessment tools such as two starts and a wish and exit ticket. At the end, we gathered important information from the final exam and output questionnaire.

Data analysis method

This research followed both a deductive and an inductive process. It started first by checking existing theories about language learning perspectives (monoglossic vs heteroglossic), curriculum design aspects (specifically some micro-curriculum elements such as methodologies, materials and assessment strategies), CLIL classroom characteristics and translanguaging principles/strategies for pedagogical purposes. After that, a research question was posed: How does the integration of translanguaging principles and strategies inside the micro-curriculum influence the learning process of a 4th grade CLIL math classroom?

Subsequently, specific observations and data collection were carried out and the analysis involved first using an open coding strategy to identify emerging findings. This analysis was implemented in each cycle of the current research. Then, through examining and analyzing the information, an axial coding strategy was implemented to reveal relationships among the categories and subcategories. Then, a selective coding process was applied to get a better understanding of the information. Finally, a triangulation method was used to validate the findings by linking them with established theory

In this sense, to start with the deductive process, when the theory was first analyzed and compared with the present context (Streefkerk, 2023), it became possible to draw the conclusion that the exclusive use of one language in this setting negatively affected the learning process.

Consequently, the idea emerged to introduce translanguaging principles and strategies to redesign the micro-curriculum in a math CLIL classroom. This approach aimed to promote dynamic bilingualism and implement strategies to help students overcome their difficulties in the subject, allowing researchers to get a deeper understanding of the students' interactions and

perceptions, and evaluate the influence of the pedagogical and didactic strategies and principles previously used, as stablished in the specific objectives.

Then, given the nature of the research and the type of data, it was decided to use the inductive method for the analysis of the data collected. It began with the examination of the particulars found from the observations, interactions and results, to determine patterns and finally generate general statements about the process (Potter, 1996).

Hatch (2002) emphasizes that the process of inductive analysis is not done at the end of the data collection, but rather, on the contrary, the analysis begins from the very collection of data, where questions arise about them, they are read over and over again which contributes to new insights, so that each time data are added, the analysis of all the data collected so far must be done; as it happened during the cycles established for the present research.

In view of the above, an analysis was carried out for each of the three cycles conducted in this study, as it is presented below:

The first cycle of this study started by analyzing data related to students' perceptions before and after the implementation of didactic and pedagogical strategies with translanguaging principles. To verify the analysis of student perceptions prior to the implementation of the strategies, the input questionnaire was administered. Following this analysis, translanguaging principles and strategies were implemented. Now, with this change, a field journal and the assessment strategies "two stars and a wish" were employed to validate the analysis of students' interactions and perceptions up to this point. This analysis enabled researchers to identify categories that closely aligned with the reference framework and were more prominently observed throughout the cycle.

After this first cycle, feedback was incorporated to refine the implemented strategies. That is why, throughout the second cycle, student interactions and perceptions continued being analyzed through the field journal, and modified artifacts (worksheets, quizzes, project advances) based on translanguaging principles implemented. In this process cycle, examining the insights gathered from these artifacts not only served to analyze and assess the students' progress but also provided a means to evaluate their learning process. Finally, data obtained from the formative assessment strategy “two stars and a wish” remained integral in confirming and validating the students' comprehensive grasp and viewpoint of the entire process.

During the final phase of the research cycle, the insights obtained from prior analyses were used to refine strategies. Consequently, adjustments were made to specific artifacts such as Worksheet 3, the final exam, and the project presentation. To finish validation of the entire process, data was collected through an output questionnaire. Additionally, the results derived from the last set of implemented artifacts (Worksheet 3, final exam, and project presentation) were also examined. Subsequently, the process culminated with a conclusive summary.

In order to get a more detailed idea, this analysis was approached by adapting the steps recommended by Hatch (2002, p. 162) for an inductive analysis. Additionally, the NVivo Software was used in order to organize, analyze and extract insights from the instruments data. They were implemented as a framework to examine and interpret the data gathered from each cycle in the study as follows:

1. Considering the translanguaging principles and the strategies utilized in the micro-curriculum, data was read line by line to identify them in the analysis framework in each cycle.

2. Data was translated into a single language to use the software NVivo that facilitates the classification of the proposed categories or allows the discovery of new frameworks or categories of analysis cycle by cycle.
3. Categories were identified, highlighted and assigned with a code and the rest was refined.
4. Relationships between the data and the categories established in the theoretical framework were created based on the problems identified in the selected context.
5. Matches and discrepancies between identified relationships and categories of analysis were found.
6. An individual analysis of the three cycles was carried out considering the identified categories, theoretical framework and objectives established.
7. A general analysis of the three cycles was developed in a transversal way considering the identified categories, theoretical framework and objectives established.
8. Further considerations were given according to the findings.

First Cycle

Building upon the previous discussion and considering the research question: how does the integration of translanguaging principles and strategies influence the learning process in a 4th grade CLIL math classroom? the following main categories and subcategories emerged (Table 4)

Table 4

First cycle coding

Research Question	Main Categories	Subcategories
How does the integration of translanguaging principles and strategies inside the micro-curriculum influence the learning process in a 4th-	Didactic influence in the teaching process of mathematics and language.	**Spinning top alone** strategies for cross-linguistic flexibility, laying background knowledge, cultural and metalinguistic awareness. **Spinning top-together** strategies for cross-linguistic flexibility, laying background knowledge, and cultural and metalinguistic awareness.

grade CLIL Math classroom?	Translanguaging influence on language learning and mathematics competency. Influence on students' process (metacognition)	Interlanguage for metalinguistic awareness in math performance. Interlanguage for writing and speaking skills. Affective filter. Monitoring and evaluation through reflective thinking

Note: These categories emerge from the analysis developed with the NVivo software of the data collected in the first cycle.

Since the main objective of this research is to reframe the learning of math and language through the development and implementation of didactic and pedagogical strategies based on the principles of translanguaging reflected in the micro-curriculum of a fourth grade CLIL classroom, the categories and subcategories of analysis emerged in alignment with the specific objectives of the present study:

The first category, 'Didactic Influence in the Teaching Process of Mathematics and Language,' is aligned with the objective of examining pedagogical and didactic strategies based with the glasses of translanguaging principles to implement them in the micro-curriculum of a math content area. This category accounts for how the teaching process unfolded concerning the strategies and principles used in the micro-curricular design.

The second category, 'Translanguaging Influence on the Efficiency of Learning in Both Mathematics and Language Acquisitions,' is aligned to evaluate the integration of math and language learning after implementing pedagogical and didactic strategies from the perspective of translanguaging. This category evaluates the effectiveness of the learning process for students in terms of mathematical and linguistic skills, as observed through the lens of the strategies and principles utilized

Finally, the third category, 'Influence on Students' Process (Metacognition),' is aligned to explain classroom interactions and the learners' experiences through the pedagogical

implementation. This category is directed towards understanding all those metacognitive processes that arise in students regarding their perception of the teaching and learning process.

Figure 2 presents the coding matrix and the hierarchical map of cycle 1, where the category with the highest frequency is the third, with a total of 166, followed by the second, with 46, and the first, with 22.

Figure 2

Coding matrix and hierarchical map of cycle 1

Nombre	Referencias	Porcentaje (%)
1. Didactic Influence in the teaching process of mathematics and language	22	9,4
1.1. Spinning top alone strategies for cross-linguistic flexibility, laying background knowledge, cultural and metalinguistic awareness.	8	3,4
1.2. Spinning top-together strategies for cross-linguistic flexibility, laying background knowledge, cultural and metalinguistic awareness.	14	6,0
2. Translanguaging influence on language learning and mathematics competency.	46	19,7
2.1. Interlanguage for metalinguistic awareness in math performance.	23	9,8
2.2. Interlanguage for writing and speaking skills.	23	9,8
3. Influence on the students' metacognitive process	166	70,9
3.1. Affective filter.	78	33,3
3.2. Monitoring and evaluation through reflective thinking.	88	37,6

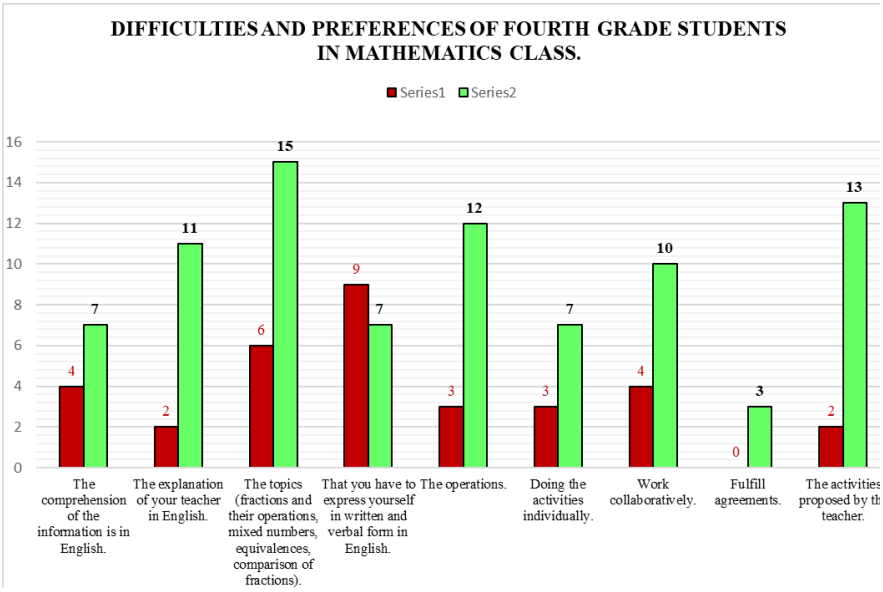
Note: For more detailed information, please see **Appendix E**

1. Didactic influence on the teaching process of mathematics and language.

Considering the results of the first questionnaire, it shows that the major difficulty for students is expressing their ideas verbally or in writing in English, that's why translanguaging use was highly important through the current research because "pedagogical uses of translanguaging provide such a 'liberty of speaking' (Anwaruddin, 2018, p. 309).

Figure 3

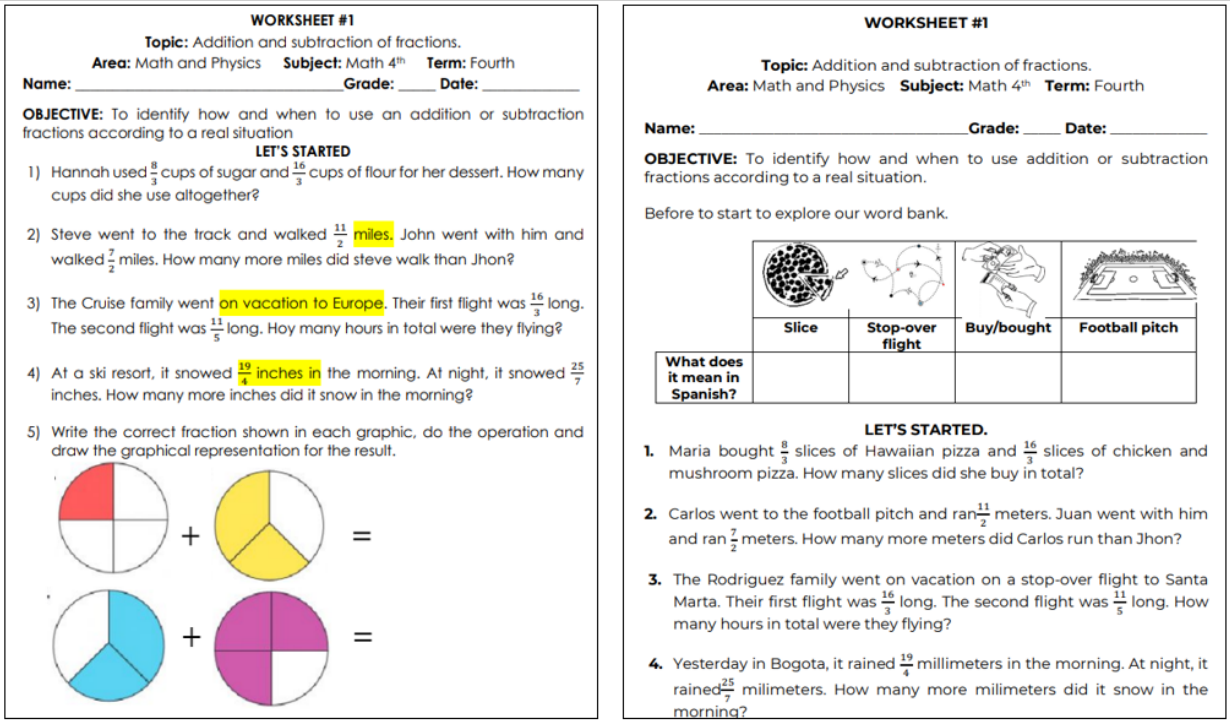
Graph of the results of questions 5 and 6 of the questionnaire



Furthermore, students express a preference for collaborative work in class. Based on the previous questionnaire results, it was decided to divide teaching strategies into two types: one based on collaborative work (Spinning Top Together) and the other on individual work (Spinning Top Alone). Both are oriented towards the principles of translanguaging. As is mentioned by Sangsok S., & Minjung Kim. (2021) translanguaging involves using all available linguistic skills dynamically and appropriately according to and the context to communicate effectively, using spinning top as well as static top strategies. Additionally, the materials used during this cycle were adapted to incorporate translanguaging principles. Prior to this intervention, the materials were characterized by a monoglossic approach, exclusively focusing on the mastery of English and foreign contexts (Miranda-Nieves, 2018). According to Freeman (2014), the new locally developed materials aimed to reflect the learners' context, addressing linguistic diversity and cultural relevance.

Figure 4

Worksheet 01



WORKSHEET #1

Topic: Addition and subtraction of fractions.
Area: Math and Physics **Subject:** Math 4th **Term:** Fourth
Name: _____ **Grade:** ____ **Date:** _____

OBJECTIVE: To identify how and when to use an addition or subtraction fractions according to a real situation

LET'S STARTED

1) Hannah used $\frac{8}{3}$ cups of sugar and $\frac{16}{3}$ cups of flour for her dessert. How many cups did she use altogether?
2) Steve went to the track and walked $\frac{11}{2}$ miles. John went with him and walked $\frac{7}{2}$ miles. How many more miles did steve walk than Jhon?
3) The Cruise family went on vacation to Europe. Their first flight was $\frac{16}{3}$ long. The second flight was $\frac{11}{5}$ long. Hoy many hours in total were they flying?
4) At a ski resort, it snowed $\frac{19}{4}$ inches in the morning. At night, it snowed $\frac{25}{7}$ inches. How many more inches did it snow in the morning?
5) Write the correct fraction shown in each graphic, do the operation and draw the graphical representation for the result.

WORKSHEET #1

Topic: Addition and subtraction of fractions.
Area: Math and Physics **Subject:** Math 4th **Term:** Fourth

Name: _____ **Grade:** ____ **Date:** _____

OBJECTIVE: To identify how and when to use addition or subtraction fractions according to a real situation.

Before to start to explore our word bank.

	Slice	Stop-over flight	Buy/bought	Football pitch
What does it mean in Spanish?				

LET'S STARTED.

1. Maria bought $\frac{8}{3}$ slices of Hawaiian pizza and $\frac{16}{3}$ slices of chicken and mushroom pizza. How many slices did she buy in total?
2. Carlos went to the football pitch and ran $\frac{11}{2}$ meters. Juan went with him and ran $\frac{7}{2}$ meters. How many more meters did Carlos run than Jhon?
3. The Rodriguez family went on vacation on a stop-over flight to Santa Marta. Their first flight was $\frac{16}{3}$ long. The second flight was $\frac{11}{5}$ long. How many hours in total were they flying?
4. Yesterday in Bogota, it rained $\frac{19}{4}$ millimeters in the morning. At night, it rained $\frac{25}{7}$ milimeters. How many more milimeters did it snow in the morning?

Before After

1.1Spinning Top Together strategies for cross-linguistic flexibility, laying background knowledge, cultural and metalinguistic awareness. Based on the principles of translanguaging, the first principle that was decided to implement for this strategy was cross-linguistic flexibility. This decision is informed by the first input questionnaire, which revealed that while some students were undecided about the use of Spanish in class, a majority showed a favorable attitude towards using their native language in the mathematics class (Table 5).

Table 5

Summary of student responses on whether they find math class interesting.

Answer	**Number of students**

Yes	18
No	0
More or less	4

Note: In this chart were only organized the students' answers as yes, no or more or less.

Later, for collaborative work, it was perceived that the principle of **cross-linguistic** flexibility can be complemented by another principle: **laying background knowledge**. Interaction with peers allowed students to recall past concepts and prepare for new ones, as evidenced in the field journal "September 18th,2023, class 3: Using the strategy of collaborative grouping plus the principle of building background knowledge made it easier for students to grasp the concepts." This is apparentsince translanguaging is efficient in building understanding because pre-existing knowledge with cross-linguistic transfer is a foundation with for further learning (Cenoz, J., & Gorter, D. (2022); Baker and Wright (2017).

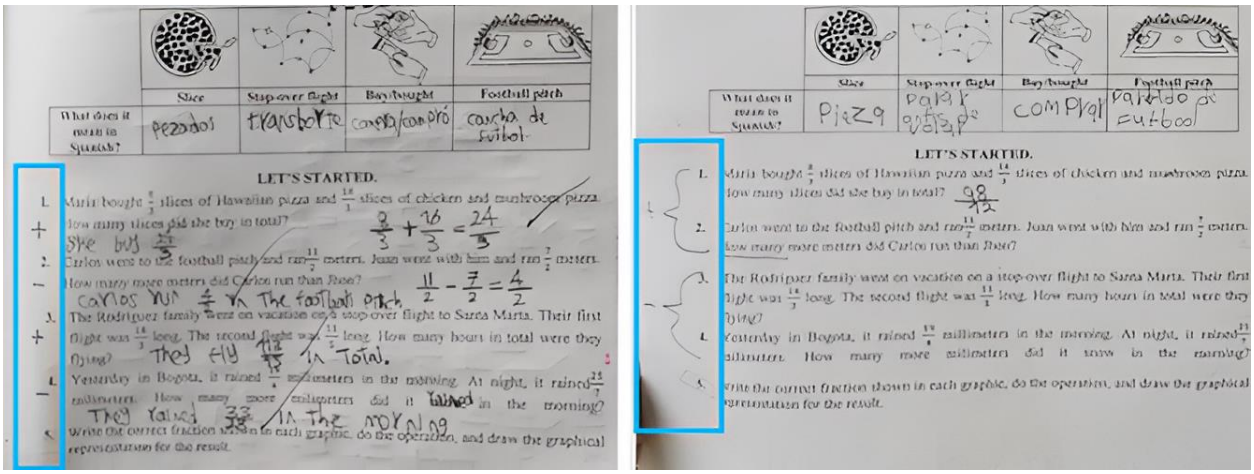
Additionally, very interestingly, during this initial cycle, it becomes apparent that the principle of cross-linguistic flexibility alone is not always beneficial for the teaching process. In the second week's motivation activity, students read a story from a book. Originally, the decision was made not to change the book despite it being a globalized material (Freeman, 2014). However, it became apparent that if the book didn't resonate with students' culture and knowledge, progress suffered. "September 18th, 2023, class 3: Then in their mother tongue, the teacher asked the students what they had understood. But all the students said that it was very confusing for them to understand what the story was about. The material used during this activity did not allow students to get a general idea even using their whole linguistic repertoire." Therefore, it was decided to also implement the principle of **differentiate and adapt**, ensuring that activities are more closely aligned

with the students' contexts. As stated “Translanguaging requires a full understanding of the language used in the input and ‘sufficient vocabulary and a firm enough grasp of the other language to express the message (Williams 2002, p. 37).

1.2. Spinning Top Alone strategies for cross-linguistic flexibility, laying background knowledge, cultural and metalinguistic awareness. At the outset, the focus for individual strategies was on crosslinguistic flexibility. However, as the implementation progressed, it became clear that another principle, metalinguistic awareness, held greater significance in this context. This shift was particularly clear when modifying the worksheet for this cycle (figure 4). The inclusion of a Pictionary aimed to facilitate students' comprehensive understanding of the presented information and their ability to identify each mathematical problem. Through this individual activity, students were encouraged to concentrate on their metacognitive language processes, thereby heightening their awareness and refining their mathematical operations. This approach is supported by Rutgers & Evans (2017), who emphasize that metalinguistic awareness empowers individuals to engage in reflective thinking about their language learning process

Figure 5

Evidence of student development work in worksheet 01



Note: to observe all evidence see [APPENDIX D_EVIDENCE WORKSHEET 01]

2. Translanguaging influence on language learning and mathematics competency.

Given that the primary objective of the CLIL approach is to merge language skills with content competencies (Hemmi & Banegas, 2021), monitoring student progress in both domains was imperative. Observations from the field journal started revealing the effectiveness of strategies aligned with these principles, impacting both language acquisition and the advancement of mathematical competencies. Consequently, two distinct categories began to emerge

2.1. Interlanguage for metalinguistic awareness in math performance. While implementing translanguaging principles such as cross-linguistic flexibility, students mother tongue correlation with their target language facilitated students' metalinguistic awareness by enabling them to recognize operations, establish connections between words and mathematical concepts, and identify problem-solving strategies. Consequently,

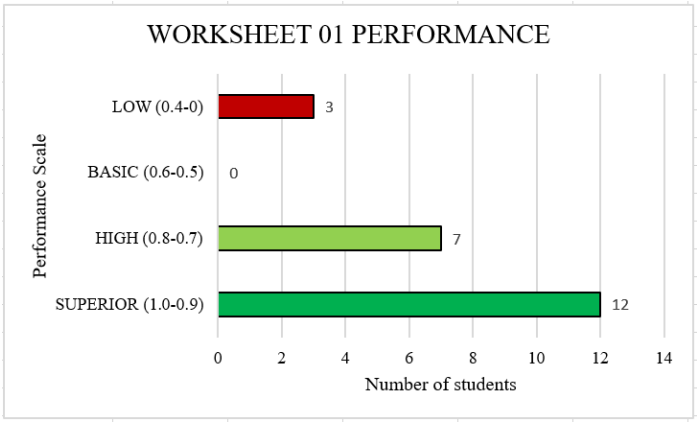
students became more conscious of mathematical intricacies, which positively impacted their academic performance.

Firstly, regarding the activities conducted during the initial cycle, there is a notable reduction in the number of questions asked by students after the explanation of the topics "September 18th, 2023, class 3: Compared with what was previously done in the other terms, students' doubt decreased considerably, and they were more oriented to the mathematical process rather than understanding what the problems were about."

Furthermore, as previously mentioned, during the implementation of spinning top alone strategies in worksheet 1, metalinguistic awareness emerged as a potent tool for enhancing students' performance (see APPENDIX B_ ARTIFACT WEEK 2_WORKSHEET NO 1). Regarding the outcomes of this worksheet, it's important to highlight those 2 students achieved the highest possible score, while 7 students attained a commendable score. However, 3 students encountered challenges, resulting in a lower score. This breakdown indicates that 86% of students successfully comprehended the content and performed satisfactorily in the activity, while the remaining 14% faced difficulties (see Figure 5).

Figure 6

Student performance in the development of the worksheet 01.

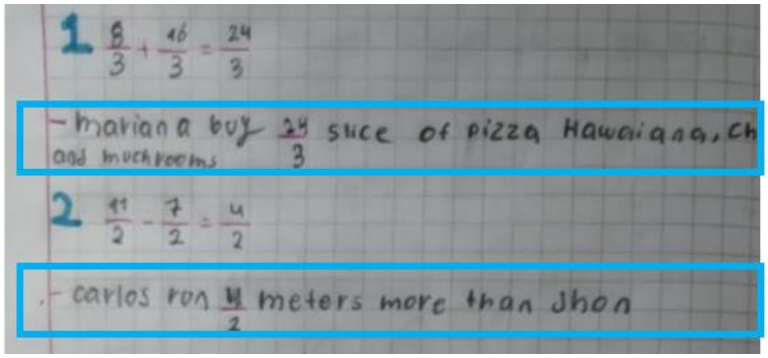


2.2. Interlanguage for writing and speaking skills. In the speaking aspect, it becomes apparent that students, given the opportunity to communicate in their native language as facilitated by the principle of cross-linguistic flexibility, showed some reluctance to engage in conversation in the target language when prompted "September 15th, 2023, class 2: It can be said that the principle of cross-linguistic flexibility plus working collaboratively encouraged students to be more involved in the activity (...) them to participate during the class. In terms of linguistic skills, more students were able to communicate their ideas". This reluctance might stem from various factors, including a lack of confidence in their language skills, fear of making mistakes, or simply feeling more comfortable expressing themselves in their native language.

However, what's intriguing is an observation made during this initial cycle. Despite the hesitation in spoken communication, there was a notable shift in behavior regarding written expression. Unlike in previous periods, students began to write sentences more frequently in the target language. This change suggests a growing

willingness or ability to express mathematical concepts and findings in written form, beyond mere numerical representations (Figure 6).

Figure 7
Evidence of answers given by a student in worksheet 01



Note: to observe all evidence see APPENDIX D_EVIDENCE WORKSHEET 01

3. Influence on students' process (metacognition). Beyond the outcomes achieved, there's clear evidence of the influence of principles and strategies on the metacognitive process of students.

This observation delves into the deeper layers of learning, highlighting how the principles and strategies implemented have impacted the students' metacognitive awareness— their ability to reflect on and regulate their own thinking processes.

This metacognitive analysis was structured into two main components. The first part, referred to as the "affective filter," draws from Krashen's (1982) theory, which highlights various affective factors influencing second language learning, such as motivation, self-confidence, and anxiety. In contrast, the second part encompasses students' self-monitoring and reflective insights into their learning processes. This perspective emphasizes that education extends beyond merely achieving predetermined outcomes; it also aims to cultivate deeper cognitive development and

self-awareness among students. It underscores the significance of not only the content learned but also the methods and processes through which learning occurs.

Throughout the initial cycle, three key tools were utilized to gather information regarding the metacognition process. Initially, the initial perception questionnaire (see APPENDIX C_INSTRUMENT 2_ INITIAL PERCEPTION QUESTIONNARIE) was administered to gain insights into students' preferences about their math class and their perceptions of translanguaging. Subsequently, the field journal (see APPENDIX B_INSTRUMENT 1_FIELD JOURNAL) was employed to document evolving student and teacher perceptions as classes implementing translanguaging strategies progressed. Finally, an exit ticket (see APPENDIX D_EXIT TICKET_WEEK 2) was utilized as a final formative assessment to evaluate the overall process during the concluding phase of the cycle. These formative assessment strategies were introduced to address gaps created by assessment methods that primarily focused on evaluating students' domain knowledge to attain native language proficiency (Granados, 2022), thus being able to address specific student needs in a better way.

3.1 Affective filter. During this first cycle, in general, students displayed increased confidence and motivation to participate in activities throughout the classes during this initial cycle. Students showed greater motivation to ask questions, particularly when they could do so in their mother tongue “September 7th,2023, class 1: (...) it was observed in them greater freedom to ask questions when using their mother tongue.”

This allowed them to grasp new concepts and ideas more rapidly, as evidenced by their consistent engagement during class discussions “September 15th,2023, class 2: (...)

Made them grasp ideas and get connected effectively. (...) feel more comfortable to participate in the activity."

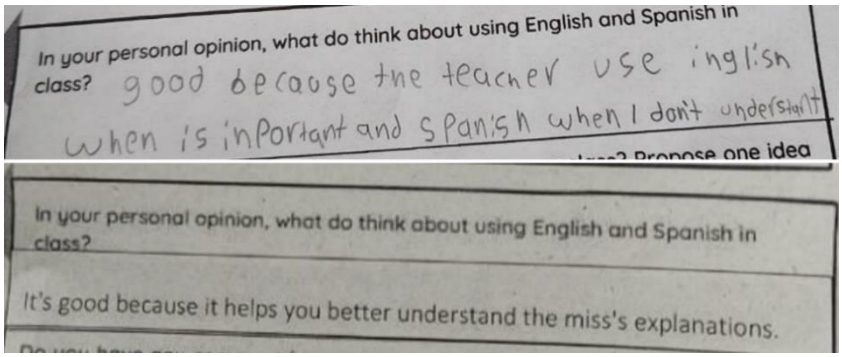
Another significant discovery during this cycle was a reduction in perceived stress among students when completing assigned activities. It was observed that all students were able to complete the in-class tasks "September 18th,2023, class 3: Additionally, the use of the principle build background knowledge with cross-linguistic flexibility made them finish all the activities during the class and they were not afraid as they usually were during this type of activities".

These findings collectively suggest a positive impact of the instructional strategies and principles employed during the cycle, fostering a more conducive learning environment characterized by increased student confidence, motivation, and reduced stress levels.

3.2 Monitoring and evaluation through reflective thinking. Upon reflective analysis of this initial cycle, students expressed the following: The majority of students conveyed that the use of their native language served as a conduit that facilitated a better understanding of the concepts presented in class, thus aiding them in their learning process:

Figure 8

Responses of two different students to the exit ticket artifact (self-assessment)



Note: to observe all evidence see APPENDIX D_EXIT TICKET_WEEK 2

Furthermore, some students underwent a change of opinion regarding the use of their native language in class, as shown in the following excerpt.

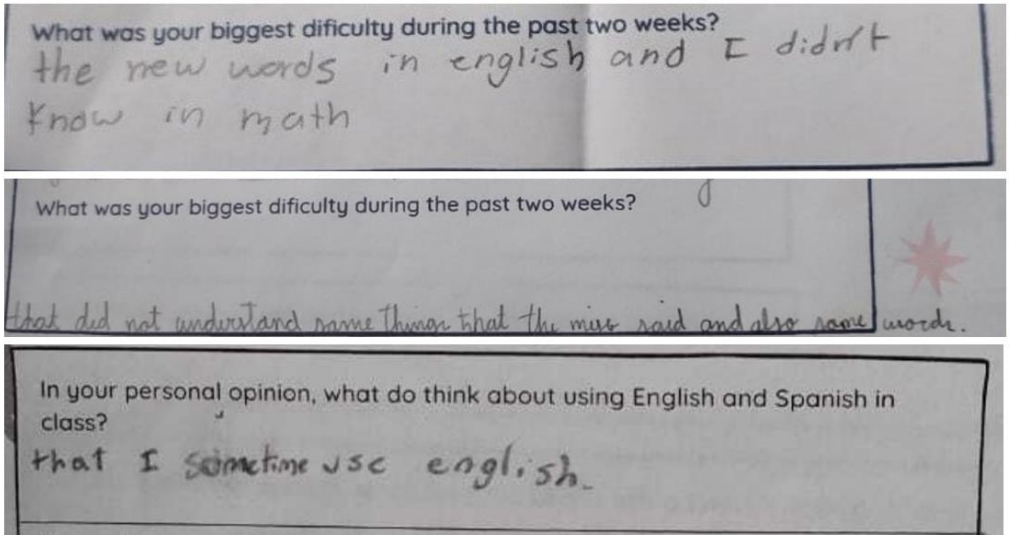
Before: "No porqué si usamos el español no vamos a poder hablar más fluido en otro país que hable ingles" (student 15, input questionnaire, September 9th, 2023)

Afther: "About the use of the english is so important to known some new words and expressions in a new an important languadge about spanish is so helful to understand the main aidia of what are we to doing about bery good complement" (student 15, exit ticket, September 25th, 2023)

On the other hand, contrasting with the input questionnaire where nine students indicated difficulty expressing themselves verbally and in writing in English, a shift is evident. In the self-assessment during this initial cycle, only three students mentioned that this difficulty persisted (Figure 8). Instead, their primary challenges were mathematical topics, particularly heterogeneous fractions. However, the majority also expressed that their greatest enjoyment in class stemmed from these same topics.

Figure 9

Answer of three different students to the question: What has been your greatest difficulty during the last two weeks? on the exit ticket (self-assessment)



Note: to observe all evidence see APPENDIX D_EXIT TICKET_WEEK 2

This is how, according to Garcia and Wei (2014), "Translanguaging refers to the flexibility of bilingual learners to take control of their own learning, to self-regulate when and how to language, depending on the context in which they're being asked to perform" (p. 80).

From the formative assessment tools, several important insights emerged:

- Students frequently cite challenges with specific mathematical topics, particularly fractions and their operations, as well as grappling with new vocabulary and collaborative work.

- Participants express appreciation for the teacher's bilingual approach, noting that using both Spanish and English enhances comprehension (see APPENDIX D_EXIT TICKET_WEEK 2).

- During peer-assessment activities, students were able to recognize positive attributes in their classmates, such as intelligence and willingness to collaborate, while also identifying areas for improvement, such as reducing distractions, focusing attention, and enhancing participation (see APPENDIX D_TWO STARS AND A WISH_WEEK 2).

In conclusion, the first cycle of the research has provided clear insight into the effects of the translanguaging strategies. First, as noted by Garcia and Wei (2014), translanguaging allows bilingual students to take control of their own learning, self-regulating when and how to use their language depending on the context in which they are asked to perform. Through the implementation of this strategy, a significant shift in students' perceptions of the class difficulties was observed.

Initially, the difficulty of the class was perceived primarily in the realm of language. However, as students became more familiar with the practice of translanguaging, this perception began to change. Now, challenges are more focused on understanding the mathematical concepts themselves. This shift in focus is indicative of students' growth in terms of their ability to access and manipulate mathematical concepts across multiple languages.

Additionally, during this cycle, the effectiveness of "spinning top-together" and "spinning top-alone" strategies in fostering cross-linguistic flexibility and building background knowledge was identified. However, it was also recognized the importance of differentiating and adapting the content before applying these strategies. It is crucial to ensure that the content is relevant and accessible to all students, regardless of their language proficiency. The "spinning top-alone" strategy, in addition to promoting cross-linguistic flexibility, proved valuable in fostering metalinguistic awareness among students. This heightened linguistic awareness provides a solid foundation for continuous adaptation in future activities.

Second Cycle

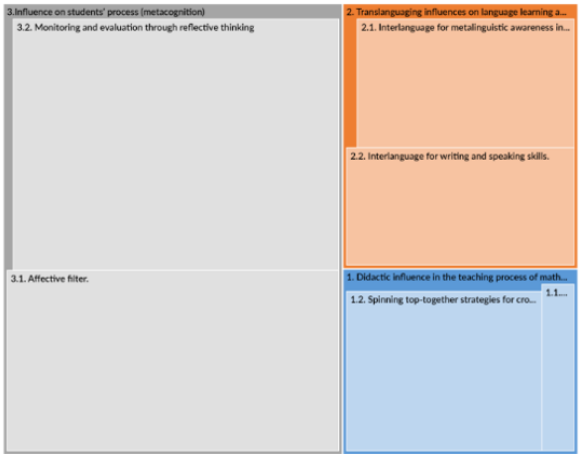
Building upon the insights gained from the previous cycle, an analysis of the results was conducted stemming from the actions implemented during weeks 3, 4, and 5. During this cycle, we continued to explore the effectiveness of translanguaging strategies in this fourth grade CLIL math classroom.

Figure 9 presents the coding matrix and the hierarchical map of cycle 2, where it can be seen that the category with the highest frequency is the third, with a total of 97, followed by the second, with 39, and the first, with 27.

Figure 10

Coding matrix and hierarchical map of cycle 2

Nombre	Referencias	Porcentaje (%)
1. Didactic Influence in the teaching process of mathematics and language	27	16,6
1.1. Spinning top alone strategies for cross-linguistic flexibility, laying background knowledge, cultural and metalinguistic awareness.	4	2,5
1.2. Spinning top-together strategies for cross-linguistic flexibility, laying background knowledge, cultural and metalinguistic awareness.	23	14,1
2. Translanguaging influence on language learning and mathematics competency.	39	23,9
2.1. Interlanguage for metalinguistic awareness in math performance.	20	12,3
2.2. Interlanguage for writing and speaking skills.	29	17,8
3. Influence on the students' metacognitive process	97	59,5
3.1. Affective filter.	41	25,2
3.2. Monitoring and evaluation through reflective thinking.	56	34,4

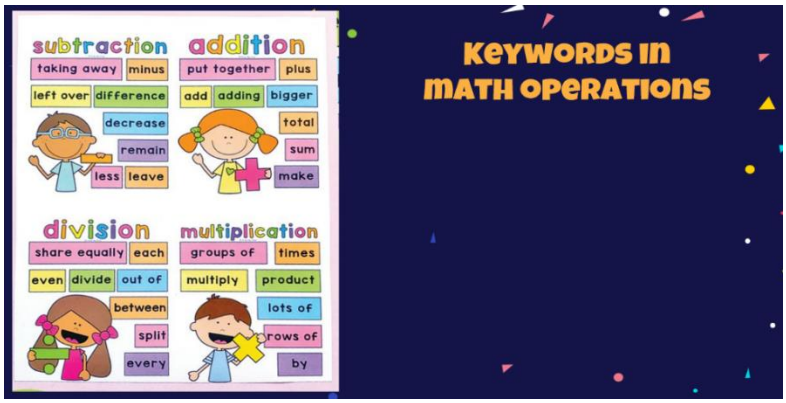


1. Didactic influence on the teaching process of mathematics and language. In terms of the influence of these strategies in the teaching process, during the second cycle, some results were exposed as follows:

1.1 Spinning Top Together strategies for cross-linguistic flexibility, laying background knowledge, cultural and metalinguistic awareness. Building on the findings of the previous cycle, it was determined to continue utilizing cross-linguistic flexibility and establishing

background knowledge through collaborative group activities within the "spinning top-together" approach. However, there was a recognition of the necessity to enhance this process by emphasizing the principle of differentiation and adaptation. To achieve this, word walls were implemented, conventionally utilized for cross-linguistic transfer and metalinguistic awareness, as a means to prepare students before group activities (Garcia & Wei, 2014). Specifically, considering the age range of students (between 9 and 11 years old) and their optimal learning preferences, word walls were adapted into pictionaries. This decision was informed by research suggesting that visual presentations are particularly effective during this stage of child development, coinciding with the maturation of the visual system. Consequently, these pictionaries served as a valuable tool not only for individual activities but also to support comprehension and engagement during collaborative learning activities, and were presented in slides during classes, as in the following example:

Figure 11
Slide with keywords for math operations



Additionally, further observations were made during this cycle regarding spinning top-together strategies. Firstly, it was noted that employing cross-linguistic flexibility in a sequential manner (beginning with the mother tongue and transitioning to the target language) proved to be more effective. This approach allowed students to initially discuss concepts in

their mother tongue, facilitating a deeper internalization of the material, before transitioning to discussions in the target language. This observation stemmed from the field journal entry: “November 7th,2023, class 10: (..) However, the understanding of this specific topic was very complex for students to do it first in the target language. Because of this, the teacher decided to implement cross-linguistic flexibility and switch between student's mother tongue and target language when explaining more examples.”

Furthermore, an important consideration regarding spinning top-together strategies involves the beneficial use of repetition, particularly within teacher-student interactions. Despite the implementation of cross-linguistic flexibility strategies and the differentiation and adaptation of teaching methods, students may still encounter difficulties with certain topics. These challenges were effectively addressed through the strategic use of repetition during instruction. For instance, as documented in the class journal entry: "November 8th,2023, class 11: (...) However, the repetition of problems explained by the teacher made students grasp ideas more quickly.”

1.2 Spinning Top Alone strategies for cross-linguistic flexibility, laying background knowledge, cultural and metalinguistic awareness. Continuing with the implementation of spinning top alone strategies, they have consistently proven to be effective in enhancing students' metalinguistic awareness. Similarly, when utilizing spinning top strategies collectively, as previously discussed, the objective of enhancing metalinguistic awareness prompts teachers to employ additional strategies. For instance, incorporating word walls with accompanying pictures directs students' focus towards relevant vocabulary, thereby increasing their language awareness. This targeted approach aids in facilitating a deeper understanding of mathematical operations among students. (See APPENDIX B_ ARTIFCACTS_ WEEK 3,4 & 5).

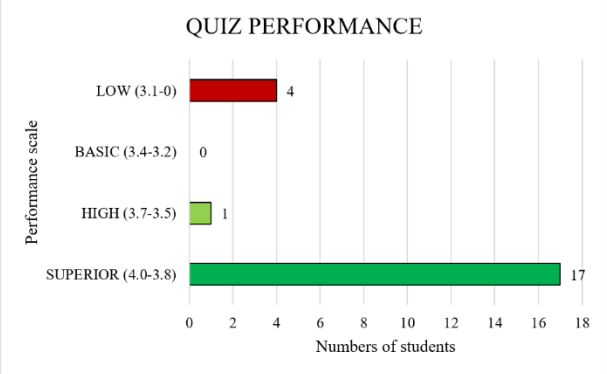
Throughout this cycle, an intriguing observation made by the teacher was that, while employing spinning top alone strategies notably enhanced students' comprehension of the problems they were tasked with, there persisted a need among students to verify their understanding of the mathematical operations required based on the problem's description. This was articulated in the field journal: "October 27th,2023, class 9: (...) Using the metalinguistic principle helped students to understand the whole vocabulary; however, they still needed confirmation when deciding whether a problem was about multiplication or division."

2. Translanguaging influence on language learning and mathematics competency. In the second cycle, two summative activities were developed (the fraction multiplication quiz and the worksheet 2, on multiplication and division of fractions) and a formative activity (scape room on basic operations with fractions). The field diary (See APPENDIX B_INSTRUMENT 1_FIELD JOURNAL) and the analysis (See APPENDIX D_STUDENTS GRADEBOOK) of these activities continued showing the pertinence of the role of interlanguage for gaining metalinguistic awareness and improving the academic and linguistic performance of the students.

2.1. Interlanguage for metalinguistic awareness in math performance. For quiz number 1, cross-linguistic flexibility was implemented to foster metalinguistic awareness. (see APPENDIX B_ ARTIFACT WEEK 3_QUIZ). Here students were given questions both in English and Spanish to identify math operations and interrelate both languages. It was observed that 17 students obtained a superior performance and one of them a high performance, that is, 82% (See figure 11) of the study population was able to understand the activity and solve it in accordance with the application of the topics studied in class on the multiplication of fractions. On the other hand, 4 of the students did not achieve the basic knowledge in the test, obtaining a low performance, that is, 18% of the population. This

shows that "October 13th, 2023, class 6: the principle of differentiate and adapt and cross-linguistic flexibility allowed students to start identifying key information in both their mother tongue and their target language when facing a mathematical problem".

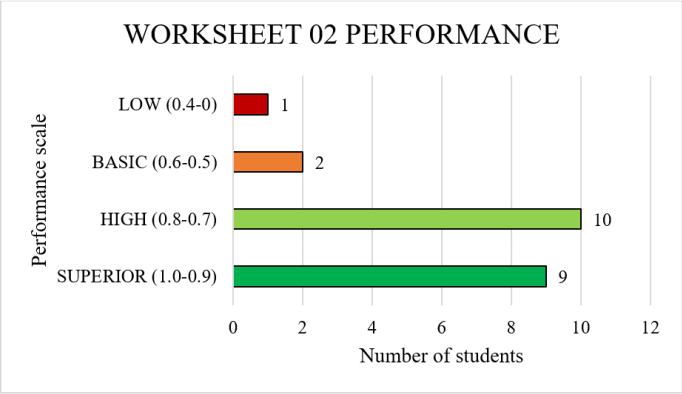
Figure 12
Student performance in the development of the Quiz.



On the other hand, in the worksheet 02 it was observed that "October 27th ,2023, class 9: students seemed to be more committed to the solution of the worksheet thanks to the word walls with key words in their mother tongue" and this was reflected in the results of the students, where 19 of them achieved a performance between superior and high, 2 of them managed to apply the basic knowledge and only one of them still presents difficulties in their process (See figure 12). When contrasting these results with those obtained in previous activities (worksheet 01 and quiz), clear progress in the learning process is evidenced, thus as mentioned by García (2014) it is important to monitor the progress of students over time and adjust pedagogical strategies as needed. In this case, the inclusion of the mother tongue and the strategies implemented seem to have had a positive impact on the student's academic performance.

Figure 13

Student performance in the development of the worksheet 02.

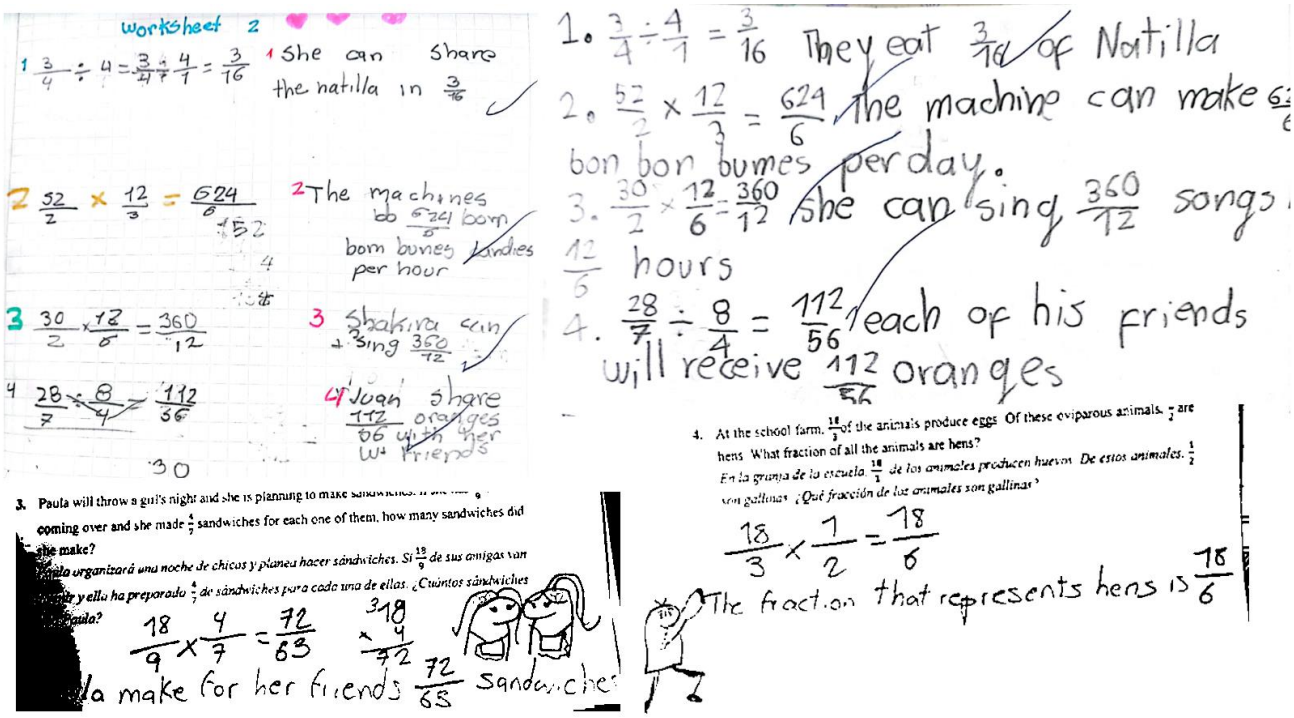


Finally, in the scape room activity it was observed that "October 27th, 2023, class 9: mathematical skills of problem formulation, treatment and resolution were also achieved" since the students organized in groups were able to solve most of the proposed exercises, however, even though they were clear about the algorithms to be used, they constantly requested the teacher's approval to verify their solution.

2.2. Interlanguage for writing and speaking skills. It was observed both in the quiz and in worksheet 02, that most students wrote complete sentences that gave answers to the questions posed in the activities and not only the numbers, as shown in Figure 13.

Figure 14

Evidence from quiz and worksheet 02



Note: to observe all evidence see APPENDIX D_ QUIZ 1 EVIDENCES and APPENDIX D_ EVIDENCES WORKSHEET 02

Furthermore, in the motivational class phases it was perceived how more and more students are able to use their target language to explain procedures or their ideas, as illustrated in the following excerpts from the field diary:

"September 26th,2023, class 5: In terms of linguistic skills, more students were able to communicate their ideas in their target language when having previously shared their ideas with their partners in their mother tongue".

"October 18th,2023, class 6: When students were requested to express their ideas in their target language, they did so without much difficulty, arguing and explaining the process adequately."

"October 19th,2023, class 7: (…) answers in English without any problems at the moment of expressing themselves."

"October 27th,2023, class 9: It was evident that the students used complete sentences when solving a problem situation."

Thus, the evidence collected reflects progress in the linguistic competence of the students, especially in speaking and writing, given that in this cycle they are able to provide complete answers and express ideas fluently in the target language. These advances not only demonstrate the effectiveness of the strategies employed, but also the students' commitment and willingness to actively participate in their learning process. These results support the importance of cultivating language proficiency in the classroom, as suggested by the theories of Garcia & Wei (2014), thus preparing students to face academic and communicative challenges with confidence and skill.

3.Influence on students' process (metacognition). During the second cycle, this time, in order to evaluate the influence of translanguaging strategies on student's metacognition, two formative assessment tools were used (See APPENDIX D_TWO STARS AND A WISH & EXIT TICKET_WEEK 5). Additionally, from the field journal, students' perceptions were taken into account.

3.1 Affective filter. The results obtained from the first cycle closely mirrored those of the second cycle, indicating consistent trends in student behaviour and engagement.

In general, students continued exhibiting a notable increase in confidence and motivation to actively participate in classroom activities throughout the second cycle. This heightened motivation was particularly present in their willingness to ask questions, especially when given the opportunity to do so in their native language first. For instance, according to field journal: "September 26th,2023, class 5: (..) more students were able to communicate their ideas in their target language when having previously shared their ideas with their partners in their mother tongue.", and "October 18th,2023, class 6: once students grasp the ideas of how to make the exercises and discussed them in their mother

tongue, it was easier for them to participate and speak in the target language with their teacher."

Furthermore, students demonstrated enhanced comprehension and rapid assimilation of new concepts and ideas, as evidenced by their sustained engagement during class discussions. For instance, according to field journal: "On September 26th, 2023, class 5: (...) cross-linguistic flexibility and collaborative grouping encouraged students to participate in their target language and clarify doubts."

A continuing discovery during this cycle was also the reduction in perceived stress among students when completing assigned tasks. Across all classes, students exhibited a sense of confidence and ease in completing in-class activities. For instance, according to field journal: "October 18th,2023, class 6: In general students expressed they felt relieved thanks to the principle of cross-linguistic flexibility since having problems in both their mother tongue and their target language made them feel it was very similar to the exercises carried out during the class." This approach alleviated students' fears and apprehensions typically associated with such tasks, further emphasizing the positive impact of tailored instructional strategies on student well-being and academic performance.

Overall, enabling students to utilize their entire linguistic repertoire, thereby minimizing anxiety about unfamiliar topics and facilitating the acquisition of new knowledge, resulted in an increase in motivation. Consistent with research from Iowa 4-H Volunteer (2006) and Modern Family Schools (n.d.), children in middle childhood, typically aged 9 to 11, demonstrate a strong inclination towards active learning. They thrive in environments that offer diverse opportunities for exploration and discovery.

3.2 Monitoring and evaluation through reflective thinking. After the artifacts were applied, at the conclusion of the second cycle, formative assessment tools were once again employed. Analysis of the exit ticket (self-assessment tool) revealed that among participants: three students attributed their difficulties to language barriers, ten students identified math concepts as their primary challenge, one student expressed struggles with memory recall, another student found the mini project challenging. Finally, eight students reported no difficulties encountered (See APPENDIX D_EXIT TICKET_WEEK 5).

Having said that using the two stars and one wish (peer-assessment tool), students acknowledged areas for improvement as a group, including: Increasing autonomous participation, maintaining focus on attention levels, remaining calm when faced with comprehension challenges, encouraging classmates to seek assistance when needed. Additionally, students recognized each other for positive traits such as kindness, intelligence, cooperation, respectfulness, friendship, good behaviour, curiosity, and helpfulness (See APPENDIX D_TWO STARS AND A WISH_WEEK 5).

Finally, one aspect that must be highlighted during this second cycle was the necessity of students for confirmation when they finish an activity. Students, even though knowing the answer, were constantly needing their teacher for confirmation. One more time, in accordance with Iowa 4h-Volunteer (2006) and Escuelas de familia moderna (s. f.) students' insatiable curiosity leads them to frequently inquire "why", prompting adults to encourage independent exploration by not providing all the answers outright. Instead, fostering a culture where a few are tasked with finding answers and sharing them with the group promotes collaborative learning and critical thinking skills. Despite their growing independence, children still require adult support and guidance, particularly in understanding steps and processes, which includes close supervision in completing tasks

and records. Furthermore, recognition and praise for their efforts, presented in front of peers and parents, are vital for boosting their confidence and motivation.

In conclusion, during this second cycle, spinning top together and spinning top alone strategies continued to demonstrate effectiveness for improving the teaching and learning process. Cross-linguistic flexibility emerged as a powerful strategy that facilitated student participation and attentiveness, particularly when employed sequentially, beginning with the native language before transitioning to the target language. Additionally, the integration of word walls and pictionaries proved effective tools for enhancing the learning process, aligning with students' ages.

Moreover, the application of translanguaging strategies enhanced students' metalinguistic awareness in mathematical contexts and fostered their writing and speaking skills in both their native and target languages. This underscores the importance of leveraging students' linguistic repertoires to promote active engagement and comprehension, ultimately contributing to their academic and communicative competence.

Furthermore, the implementation of formative assessment tools provided valuable insights into students' learning processes, identifying areas for improvement and reinforcing positive behaviours. The recurring need for confirmation among students emphasizes the ongoing role of adult support and guidance in fostering a culture of collaborative learning and critical thinking. Recognition and praise for students' efforts further contribute to their confidence and motivation, essential elements in their educational journey.

Third Cycle

This is the final cycle of this research, covering weeks 6 and 7, where students developed worksheet 03, made the final delivery of their mini project, presented their final exam and answered the final perception questionnaire. Both, the artifacts used, as well as the field diary and questionnaire were analyzed under the same categories of the previous cycles; in figure 14,

the coding matrix and hierarchical map are shown, by the NVivo software, where third category had the highest frequency with 93, then second category with 6, and finally first category with 4.

Figure 15

Coding matrix and hierarchical map of cycle 3

Nombre	Referencias	Porcentaje (%)
1. Didactic Influence in the teaching process of mathematics and language	4	3,9
1.1. Spinning top alone strategies for cross-linguistic flexibility, laying background knowledge, cultural and metalinguistic awareness.	2	1,9
1.2. Spinning top-together strategies for cross-linguistic flexibility, laying background knowledge, cultural and metalinguistic awareness.	2	1,9
2. Translanguaging influence on language learning and mathematics competency.	6	5,8
2.1. Interlanguage for metalinguistic awareness in math performance.	3	2,9
2.2. Interlanguage for writing and speaking skills.	3	2,9
3. Influence on the students' metacognitive process	93	90,3
3.1. Affective filter.	47	45,6
3.2. Monitoring and evaluation through reflective thinking.	46	44,7

Note: For more detailed information, please see **Appendix E.**

1. Didactic influence on the teaching process of mathematics and language. Drawing from the knowledge acquired in cycles one and two, an in-depth analysis of the outcomes was undertaken following the activities implemented in week 6. This phase of the study further delved into the efficacy of translanguaging strategies within the fourth grade CLIL math classroom. Despite being the shortest cycle, it provided valuable insights into the overall process and effectiveness of the strategies employed.

1.1 Spinning Top Together strategies for cross-linguistic flexibility, laying background knowledge, cultural and metalinguistic awareness. In this final cycle, spinning top together strategies were implemented based on insights gained from previous cycles. The principle of cross-linguistic flexibility was prioritized during group conversations, starting with the native language and transitioning to the target language. Additionally, to enhance metalinguistic awareness during teacher-student interactions, word walls and pictures were

utilized. However, despite the effectiveness of these strategies overall, an interesting observation emerged during the explanation phase of the division of fractions topic. It was noted that students seemed to struggle to grasp the concepts, even when explanations were provided in both their native and target languages, as documented in the field journal:"On November 8th, 2023, class 11: (...) This time, the use of cross-linguistic flexibility, although it was useful, students didn't get the understanding of the topic even when explained in both, their mother tongue and their target language."

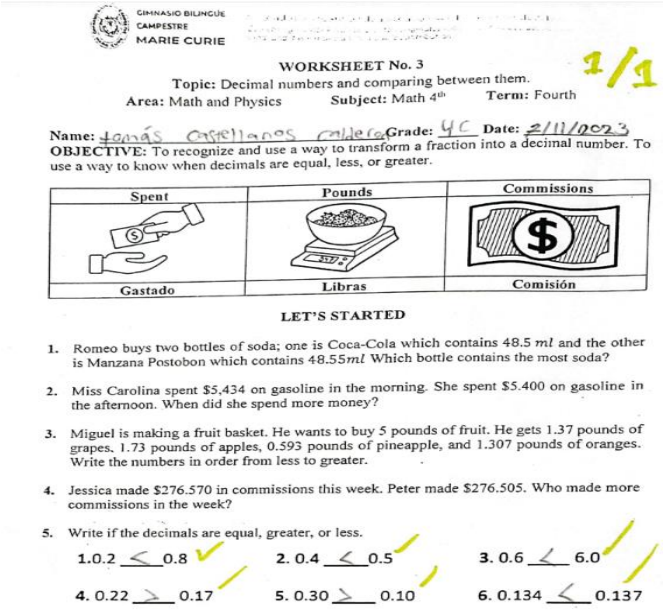
Despite the initial ineffectiveness, the teacher introduced a new strategy involving repetition. It became apparent that, despite the implementation of translanguaging strategies, some students still struggled to grasp the concepts fully. However, through the repetition of problems, demonstrated by the teacher and practiced with additional examples, students gained confidence and reinforced their understanding of the topics, as noted in the field journal entry: "On November 8th, 2023, class 11: (...) However, the repetition of problems explained by the teacher made students graps ideas more quickly."

1.2 Spinning Top Alone strategies for cross-linguistic flexibility, laying background knowledge, cultural and metalinguistic awareness.For Spinning Top Alone strategies, only one artifact was utilized; however, the outcomes proved remarkably positive. Building on insights from previous cycles, word walls and pictures were integrated into the worksheets to enhance students' metalinguistic awareness. Throughout the implementation, students demonstrated reduced inquiries about the activities, experienced low levels of stress, and exhibited high motivation, resulting in no student failures. Additionally, from the teacher's perspective, classroom management was notably streamlined, allowing for effective monitoring of all students. This was perceived in the field journal entry: "On November 8th,

2023, class 11: The utilization of cross-linguistic flexibility and metalinguistic awareness proved effective. Incorporating cross-linguistic flexibility and providing a word bank enhanced students' comprehension of the problems and improved metalinguistic awareness by furnishing key words to facilitate mathematical processes, thereby increasing student success in completing the worksheet." (See Figure 15).

Figure 16

Student answer in worksheet 03



GIMNASIO BILINGÜE CAMPESTRE MARIE CURIE

WORKSHEET No. 3

Topic: Decimal numbers and comparing between them.

Area: Math and Physics Subject: Math 4th Term: Fourth

1/1

Name: tomás castellanos cifuentes Grade: 4C Date: 2/11/2023

OBJECTIVE: To recognize and use a way to transform a fraction into a decimal number. To use a way to know when decimals are equal, less, or greater.

Spent	Pounds	Commissions
Gastado	Libras	Comisión

LET'S STARTED

1. Romeo buys two bottles of soda; one is Coca-Cola which contains 48.5 *ml* and the other is Manzana Postobon which contains 48.55*ml* Which bottle contains the most soda?
2. Miss Carolina spent $5,434 on gasoline in the morning. She spent $5.400 on gasoline in the afternoon. When did she spend more money?
3. Miguel is making a fruit basket. He wants to buy 5 pounds of fruit. He gets 1.37 pounds of grapes, 1.73 pounds of apples, 0.593 pounds of pineapple, and 1.307 pounds of oranges. Write the numbers in order from less to greater.
4. Jessica made $276.570 in commissions this week. Peter made $276.505. Who made more commissions in the week?
5. Write if the decimals are equal, greater, or less.

1. 0.2 < 0.8 2. 0.4 < 0.5 3. 0.6 < 6.0

4. 0.22 > 0.17 5. 0.30 > 0.10 6. 0.134 < 0.137

2. Translanguaging influence on language learning and mathematics competency. In this cycle, analysis will be made from interlanguage for metalinguistic awareness in math and Interlanguage for writing and speaking skills to the formative and summative activities that were developed in weeks 6 and 7 of the school term. The summative activities included worksheet 03, the mini-project, and the final exam. As for the formative activity, the students' reading plan is addressed. This analysis can be made through the review of APPENDIX D_EVIDENCES WORKSHEET 03, APPENDIX D_EVIDENCES MINI PROJECT, APPENDIX D_ANSWERS

FINAL EXAM, APPENDIX D_STUDENTS GRADEBOOK, and APPENDIX B_INSTRUMENT 1_FIELD JOURNAL

2.1. Interlanguage for metalinguistic awareness in math performance. Students' inferences and correlations among the language used in class boosted metalinguistic awareness, improving their math competences especially during this final cycle. In worksheet 3, students were proposed exercises involving the order of decimal numbers and it was designed taking into account the principles of cross-linguistic flexibility and metalinguistic awareness where, as in the previous worksheets, a Pictionary was provided with new words for the students and the problem situations presented were according to the context of the students. From the results of the worksheet and the field diary it was observed that:

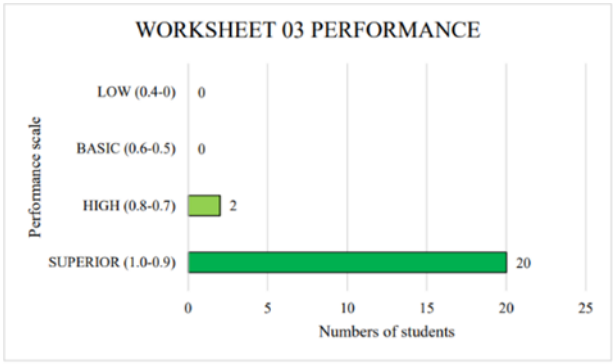
"November 8th, 2023, class 11: (…) to get the mathematical process for the problems increased students' success in the worksheet."

In addition, in figure 16 we can observe that 91% of the students obtained a superior performance in the development of worksheet 03 and the remaining 9% achieved a high performance. We can observe not only an advance in the mathematical skills of the students, since none of them obtained a basic or low performance, but also an advance in the learning of the target language, since the students were able to create complete sentences that give a solution to the proposed questions, as described in the field diary.

"November 8th, 2023, class 11: (…) amount of students who answered with whole sentences instead of just simple responses increased"

Figure 17

Student performance in the development of the worksheet 03.



To further investigate the development of metalinguistic awareness in mathematical performance through interlanguage, the final stages of this study involved two final activities: a mini-project and a final evaluation. The mini project, while not incorporating translanguaging strategies, acted as a transitional phase guiding students towards a greater emphasis on their target language over their native tongue (Marrero, 2022). It centered on the practical application of mathematical concepts and skills within real-world contexts relevant to the students. Conversely, the final evaluation included elements such as a vocabulary pictionary and math problems tailored to students' contexts, aimed at fostering metalinguistic awareness. Additionally, in adherence to institutional regulations, this final evaluation adopted the format of a SABER test, ensuring comprehensive coverage of all topics studied throughout the academic year.

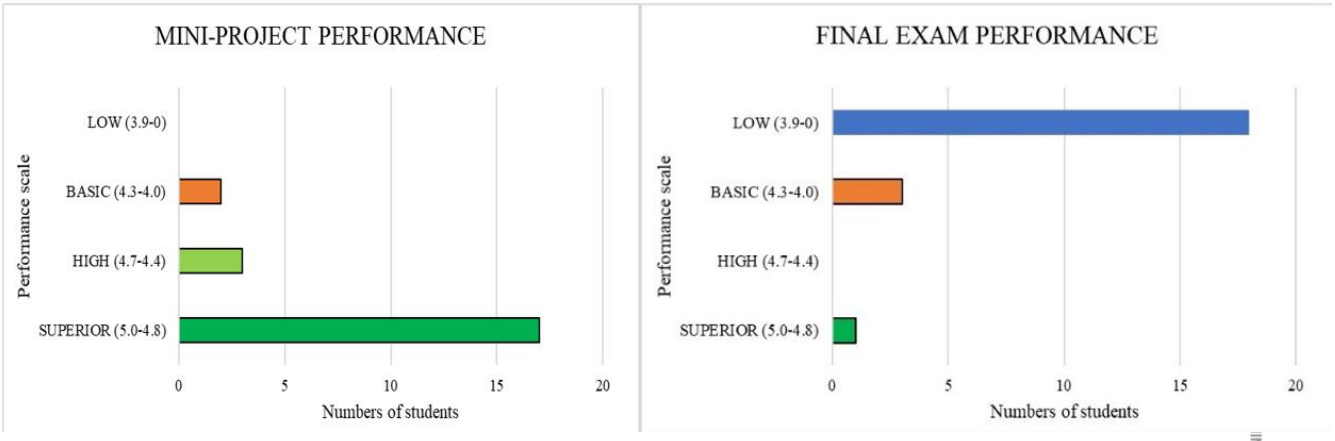
In Figure 17, on the left side we observe the performance of the students in the mini project, where most of the students obtained a superior or basic performance, as in worksheet 3, there is evidence of an articulation between the mathematical skills of the students and the learning of the target language, in the APPENDIX D_EVIDENCES MINI PROJECT it shows not only how the students managed to write sentences or

paragraphs in the target language that give solution to the questions but also how they managed to establish mathematical strategies that allow them to establish the solution to the planted problem.

On the other hand, the results of the final evaluation (Figure 17, right side), are not so promising, since 17 students obtained a low performance, 4 of them a basic performance and only one of them a superior performance. It is important to point out that a common denominator in this educational institution is that students obtain low grades in the final exams. Since students present this activity in an environment that is governed under strict rules, where students are monitored exhaustively by their homeroom teachers all the time, it is forbidden to bring their bags into the classroom, it is forbidden to talk or go to the bathroom, which has manifested in anxiety problems and concern about the development of this activity on the part of the students.

Figure 18

Student performance in the development of the mini project and final exam.



Although this artifact was modified under the principles of translanguaging, where it gave prominence to the context of the students in the problem situations, it was not enough to address the conceptual gaps that students presented during the previous

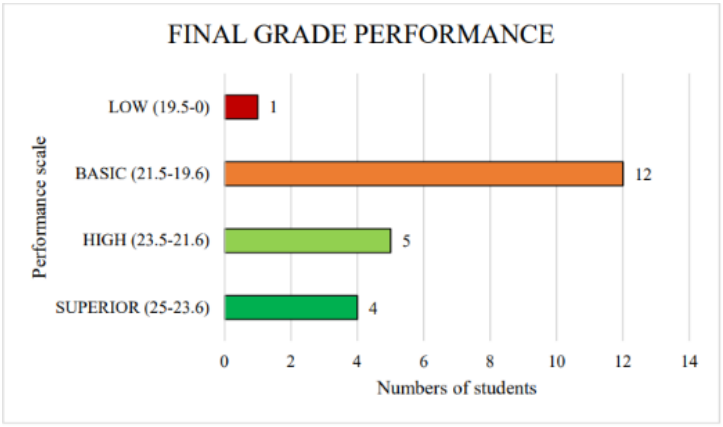
academic terms. On the other hand, for the evaluation of this artifact, only the answer sheet given by each student is taken into account, where the mathematical operations performed to reach the solution and the learning process of the second language are ignored, since it is only limited to selecting an answer option.

This analysis reflects the ideas of Garcia & Wei (2014) "Assessments should help teachers make meaningful instructional decisions. However, standardized assessments are usually administered in one language only, confounding knowledge with language ability" (p. 133). Given that although there are advances in the learning process by implementing more flexible and authentic contexts and artifacts, the final exam is still approached in a traditional way of a standardized assessment and does not consider students' language skills and mathematical reasoning.

However, when analyzing the results of the students' final performance in the subject of mathematics, during the fourth term we observed that 95% of the students were able to pass the subject. With 54% in basic performance, 23% in high performance and 18% in superior performance (See Figure 18).

Figure 19

Student performance in final grade of math subject.



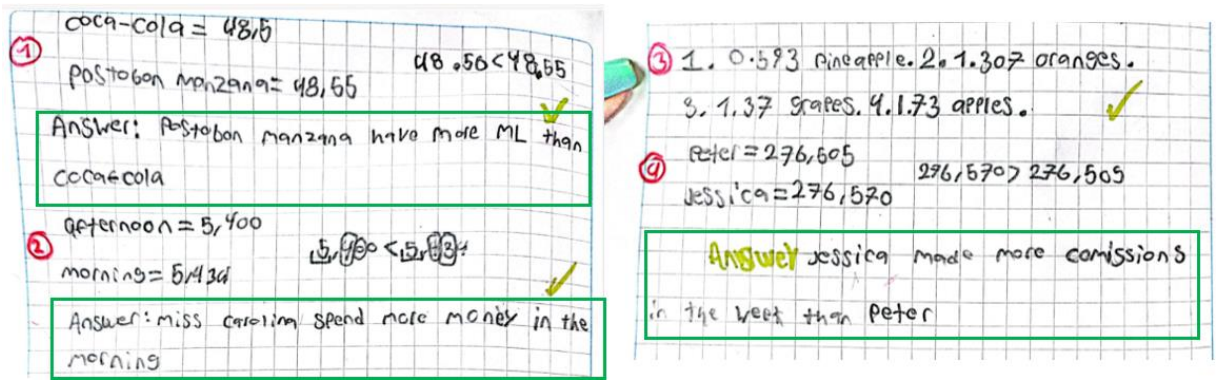
2.2. Interlanguage for writing and speaking skills. This cycle closed with the completion of the reading plan, with the reading of the book "My half day" established for the opening phase of the classes (motivation phase), where the students had a turn to read in the target language and then socialize the ideas of what they had read in their mother tongue. It is important to remember that this book replaced the book "The History of the telephones (fractions)" since during the first cycle of the research it was concluded that this book was not appropriate for the developmental stage of the students, and it was decided to change it for one with less text and closer to their environment.

Thus, in this activity it was noticeable how students easily understood the story, found it interesting and were able to socialize their ideas with their classmates in their mother tongue, without major difficulty, as mentioned in the "November 8th, 2023, class 11: It was easier for the students to socialize the ideas of this book in their mother tongue than with the previous book".

On the other hand, we evidenced both in the development of guide 3, that the students were able to construct complete sentences to solve the proposed questions, some grammatical errors are present, regarding the conjunction of verbs in third persons (See Figure 19), but the contrast of the students' progress has allowed them to move from purely numerical answers to more structured answers articulating the target language, this was also reflected in the development of the mini project (See APPENDIX D_EVIDENCES MINI PROJECT).

Figure 20

Evidence of a student's answer in worksheet 03



Once again, the ideas of García & Wei (2014) are affirmed, of the importance of adapting the artifacts and activities to the context and needs of the students. Such as happened as the need for the change of the book of the reading plan, which promoted in students greater understanding of history and their interest in it. The articulation of the process of teaching the language and the development of mathematical skills has allowed the students to develop the ability to construct and express more structured and complex answers in the target language, although some grammatical errors are observed, but these are indicative of the ongoing learning process and should not be underestimated.

3.Influence on students' process (metacognition). To conclude the analysis on students' metacognition process, the final perception questionnaire was applied during the last cycle. This questionnaire played an important role in the investigation as it provided valuable insights into how the process was perceived by students, resulting in some interesting outcomes.

3.1 Affective filter. Throughout the last cycle, the findings remained consistent with those of the preceding two cycles. Overall, students maintained high levels of motivation during classes, particularly when translanguaging strategies were employed. As it was noticed in their preferences, students expressed a strong enjoyment of the math topics

themselves, with a particular highlight on fractions and mathematical operations involving them. Moreover, they appreciated the methodology utilized, as evidenced by the following excerpts from the final perception questionnaire:

Figure 21

Excerpts from the final perception questionnaire

"Que aprendimos a dividir,multiplicar y fracciones y pues que aprendimos de una forma divertida y aprendimos cosas nuevas."

"que la profe nos enseñaba temas utilisando juegos y eso era muy dibertido y nos decia con claridad"

"La manera en la que se desarrollaron las clases, la explicación y que nos pusieron ejercicios de matemáticas "

"Que usábamos elementos interactivos"

"las operaciones 😊 😊"

"que aprendimos a hacer como hacer operaciones matematicas en la vida real"

"lo que mas me gusto fue que la miss tenia mucha actitud y se le veian los resultados a uno en las notas"

"Las temáticas del periodo que me encantaron y que tuvimos la oportunidad de trabajar en las tablets"

"I like all the things the topics heterogeneous, decimal, number, divisions, multiplication."

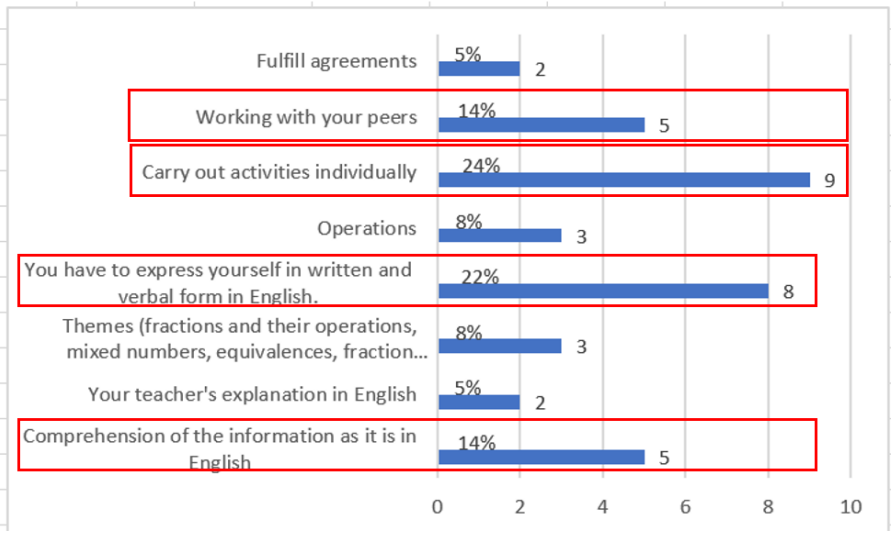
"Que hacíamos las guías en parejas y entendíamos mejor"

"todas las fracciones y hablar un poco en español"

3.2 Monitoring and evaluation through reflective thinking. When the students faced the question about the most difficult thing for them in their math class during the term, they had the opportunity to choose more than one answer and were relevant aspects related to not only language use and its comprehension, but also, the way in which students face the activities (individual and collaborative).

Figure 22

analysis of students' responses to the question about what was most difficult for them in their math class.



As it can be observed, students exhibited a preference for collaborative group work, which can be linked to the implementation of the spinning top together strategies. They expressed that working alone was particularly challenging for them now, thus the opportunity to converse with their peers and exchange ideas in their native language before transitioning to the target language facilitated a smoother learning process, as they became more conscious of this facilitation. Additionally, students recognized that beyond mastering mathematical concepts, their primary challenge in the class revolved around acquiring proficiency in the target language. Thus, they identified language acquisition as the key to achieving their learning objectives in mathematics.

Finally, about the awareness of the role of their mother tongue and how it could serve as a vehicle to learn, students answered the question about if they liked using Spanish more often in math class. According to the results, 12 of them recognized that its use allow them to understand better, comprehend complex vocabulary, and makes the explanations easier, the rest of the students (10) considered that is important English use to improve their skills in English, because they are in a bilingual school and is not logic

use Spanish, because in the future they can visit other countries, get an international job, also English add extra difficulty in their classes and transform them in challenges to overcome; however, they still saw the use of Spanish as beneficial for their process. That is to say, at the end of the process, students could recognize the importance of both languages and were freer to use their linguistic repertoire and less reluctant as they were before the term.

In conclusion, the implementation of translanguaging strategies during this final cycle continued to have beneficial results on both the teaching and learning process of mathematics and language learning. Results have provided valuable insights into the efficacy of translanguaging strategies in enhancing students' learning experiences. Through the implementation of spinning top together and spinning top alone strategies, aimed at fostering cross-linguistic flexibility, laying background knowledge, cultural, and metalinguistic awareness, significant progress was observed. Despite encountering initial challenges, particularly in grasping complex mathematical concepts such as division of fractions, innovative approaches such as repetition proved instrumental in consolidating understanding. Furthermore, the integration of translanguaging principles into formative and summative activities demonstrated marked improvements in students' mathematical competencies and language proficiency, as shown in their performance in worksheets, mini-project, and final exam. However, challenges persisted, particularly in the traditional format of standardized assessments, which may not fully capture students' language skills and mathematical reasoning. Ultimately, students' perceptions continued reflecting a strong preference for translanguaging strategies, highlighting their crucial role in facilitating comprehension and fostering a positive learning atmosphere.

Conclusions

In conclusion, integrating pedagogical and didactic strategies through the lens of translanguaging principles into the micro-curriculum marks a significant advancement in fostering an inclusive and dynamic learning environment in mathematics education. This approach not only empowers teachers to design instructional strategies that bridge language barriers but also encourages students to engage meaningfully with mathematical concepts using their whole linguistic repertoire as a powerful tool. Through the analysis of three cycles in a grade 4 CLIL program, the profound influence of translanguaging strategies on mathematics and language learning was clear.

During the initial cycle, efforts focused on developing teaching strategies grounded in translanguaging principles and strategies to address the challenge of limited English proficiency among students. Notably, strategies such as "Spinning Top Together" and "Spinning Top Alone" not only enhanced comprehension of mathematical terms but also heightened students' awareness of language use in mathematical contexts. This foundation laid the groundwork for subsequent cycles, where refined strategies led to significant progress in metalinguistic awareness and reduced stress levels among students, showcasing the importance of cross-linguistic flexibility; however, placing building background knowledge as the first crucial step.

As the research progressed into its final cycle, it became apparent that despite students' increasing awareness of their learning process, they continued to seek confirmation when solving mathematical operations, reflecting the developmental stage of fourth-grade students. However, the sustained implementation of translanguaging strategies, coupled with a focus on repetition to address persistent challenges, underscored the enduring value of linguistic diversity in the learning journey. Additionally, placing cross-linguistic flexibility in a sequential manner (mother tongue - target language) seemed to help students to gain more confidence and being more participative. Overall, these findings affirm the transformative potential of translanguaging in CLIL mathematics

classrooms, promoting linguistic competence, inclusivity, and cooperation, while enhancing subject comprehension and boosting students' self-confidence, motivation, and metacognitive awareness.

Finally, assessing the impact of translanguaging strategies on student learning outcomes in Math may pose measurement challenges. Traditional assessment measures, such as standardized tests, may not fully capture the multifaceted nature of language and content learning in a CLIL classroom. Teachers' beliefs, attitudes, and pedagogical preferences may influence their willingness to adopt translanguaging practices. Resistance from teachers may impede successful implementation and sustainability of translanguaging initiatives in the classroom. Similarly, students may resist or feel uncomfortable with translanguaging practices, particularly if they perceive their native language as stigmatized or if they are accustomed to traditional monolingual instruction.

Further Implications and Recommendations

As part of the research process, it is worth mentioning that during the project application, due to a mistake in the copying process of the worksheets, the whole 4th grade implemented all the artifacts of cycle 2 (from the quiz) and 3. It is important to mention that the 4th-grade mathematics process was guided by three different teachers (one of them is part of the current research). The two external teachers mentioned in a department meeting how the worksheets were useful in their classes and asked the department head to transform the teaching material in this area.

After the project application, the math team teachers reminded the attention about how important it is to include vocabulary and keyword banks on the worksheets, tests, quizzes in both languages, this way students overcome some language barriers.

As a recommendation for future research, it is suggested to broaden the scope beyond solely focusing on translanguaging strategies. While these strategies are undoubtedly impactful, another crucial aspect deserving attention is the incorporation of games into the learning process, particularly within the context of translanguaging. Understanding the developmental stage of children, notably middle childhood, is essential in tailoring educational approaches effectively. Moreover, insights gleaned from student suggestions highlight the importance of integrating more games, active learning activities, and experiences beyond the classroom environment. Recognizing the pivotal role games play in facilitating learning processes, further exploration in this area is warranted. By incorporating games strategically alongside translanguaging strategies, educators can create richer and more engaging learning experiences that resonate deeply with students' developmental needs and enhance their overall learning outcomes.

References

Acero, Ó. *et al* (2022). Documento Orientador Desarrollo de proyectos de grado MABA (Documento no publicado) [Documento pdf]. Universidad Santo Tomás. Decanatura de División de Educación Abierta y a Distancia -DUAD. Maestría en Ambientes Bilingües de Aprendizaje -MABA.

Anwaruddin, S. M. (2018). Translanguaging as Transformative Pedagogy: Towards a Vision of Democratic Education. *Revista Brasileira de Linguística Aplicada*, *18*(2), 301-312. https://doi.org/10.1590/1984-6398201812055

Baker, C. & Wright, W. E. (2017). Foundations of Bilingual Education and Bilingualism. Bristol, UK: Multilingual Matters.

Bastidas, J, & Jiménez, J. (2021). La política lingüística educativa en Colombia: análisis de la literatura académica sobre el Plan Nacional de Bilingüismo. Tonos Digital, 41, 1–31.

Bettney, E. (2022). Examining Hegemonic and Monoglossic Language Ideologies, Policies, and Practices Within Bilingual Education in Colombia. Ikala, Revista de Lenguaje y Cultura, 27(1), 249-270. https://doi.org/10.17533/udea.ikala.v27n1a12

Canagarajah, S. (2013). Translingual practice. Global englishes and cosmopolitan relations. New York: Routledge. **https://doi.org/10.1002/tesq.115**

Cenoz, J., & Gorter, D. (2022). Pedagogical Translanguaging and Its Application to Language Classes. *RELC Journal*, *53*(2), 342-354. https://doi.org/10.1177/00336882221082751

Cárdenas, R.; Miranda, N. (2014). Implementación del Programa Nacional de Bilingüismo: un balance intermedio. Educ. Educ. Vol. 17, No. 1, 51-67. Retrieved from: http://www.scielo.org.co/pdf/eded/v17n1/v17n1a03.pdf

Creese, A., & Blackledge, A. (2015). Translanguaging and identity in educational settings. Annual Review of Applied Linguistics, 35, 20–35. https://doi.org/10.1017/s0267190514000233

Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative, And Mixed Methods Approaches 3rd edition*. https://s.itoeste.com/q0q

Creswell, J. W., & Creswell, D. J. (2018). Research Design. Qualitative, Quantitative, and Mixed Methods Approaches. Los Angeles: SAGE

Cuartas, L. (2014). Selective use of the mother tongue to enhance students' English learning processes...Beyond the same assumptions. *PROFILE Issues in Teachers Professional Development*, *16*(1), 137–151. https://doi.org/10.15446/profile.v16n1.38661

De Mejía, A. M. (2011). The national bilingual programme in Colombia: Imposition or opportunity?. Apples – Journal of Applied Language Studies, 5(3), 7-17. Retrieved from: https://jyx.jyu.fi/bitstream/handle/123456789/37104/v5-3_p7-17_deMejia.pdf?sequence=1

De Mejía, A. M., Peña Dix, B., de Vélez, M., & Montiel Chamorro, M. (Comps.) (2012). Exploraciones sobre el aprendizaje de lenguas y contenidos en programas bilingües: Una indagación en la escuela primaria. Universidad de los Andes.

Économiques, D. E. D. (s/f). Assessment for learning formative assessment. Oecd.org. Recuperado el 9 de agosto de 2023, de https://www.oecd.org/site/educeri21st/40600533.pdf

Efron, S, & Ravid, R. (2013). *Action Research in education: A Practical Guide*. Guilford Press.

Ferrance, E. (2000). Themes in Education: Action research. New York: Brown University

Flórez, M. T., & Sammons, P. (2013). *Assessment for Learning: Effects and Impact.* Recuperado 18 de septiembre de 2023, de https://eric.ed.gov/?id=ED546817

Freeman, D. (2014). Reading Comprehension Questions: The Distribution of Different Types in Global EFL Textbooks. In N. Harwood (Ed.), English Language Teaching Textbooks.Content, Consumption, Production (pp. 72-110).Houndmills, England: Palgrave Macmillan. DOI: 10.1057/9781137276285_3

Galante, A. (2020). Pedagogical translanguaging in a multilingual English program in Canada: Student and teacher perspectives of challenges. *System, 92*, 102274. https://doi.org/10.1016/j.system.2020.102274.

García, O. (2009). Emergent bilinguals and tesol: What's in a name? tesol Quarterly, 43(2), 322-326. https://doi. org/10.1002/j.1545-7249.2009.tb00172.x

García, O. (2013). From disglossia to transglossia: Bilingual and multilingual classrooms in the 21st century. In C. Abello-Contesse, P. M. Chandler, M. D. López-Jiménez, & R. Chacón-

Beltrán (Eds.), Bilingual and multilingual education in the 21 st century: Building on experience (pp. 155-178). Multilingual Matters. https://doi.org/10.21832/9781783090716-012

Garcia, O. (2014). Translanguaging as normal bilingual discourse. In Hesson, S., Seltzer, K., Woodley, H.H. Translanguaging in curriculum and instruction: CUNY - NYSIEB guide for educators. CUNY Graduate Center.

García, O. (2018). Translanguaging, pedagogy and creativity. In Erfurt, J., Carporal, E. & Weirich, A. (Eds.). Éducation plurilingue et pratiques langagières: Hommage à Christine Hélot (pp.39-56). Peter Lang.

García, O., & Kano, N. (2014). 11. Translanguaging as Process and Pedagogy: Developing the English Writing of Japanese Students in the US. In Multilingual Matters eBooks (pp. 258–277). https://doi.org/10.21832/9781783092246-018

García, O., & Wei, L. (2014). Translanguaging. En Palgrave Macmillan UK eBooks. https://doi.org/10.1057/9781137385765

García, O., & Lin, A. (2017). Translanguaging in bilingual education (3rd Ed.). Springer. https://doi.org/10.1007/978-3-319-02258-1_9

Gimnasio Bilingüe Campestre Marie Curie and English area (2022). Programa de bilingüismo nacional GBCMC.

Gimnasio Bilingüe Campestre Marie Curie and Mathematics and physics area. (2024). Plan General de Temas Math & Physics 2024.

Granados, C. (2022). Disrupting colonial tensions in initial language teacher education: Criteria based on critical interculturality. Ikala, 27(3), 627–645. https://doi.org/10.17533/udea.ikala.v27n3a03

Guerrero, C. H. (2008). Bilingual Colombia: what does it mean to be bilingual within the framework of the National Plan of Bilingualism? PROFILE, 10 (1), 27–46. Retrieved from: https://revistas.unal.edu.co/index.php/profile/article/view/10563

Hamel, R. E. (2008). Plurilingual Latin America: Indigenous languages, immigrant languages, foreign languages towards an integrated policy of language and education. In C. Hélot, & A. M. De Mejía (Eds.), Forging multilingual spaces: Integrated perspectives on majority and minority bilingual education (pp. 58-108). Multilingual Matters. https://doi.org/10.21832/9781847690777-004

Hanson, W. E., Creswell, J. W., Plano Clark, V. L., Petska, K. S., & Creswell, J. D. (2005). Mixed methods research designs in counseling psychology. Journal of Counseling Psychology, 52, 224–235.

Harwood, N. (2014). Content, Consumption and Production: Three Levels of textbook research. In N. Harwood (Ed.), English Language Teaching textbooks (pp. 1-44). New York: Palgrave Macmillan. DOI: 10.1057/9781137276285_1

Hatch, J. A. (2002). *Doing qualitative research in education settings*. SUNY Press.

Hemmi, C., Banegas, D. (2021). CLIL: An Overview. In: Hemmi, C., Banegas, D.L. (eds) International Perspectives on CLIL. International Perspectives on English Language Teaching. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-030-70095-9_1

Krashen, S. D. (1982). *Principles and practice in second language acquisition*. Pergamon.

Le Gal, D. (2018). English Language Teaching in Colombia: A necessary paradigm shift. Matices en lenguas extranjeras, 12. https://doi.org/10.15446/male.n12.73267

Lethaby, C. (2015). Spanish/English bilingual education in Latin America:why and why not. Ruta Maestra, 2-7. https://rutamaestra.santillana.com.co/wp-

content/uploads/2018/05/Educaci%C3%B3n-biling%C3%BCe-espa%C3%B1ol-ingl%C3%A9s-en-Latinoam%C3%A9rica-%C2%BFpor-qu%C3%A9-s%C3%AD-y-por-qu%C3%A9-no.pdf

Leung, C., & Scarino, A. (2016). Reconceptualizing the nature of goals and outcomes in language/s education. Modern Language Journal, 100(S1), 81–95. https://doi.org/10.1111/modl.12300

Li, W. (2018). Translanguaging as a practical theory of language. Applied Linguistics, 39(1), 9e30. https://doi.org/10.1093/applin/amx039

Lopez Neira, L. (2012, mayo). Will Colombia be a bilingual country?. https://www.uexternado.edu.co/wp-content/uploads/2019/12/Ink10.pdf

McNiff, J. (2013). Action research: Principles and practice. London: Routledge.

Ministry of National Education (2006). Estándares básicos de competencias en lenguaje, matemáticas, ciencias y ciudadanas. Bogotá, Colombia. ISBN 958-691-290-6.

Ministry of National Education. (2016). Derechos Básicos de Aprendizaje. Mathematics (Second version). Bogotá, Colombia: ISBN: 978-958-691-925-8.

Miranda, N. (2016). Bilingual Colombia Program: Curriculum as Product, Only? 31 (2), Retrieved from https://repository.upenn.edu/wpel/vol31/iss2/2

Miranda-Nieves, N. (2018). Política educativa para el bilingüismo español-inglés en Colombia: rastreo de su trayectoria desde las aulas (Unpublished doctoral dissertation). Universidad del Quindío, Armenia, Colombia.

Mosquera Pérez, J. E. (2022). CLIL in Colombia: Challenges and Opportunities for its Implementation. GiST Education and Learning Research Journal, 24, 7–24. https://doi.org/10.26817/16925777.1347

Nuñez, A. (2018). The English Textbook. Tensions from an intercultural perspective. GiST Education and Learning Research Journal, 17, 230–259. https://doi.org/10.26817/16925777.402

Ortega, Y. (2019). “Teacher, ¿Puedo Hablar en Español?” A Reflection on Plurilingualism and Translanguaging Practices in EFL. *Profile Issues in Teachers’ Professional Development*, *21*(2), 155-170. https://doi.org/10.15446/profile.v21n2.74091

Otheguy, R., García, O., & Reid, W. (2015). Clarifying translanguaging and deconstructing named languages: A perspective from linguistics. Applied Linguistics Review, 6(3). https://doi.org/10.1515/applirev-2015-0014

Padilla, D., *et al* (2016). TRANSLANGUAGING COMO ESTRATEGIA DE APRENDIZAJE DE L2. International Journal of Developmental and Educational Psychology, 1(1), 307-314. https://www.redalyc.org/articulo.oa?id=349851776034

Paz-Albo, J., Escobar, A. (2016). Exit tickets' effect on engagement in college classrooms. 5915-5918. 10.21125/edulearn.2016.0256.

Perez, D. (2016). CLIL as a strategy to fulfill mathematics content and language needs at primary levels: A case study at Aspaen Gimnasio Los Corales (master's thesis). Universidad del Norte, Instituto de Idiomas.

Potter, W. J. (1996). An analysis of thinking and research about qualitative methods. Mahwah, NJ: Lawrence Erlbaum.

Quintana, E. (2008). Técnicas e instrumentos de observación de clases y su aplicación en el desarrollo de proyectos de investigación reflexiva en el aula y de autoevaluación del proceso docente. In La evaluación en el aprendizaje y la enseñanza del español como lengua extranjera/segunda lengua: XVIII Congreso Internacional de la Asociación para la Enseñanza

del Español como lengua Extranjera (ASELE). Alicante, 19-22 de septiembre de 2007 (pp. 336-342). Servicio de Publicaciones.

Richards, J. C. (2005). The role of textbooks in a language program. https://www.professorjackrichards.com/wp-content/uploads/role-of-textbooks.pdf

Ruiz de Zarobe, Y. (2017). Language awareness and CLIL. In J. Cenoz, D. Gorter & S. May (Eds.), Language awareness and multilingualism (pp. 1-10). Cham: Springer.

Ramírez, B. & Ortiz J. (2022). El uso del translenguaje como estrategia de enseñanza en el aprendizaje del inglés. Pontificia Universidad Javeriana. http://hdl.handle.net/10554/61631.

Rodríguez, Y. M. S., & Camacho, L. y. V. (2019). Artefactos pedagógicos: una experiencia innovadora. *Revista Centro Sur*, *3*(2), 54-66. https://doi.org/10.31876/cs.v3i2.25

Rutgers, R. & Evans, M. (2017). Bilingual education and L3 learning: Metalinguistic advantage or not? International Journal of Bilingual Education and Bilingualism, 20(7), 788–806. doi:10.1080/13670050.2015 .1103698

Sampieri, R. H. (2018). *METODOLOGÍA DE LA INVESTIGACIÓN: LAS RUTAS CUANTITATIVA, CUALITATIVA Y MIXTA*. McGraw Hill Mexico.

Sangsok S., & Minjung Kim. (2021). Translanguaging Strategies. Translanguagingeducation.org. https://www.translanguagingeducation.org/translanguaging-strategies

Spiro, J. & Crisfield, E. (2018). Mapping the terrain. Linguistic and Cultural Innovation in Schools (pp. 1-30). Palgrave Macmillan. https://doi.org/10.1007/978-3-319-64382-3_1

Streefkerk, R. (2023, June 22). Qualitative vs. Quantitative Research | Differences, Examples & Methods. Scribbr. Retrieved September 13, 2023, from https://www.scribbr.com/methodology/qualitative-quantitative-research/

Tomal, R. D. (2010). Action Research for Education. Lanham, Maryland: Rowman & Littlefield.

Usma, J., & Peláez, O. (2017). Teacher autonomy: From the conventional promotion of independent learning to the critical appropriation of language policies. In C. Nicolaides & W. Magno (Eds.), Innovations and challenges in applied linguistics and learner autonomy. Campinas, br: Pontes Editores.

Usma, J. (2009). Globalization and language and education reform in Colombia: A critical outlook. Íkala, Revista de Lenguaje y Cultura, 14(22), 19-42.

Usma, J. (2015). From transnational language policy transfer to local appropriation: The case of the National Bilingual Program in Medellin, Colombia. Deep University Press.

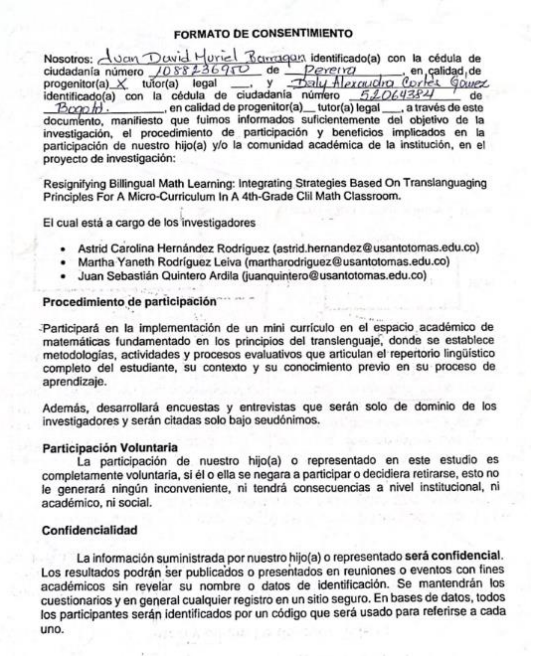
Valencia, M. (2013). Language Policy and the Manufacturing of Consent for Foreign Intervention in Colombia. PROFILE Issues in Teachers' Professional Development,15(1), 27-43. https://revistas.unal.edu.co/index.php/profile/article/view/37859

Williams, C. (2002). A Language Gained: A Study of Language Immersion at 11–16 Years of Age. Bangor, UK: School of Education. www.bangor.ac.uk/education-and-human-development/publications/Language_Gained%20.pdf

Zikos D, Thiel A. Action Research's Potential to Foster Institutional Change for Urban Water Management. Water. 2013; 5(2):356-378. https://doi.org/10.3390/w5020356

Appendixes

APPENDIX A_CI_ESTUDIANTES_GBCMC



FORMATO DE CONSENTIMIENTO

Nosotros: Juan David Muriel Barragan identificado(a) con la cédula de ciudadanía número 1088236950 de Pereira, en calidad de progenitor(a) X tutor(a) legal ___, y Daly Alexandra Cortés Gómez identificado(a) con la cédula de ciudadanía número 52064384 de Bogotá, en calidad de progenitor(a)__ tutor(a) legal ___, a través de este documento, manifiesto que fuimos informados suficientemente del objetivo de la investigación, el procedimiento de participación y beneficios implicados en la participación de nuestro hijo(a) y/o la comunidad académica de la institución, en el proyecto de investigación:

Resignifying Billingual Math Learning: Integrating Strategies Based On Translanguaging Principles For A Micro-Curriculum In A 4th-Grade Clil Math Classroom.

El cual está a cargo de los investigadores

- Astrid Carolina Hernández Rodríguez (astrid.hernandez@usantotomas.edu.co)
- Martha Yaneth Rodríguez Leiva (martharodriguez@usantotomas.edu.co)
- Juan Sebastián Quintero Ardila (juanquintero@usantotomas.edu.co)

Procedimiento de participación

Participará en la implementación de un mini currículo en el espacio académico de matemáticas fundamentado en los principios del translenguaje, donde se establece metodologías, actividades y procesos evaluativos que articulan el repertorio lingüístico completo del estudiante, su contexto y su conocimiento previo en su proceso de aprendizaje.

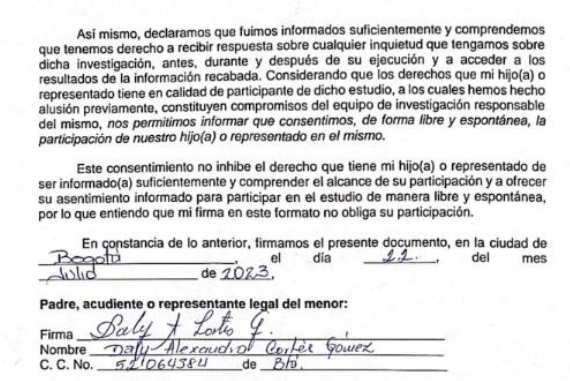
Además, desarrollará encuestas y entrevistas que serán solo de dominio de los investigadores y serán citadas solo bajo seudónimos.

Participación Voluntaria

La participación de nuestro hijo(a) o representado en este estudio es completamente voluntaria, si él o ella se negara a participar o decidiera retirarse, esto no le generará ningún inconveniente, ni tendrá consecuencias a nivel institucional, ni académico, ni social.

Confidencialidad

La información suministrada por nuestro hijo(a) o representado **será confidencial**. Los resultados podrán ser publicados o presentados en reuniones o eventos con fines académicos sin revelar su nombre o datos de identificación. Se mantendrán los cuestionarios y en general cualquier registro en un sitio seguro. En bases de datos, todos los participantes serán identificados por un código que será usado para referirse a cada uno.



Así mismo, declaramos que fuimos informados suficientemente y comprendemos que tenemos derecho a recibir respuesta sobre cualquier inquietud que tengamos sobre dicha investigación, antes, durante y después de su ejecución y a acceder a los resultados de la información recabada. Considerando que los derechos que mi hijo(a) o representado tiene en calidad de participante de dicho estudio, a los cuales hemos hecho alusión previamente, constituyen compromisos del equipo de investigación responsable del mismo, *nos permitimos informar que consentimos, de forma libre y espontánea, la participación de nuestro hijo(a) o representado en el mismo.*

Este consentimiento no inhibe el derecho que tiene mi hijo(a) o representado de ser informado(a) suficientemente y comprender el alcance de su participación y a ofrecer su asentimiento informado para participar en el estudio de manera libre y espontánea, por lo que entiendo que mi firma en este formato no obliga su participación.

En constancia de lo anterior, firmamos el presente documento, en la ciudad de Bogotá, el día 12, del mes Julio de 2023.

Padre, acudiente o representante legal del menor:

Firma Daly A Cortés G.
Nombre Daly Alexandra Cortés Gómez
C. C. No. 52064384 de Bta.

APPENDIX A_CI_INSTITUCIÓN_GBCMC

FORMATO DE CONSENTIMIENTO

Yo: Gnette Ruiz Silva, identificado(a) con la cédula de ciudadanía número 1014206946 de Bogotá, en calidad de directora académica del Gimnasio Bilingüe Campestre Marie Curie ubicada en Mosquera, Cundinamarca a través de este documento, manifiesto que fui informado suficientemente sobre el objetivo de la investigación, el procedimiento de participación y beneficios implicados en la participación para la comunidad académica en el proyecto de investigación:

Resignifying Billingual Math Learning: Integrating Strategies Based On Translanguaging Principles For A Micro-Curriculum In A 4th-Grade Clil Math Classroom.

El cual está a cargo de los investigadores

- Astrid Carolina Hernández Rodríguez (astrid.hernandez@usantotomas.edu.co)
- Martha Yaneth Rodríguez Leiva (martharodriguez@usantotomas.edu.co)
- Juan Sebastián Quintero Ardila (juanquintero@usantotomas.edu.co)

Procedimiento de participación

Previa su autorización y el consentimiento de los participantes en la investigación, los mismos participaran de acuerdo con la planificación del proyecto de la siguiente forma:

Estudiantes: serán los directamente involucrados en la aplicación de los principios de translanguaging en la práctica pedagógica y diseño de un mini currículo que se realizar en la asignatura de matemáticas en grado 4C y serán partícipes de encuestas y entrevistas. Con el propósito de analizar las implicaciones en el proceso de aprendizaje de estos estudiantes al aplicar los principios del translanguaging.

Fecha de la participación: segundo semestre del 2023.

Docentes: la docente titular de asignatura será quien aplique con el grupo de estudio la practica pedagógica y el mini currículo enmarcado en los principios del translanguaging con el propósito de: ejecutar y recoger los datos para este estudio.
Fecha de la participación; segundo semestre del 2023.

Personal administrativo: en proporcionar la documentación que regula el modelo de bilingüismo de la institución, y evaluar la pertinencia del material propuesto en concordancia con los principios institucionales y el área de matemáticas, con el propósito de: obtener la base teórica que fundamenta el estudio.
Fecha de la participación: segundo semestre del 2023.

Participación Voluntaria

La participación los individuos que hacen parte de la comunidad académica en este estudio es completamente voluntaria, si él o ella se negara a participar o decidiera retirarse, esto no le generará ningún inconveniente, ni tendrá consecuencias a nivel institucional, ni académico, ni social.

Confidencialidad

La información suministrada por la organización **será confidencial**. Los resultados podrán ser publicados o presentados en reuniones o eventos con fines académicos sin revelar su nombre o datos de identificación de los participantes.

Así mismo, declaro que fui informado suficientemente y comprendo que tengo derecho a recibir respuesta sobre cualquier inquietud institucional que se presente antes, durante y después de su ejecución y acceder a los resultados de la información recabada. En consecuencia, ***me permito informar que consiento, de forma libre y espontanea, la participación la institución que represento.***

En constancia de lo anterior, firmo el presente documento, en la ciudad de Mosquera el día 26 del mes Mayo de 2023.

GIMNASIO BILINGÜE CAMPESTRE MARIE CURIE DIRECCIÓN ACADEMICA

Firma Gnette Ruiz S.
Nombre Gnette Ruiz Silva.
C. C. No. 1014206946 de Bogotá

Directora Académica:

Datos institución

NIT

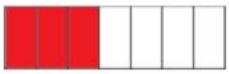
APPENDIX B_ ARTIFACT WEEK 1_DIAGNOSTIC ASSESSMENT

LET'S STARTED

1) Show how you can represent the **combination** of the next graphics.

2) Show how you can represent if you **take away** the second graphic from the first graphic.

3) If you reply three **times** the next graphic how would be the result?



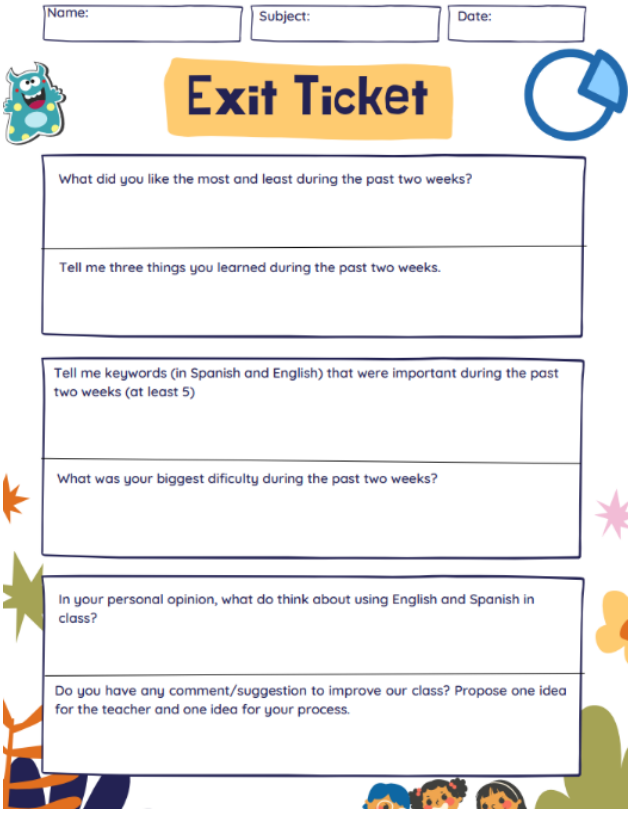
4) If you **divide** two times the next graphic how would be the result?

5) Using the next number line situate the next numbers:

0.5 1.5 2.5 3.7 4.1

APPENDIX B_ ARTIFACT WEEK 2 AND 5_PEER ASSESSMENT

APPENDIX B_ ARTIFACT WEEK 2 AND 5_SELF ASSESSMENT (EXIT TICKET)



APPENDIX B_ ARTIFACT WEEK 2_WORKSHEET NO 1

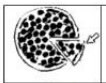
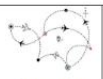
WORKSHEET #1

Topic: Addition and subtraction of fractions.
Area: Math and Physics **Subject:** Math 4th **Term:** Fourth

Name: _____ **Grade:** ____ **Date:** _____

OBJECTIVE: To identify how and when to use addition or subtraction fractions according to a real situation.

Before to start to explore our word bank.

				
	Slice	**Stop-over flight**	**Buy/bought**	**Football pitch**
What does it mean in Spanish?				

LET'S STARTED.

1. Maria bought $\frac{8}{3}$ slices of Hawaiian pizza and $\frac{16}{3}$ slices of chicken and mushroom pizza. How many slices did she buy in total?
2. Carlos went to the football pitch and ran $\frac{11}{2}$ meters. Juan went with him and ran $\frac{7}{2}$ meters. How many more meters did Carlos run than Jhon?
3. The Rodriguez family went on vacation on a stop-over flight to Santa Marta. Their first flight was $\frac{16}{3}$ long. The second flight was $\frac{11}{5}$ long. How many hours in total were they flying?
4. Yesterday in Bogota, it rained $\frac{19}{4}$ millimeters in the morning. At night, it rained $\frac{25}{7}$ milimeters. How many more milimeters did it snow in the morning?

APPENDIX B_ ARTIFACT WEEK 3_QUIZ

QUIZ

Topic: Multiplying fractions.

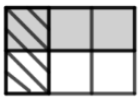
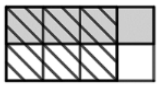
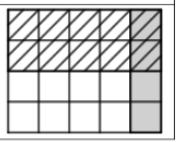
Area: Math and Physics **Subject:** Math 4th **Term:** Fourth

Name: _____ **Grade:** ____ **Date:** _____

OBJECTIVE: To identify how and when to use multiplication of fractions.

LET'S STARTED

1. Solve the next multiplications with the help of the graphics.

a. $\frac{1}{3} \times \frac{1}{2} = -$	b. $\frac{1}{2} \times \frac{3}{4} = -$	c. $\frac{1}{5} \times \frac{2}{4} = -$
		

2. Solve the next multiplications.

a. $\frac{3}{4} \times \frac{2}{3} = -$	b. $\frac{6}{8} \times \frac{1}{2} = -$	c. $\frac{1}{3} \times \frac{1}{7} = -$

3. Paula will throw a girl's night and she is planning to make sandwiches. If she has $\frac{18}{9}$ friends coming over and she made $\frac{4}{7}$ sandwiches for each one of them, how many sandwiches did she make?
Paula organizará una noche de chicas y planea hacer sándwiches. Si $\frac{18}{9}$ de sus amigas van a venir y ella ha preparado $\frac{4}{7}$ de sándwiches para cada una de ellas. ¿Cuántos sándwiches hizo Paula?

APPENDIX B_ ARTIFACT WEEK 4_WORKSHEET NO 2

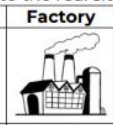
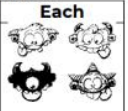
WORKSHEET No. 2

Topic: Multiplication and division of fractions.

Area: Math and Physics **Subject:** Math 4th **Term:** Fourth

Name: _____ **Grade:** ____ **Date:** _____

OBJECTIVE: To identify how and when the student has to do a multiplication or division of fractions according to the real situation.

Bought	Forgot	Coming	Amount	Factory	Each
					
comprado	**olvidado**	**viniendo**	**cantidad**	**fábrica**	**cada**

LET'S STARTED

For the next situations, justify your answer with the right processes. If is necessary make a graphical representation

1. bought a Natilla for Christmas dinner and I cut it into four equal parts for me and three of my friends. I forgot that my daddy was coming and I had to save one piece for him. Now I just have 3 pieces of Natilla. What could I do to share the three pieces of Natilla between me and my friends with the same amount of Natilla? Explain your answer.
2. A candy factory has machines that make $\frac{52}{2}$ bon bon bumes per hour. The machines operate $\frac{12}{3}$ hours each day. How many bon bon bumes can the machines make in a day? Explain your answer.
3. Shakira can sing $\frac{30}{2}$ songs in an hour. How many songs can she sing in $\frac{12}{6}$ hours?
4. Juan shares $\frac{28}{7}$ oranges equally among $\frac{8}{4}$ of his friends. How many oranges will receive each of his friends?
5. Solve the next operations doing the complete process:

$\frac{2}{3} \times 4 = -$	$\frac{1}{5} \times 3 = -$	$\frac{3}{10} \times \frac{1}{4} = -$	$\frac{1}{9} \times \frac{4}{10} = -$
$\frac{2}{3} \div 4 = -$	$\frac{1}{5} \div 3 = -$	$\frac{3}{10} \div \frac{1}{4} = -$	$\frac{1}{9} \div \frac{4}{10} = -$

APPENDIX B_ ARTIFACT WEEK 6_WORKSHEET NO 3

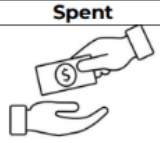
WORKSHEET No. 3

Topic: Decimal numbers and comparing between them.

Area: Math and Physics **Subject:** Math 4th **Term:** Fourth

Name: _____ **Grade:** _____ **Date:** _____

OBJECTIVE: To recognize and use a way to transform a fraction into a decimal number. To use a way to know when decimals are equal, less, or greater.

Spent	Pounds	Commissions
		
Gastado	**Libras**	**Comisión**

LET'S STARTED

1. Romeo buys two bottles of soda; one is Coca-Cola which contains 48.5 ml and the other is Manzana Postobon which contains 48.55ml Which bottle contains the most soda?

2. Miss Carolina spent $5,434 on gasoline in the morning. She spent $5.400 on gasoline in the afternoon. When did she spend more money?

3. Miguel is making a fruit basket. He wants to buy 5 pounds of fruit. He gets 1.37 pounds of grapes, 1.73 pounds of apples, 0.593 pounds of pineapple, and 1.307 pounds of oranges. Write the numbers in order from less to greater.

4. Jessica made $276.570 in commissions this week. Peter made $276.505. Who made more commissions in the week?

5. Write if the decimals are equal, greater, or less.

1. 0.2 ____ 0.8 **2.** 0.4 ____ 0.5 **3.** 0.6 ____ 6.0

4. 0.22 ____ 0.17 **5.** 0.30 ____ 0.10 **6.** 0.134 ____ 0.137

APPENDIX B_ WEEK 5_SCAPE ROOM

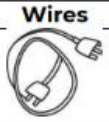
Laura has a jar of lemonade. She can fill six glasses, but in each glass, she puts $\frac{3}{4}$ of lemonade. How much lemonade does she put in the six glasses?  Jar of lemonade Glasses	Mariana has 8 pints of milk. If she drinks $\frac{1}{4}$ of a pint of milk each day, how many days will the 8 pints of milk last?  Pint of milk	Salome has 9 problems to solve for his math homework. She has solved $\frac{2}{3}$ of the problems already. How many of her problems has she solved?
Sebastián, Job, Isabella y Karen want to divide7 chocoramos in equal parts, but they don't want any leftovers. How many Chocoramo will have each one?  Leftover	From 40 marbles, $\frac{1}{5}$ are blue. How many marbles have a different color?  Marbles	For a party, it was calculated that each person will drink $\frac{1}{4}$ liter of Coca-cola. If there are 21 people. How many liters of Coca-Cola must we buy?
Solve this operation $\frac{2}{4} - \frac{1}{5}$	Solve this operation $\frac{2}{4} - \frac{1}{5}$	Solve this operation $\frac{2}{4} - \frac{1}{5}$

APPENDIX B_ ARTIFACT WEEK 7_FINAL EXAM

Math Final Exam
Fourth Term
Fourth _____

Name: _____ **Date:** _____

Bought	Spend	Pitcher of lemonade	Milliliters	Through
				
Compró	Gastó	Jarra de limonada	Mililitros	A través de

Traffic light	Wires	Achievement	Recipe	Oviparous
				
Semáforo	Cables	Logro	Receta	Oviparo

1. Paula bought 12 balls for her Christmas tree in Dollar City. If each ball costs 3.650 pesos, how much money did Paula spend?

   A. $10.950.
   B. $42.700.
   C. $43.800.
   D. $41.802.

2. Miguelangel has a pitcher of lemonade; the pitcher contains 1230 milliliters. If Miguelangel wants to serve 6 glasses of lemonade, how many milliliters will each glass contain?

APPENDIX B_INSTRUMENT 1_FIELD JOURNAL

Date:	Monday, September 18th,2023	**Class time:**	8:20 a.m. a 9:40 a.m.
Week	2	**Class:**	3
Objective:	To use different strategies to subtract heterogeneous fractions.		
Stage	**Description**		**Interpreting**
Motivation	The class began with the projection of the book proposed for this term. "The History of the telephones (fractions)". The teacher asked the students to take turns reading the first pages of the book. Then in their mother tongue, the teacher asked the students what they had understood. But all the students said that it was very confusing for them to understand what the story was about.  Despite looking up the translation of some words such as junkyard, contraption, tightens, screw, buckles, among others, the students were unable to understand what was being talked about on this page.		It was intended that the principle of cross-linguistic flexibility helped students to get more involved in the activity and grasp ideas quickly. However, the material used during this activity did not allow students to get a general idea even using their whole linguistic repertoire. It was then recommended using the principle of differentiate and adapt first since even though there is cross-linguistic flexibility neither linguistic skills nor mathematical skills were achieved during this activity.
Exploration	The teacher using the power point presentation explains to the students the subtraction of fractions, emphasizing that for the moment only subtractions can be done when the minuend is greater than the subtrahend. A step-by-step presentation was made on how to subtract two heterogeneous fractions.		Using the strategy of collaborative grouping plus the principle of build background knowledge made it easier for students to grasp the concepts. However, it was evident that when using collaborative grouping, students

APPENDIX B_TRANSLANGUAGING TEACHING-LEARNING PLAN

SUBJECT/GRADE	MATH/ GRADE 4°
UNIT TITLE AND TOPICS	Fractional numbers of operations, decimal numbers of operations.
CONTENT OBJECTIVES • To identify when and how to solve a problem using operations between fractions, as addition, subtraction, multiplication and division. • To use the algorithm to operate fractions.	LANGUAJE OBJECTIVES • To communicate effectively, exchanging information assertively.
KEY CONCEPTS: Addition, subtraction, multiplication and division of fractional numbers and decimal numbers.	
TRANLANGUAGING STRATEGIES: - STA (STATTIC TOP ALONE): INDIVIDUAL ACTIVITIES USING ONE LANGUAGE - STT (STATIC TOP TOGETHER): GROUP ACTIVITIES USING ONE LANGUAGE - SPA (SPINNING TOP ALONE): INDIVIDUAL ACTIVITIES USING MORE THAN ONE LANGUAGE - SPT (SPINNING TOP TOGETHER): GROUP ACTIVITIES USING MORE THAN ONE LANGUAGE Based on Son (2021) translanguaging Pedagogy in the Multilingual Classrooom for the MUltilingual Students from Multiple Ethnolinguistic Minority Communities from: from: ttps://www.translanguagingeducation.org/ & Offelia & Wei (2014) Translanguaging: Language, Bilingualism and Education	
WEEK 1: Objective: To use different strategies to add homogeneous fractions. Keywords: Least common multiple, same denominator.	

STAGE	TASKS	TRANSLANGUAGING STRATEGY (IES) *Target skills**	TRANSLANGUAGING PRINCIPLE	RESOURCES	TIME
1. MOTIVATION	**Class 1**: In groups, students solve a mathematical problem given by the teacher in their math calendar. They discuss each in their mother tongue and then discuss and share all their ideas in the class using English (target language). **Class 2:** In groups, students solve a mathematical problem given by the teacher in their math calendar. They discuss each in their mother tongue and then discuss and share all their ideas in the class using English (target language)	Spinning top together (Collaborative grouping) (Alternative languages and media) *(Reading and speaking*) (Problem-solving and logical-mathematical reasoning*)*	Build background knowledge Cross-linguistic flexibility	Math Calendar	10' 10'

APPENDIX C_INSTRUMENT 2_ FINAL PERCEPTION QUESTIONNARIE

APPENDIX C_INSTRUMENT 2_ INITIAL PERCEPTION QUESTIONNARIE

APPENDIX D_ANSWERS FINAL PERCEPTION QUESTIONNAIRE

ANSWERS OUTPUT QUESTIONNAIRE

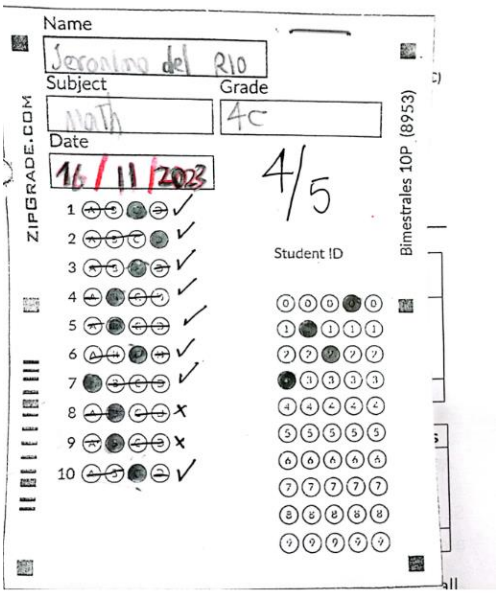
1	Maria Paula Niño Roa	Me gusto la tecnica de como dividir fracciones, multiplicarlas y el metodo de dividir decimales	La comprensión de la información pues esta en inglés.;	si porque se me facilita entender	las divisiones de fraccion y la division de decimales
2	Salome Avila Hernandez	aprender a Dividir fracciones	Realizar las actividades individualmente.;Que tengas que expresarte de forma escrita y verbal en inglés.;	si me gusto por que entendia mucho mas lo que explicaban	Los temas que vimos y las actividades
3	Laura Sofia Moreno Garnica	las multiplicaciones de la fracciones	Las temáticas (fracciones y sus operaciones, números mixtos, equivalencias, comparación de fracciones).;	si por que hay temas que mas se entiendenen español y otros en ingles	sumas y restas en fracciones
4	Luciana Bernal Aponte	Que aprendimos a dividir,multiplicar y fracciones y pues que aprendimos de una forma divertida y aprendimos cosas nuevas.	La explicación de tu profe en inglés.;Que tengas que expresarte de forma escrita y verbal en inglés.;Realizar las actividades individualmente.;La comprensión de la información pues esta en inglés.;	si porque pues es nuestro idioma natal y es facil	que aprendimo leyendo libros,jugando juegos y aprendimos cosas nuevas y divertidas
5	Dana gabriela rodriguez leon	las fracciones	La comprensión de la información pues esta en inglés.;La explicación de tu profe en inglés.;Que tengas que expresarte de forma escrita y verbal en inglés.;Realizar las actividades individualmente.;Cumplir acuerdos.;	si porque entiendo mejor	las fracciones
6	Paula Camila Blanco Rodriguez	Las fracciones	Que tengas que expresarte de forma escrita y verbal en inglés.;Cumplir acuerdos.;	si porque puedo entender mas el tema	Las fracciones y las esplisicaciones
7	juanita hernandez claros	las multiplicasiones de fracciones	Realizar las actividades individualmente.;Que tengas que expresarte de forma escrita y verbal en inglés.;	si porque puedo entender mas	todas las fracciones y hablar un poco en español

APPENDIX D_ANSWERS INITIAL PERCEPTION QUESTIONNAIRE

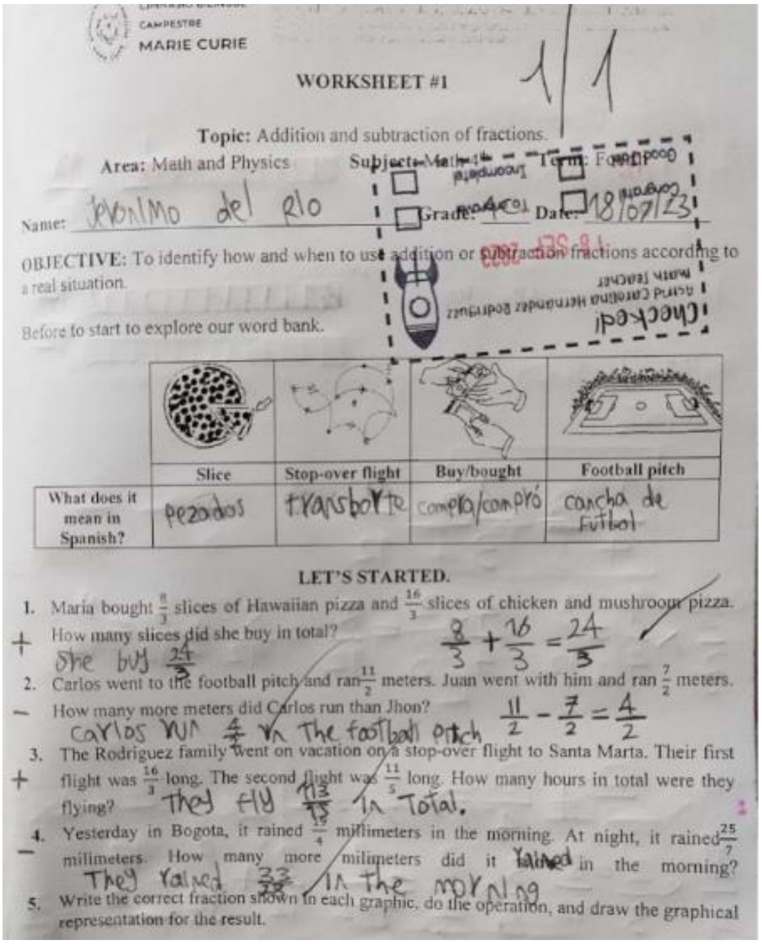
ANSWERS INPUT QUESTIONNAIRE

ID	Escribe tu nombre completo.	¿Cuántos años tienes?	¿Cuántos años llevas en el colegio?	¿Te parece interesante la clase de matemáticas? Si/No/Más o menos ¿Por qué?	¿Qué es lo más difícil para ti en la clase de matemáticas? Puedes escoger más de una opción.	¿Qué es lo que más te gusta de la clase de matemáticas? Puedes escoger más de una opción.	¿Te gustaría usar el español con mayor frecuencia en clase? Si/no/más o menos ¿Por qué?
1	Juan Camilo Ávila Puerto	9 años	4 años	Si porque podemos aprender más y la profe usa estrategias divertidas para aprender	Las temáticas (fracciones y sus operaciones, números mixtos, equivalencias, comparación de fracciones).;	La explicación de tu profe en inglés.;Las actividades que propone la profe.;Que tengas que expresarte de forma escrita y verbal en inglés.;Las operaciones.;	No porqué estamos en un colegio 🏫 bilingüe
2	Salome Avila Hernandez	9 años	4 años	mas o menos ya que algunas veces podemos sacar muchisimas teorias pero tambien puede ser un poco aburrida y aveces no entiendo	La comprensión de la información pues esta en inglés.;Que tengas que expresarte de forma escrita y verbal en inglés.;	La explicación de tu profe en inglés.;Las temáticas (fracciones y sus operaciones, números mixtos, equivalencias, comparación de fracciones).;Las operaciones.;Las actividades que propone la profe.;	mas o menos y en algunos momentos ta que aveces no podemos entender algunas palabras o explicaciones pero el ingles tambien es muy importante y en algunos momentos se nececita el español y el ingles
3	Luciana Bernal Aponte	9 años	3 años	Si porque uno aprende diferentes cosas divertidas	Que tengas que expresarte de forma escrita y verbal en inglés.;Realizar las actividades individualmente.;	Trabajar colaborativamente.;Las temáticas (fracciones y sus operaciones, números mixtos, equivalencias, comparación de fracciones).;	Si porque aveces uno no entiende algunas palabras en ingles
4	Paula Camila Blanco Rodriguez	10 años	6 años	Si es muy interesante por que en matematicas nos enseñan cosas que nos sirven para nuestra vida cotidiana y es divertido	Que tengas que expresarte de forma escrita y verbal en inglés.;La explicación de tu profe en inglés.;	Las temáticas (fracciones y sus operaciones, números mixtos, equivalencias, comparación de fracciones).;Las operaciones.;Realizar las actividades individualmente.;Trabajar colaborativamente.;Las actividades que propone la profe.;	Mas o menos por que abeses no entiendo lo que la miss nos explica en ingles
5	martin romeo castro calderon	11 años	3 años	mas o menos por que se me dificulta no como los otros niños	Las temáticas (fracciones y sus operaciones, números mixtos, equivalencias, comparación de fracciones).;Realizar las actividades individualmente.;Las actividades que propone la profe.;	El uso del inglés dentro de la clase.;La explicación de tu profe en inglés.;Que tengas que expresarte de forma escrita y verbal en inglés.;	si por que a veses no entiendo algunas palabras

APPENDIX D_ANSWERS FINAL EXAM



APPENDIX D_EVIDENCE WORKSHEET 01



CAMPESTRE MARIE CURIE

WORKSHEET #1

Topic: Addition and subtraction of fractions.

Area: Math and Physics **Subject:** Math **Term:** Fourth

Name: Jeronimo del rio **Grade:** **Date:** 18/07/23

OBJECTIVE: To identify how and when to use addition or subtraction fractions according to a real situation.

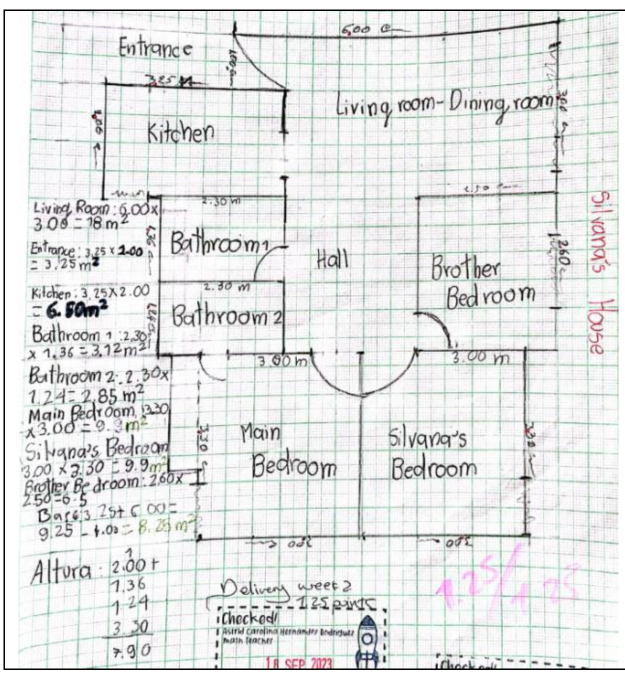
Before to start to explore our word bank.

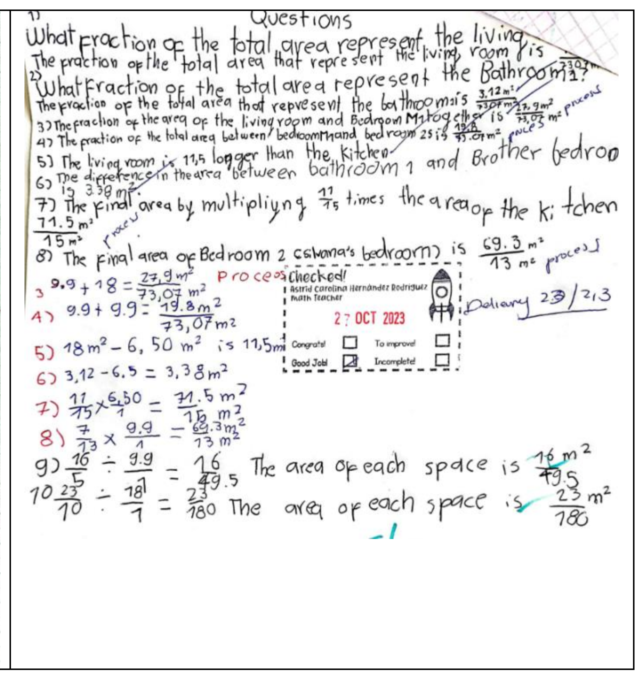
	Slice	Stop-over flight	Buy/bought	Football pitch
What does it mean in Spanish?	pezados	transborte	compra/compró	cancha de futbol

LET'S STARTED.

1. Maria bought $\frac{8}{3}$ slices of Hawaiian pizza and $\frac{16}{3}$ slices of chicken and mushroom pizza. How many slices did she buy in total? She buy $\frac{24}{3}$ — $\frac{8}{3}+\frac{16}{3}=\frac{24}{3}$
2. Carlos went to the football pitch and ran $\frac{11}{2}$ meters. Juan went with him and ran $\frac{7}{2}$ meters. How many more meters did Carlos run than Jhon? Carlos run $\frac{4}{2}$ in the football pitch — $\frac{11}{2}-\frac{7}{2}=\frac{4}{2}$
3. The Rodriguez family went on vacation on a stop-over flight to Santa Marta. Their first flight was $\frac{16}{3}$ long. The second flight was $\frac{11}{5}$ long. How many hours in total were they flying? They fly $\frac{113}{15}$ in total.
4. Yesterday in Bogota, it rained $\frac{15}{4}$ millimeters in the morning. At night, it rained $\frac{25}{7}$ milimeters. How many more milimeters did it rained in the morning? They rained $\frac{33}{}$ in the morning
5. Write the correct fraction shown in each graphic, do the operation, and draw the graphical representation for the result.

APPENDIX D_EVIDENCES MINI PROJECT





APPENDIX D_EVIDENCES WORKSHEET 02

Topic: Multiplication and division of fractions.
Area: Math and Physics Subject: Math 4th Term: Fourth
Name: [illegible] Grade: 4C Date: 28/09/2023

OBJECTIVE: To identify how and when the student has to do a multiplication or division of fractions according to the real situation.

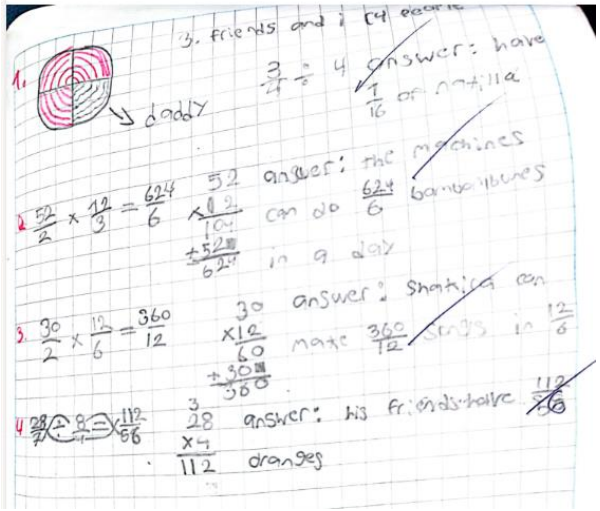
Bought	Forgot	Coming	Amount	Factory	Each
comprado	olvidado	viniendo	cantidad	fábrica	cada

LET'S STARTED

For the next situations, justify your answer with the right processes. If is necessary make a graphical representation

1. I bought a Natilla for Christmas dinner and I cut it into four equal parts for me and three of my friends. I forgot that my daddy was coming and I had to save one piece for him. Now I just have 3 pieces of Natilla. What could I do to share the three pieces of Natilla between me and my friends with the same amount of Natilla? Explain your answer.
2. A candy factory has machines that make $\frac{52}{2}$ bon bon bumes per hour. The machines operate $\frac{12}{3}$ hours each day. How many bon bon bumes can the machines make in a day? Explain your answer.
3. Shakira can sing $\frac{30}{2}$ songs in an hour. How many songs can she sing in $\frac{14}{6}$ hours?
4. Juan shares $\frac{28}{7}$ oranges equally among $\frac{8}{4}$ of his friends. How many oranges will receive each of his friends?
5. Solve the next operations doing the complete process:

$\frac{2}{3} \times 4 = \frac{8}{3}$	$\frac{1}{5} \times 3 = \frac{3}{5}$	$\frac{3}{10} \times \frac{1}{4} = \frac{3}{40}$	$\frac{1}{9} \times \frac{4}{10} = \frac{4}{90}$
$\frac{2}{3} \div 4 = \frac{2}{12}$	$\frac{1}{5} \div 3 = \frac{1}{15}$	$\frac{3}{10} \div \frac{1}{4} = \frac{12}{10}$	$\frac{1}{9} \div \frac{4}{10} = \frac{10}{36}$



APPENDIX D_EVIDENCES WORKSHEET 03

GIMNASIO BILINGÜE CAMPESTRE MARIE CURIE

WORKSHEET No. 3
Topic: Decimal numbers and comparing between them.
Area: Math and Physics Subject: Math 4th Term: Fourth

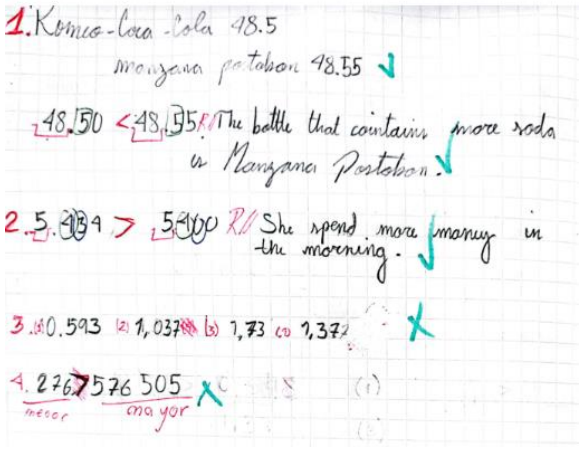
Name: Salome Avila Grade: 4C Date: Tue/7/17
OBJECTIVE: To recognize and use a way to transform a fraction into a decimal number. To use a way to know when decimals are equal, less, or greater.

Spent	Pounds	Commissions
Gastado	Libras	Comisión

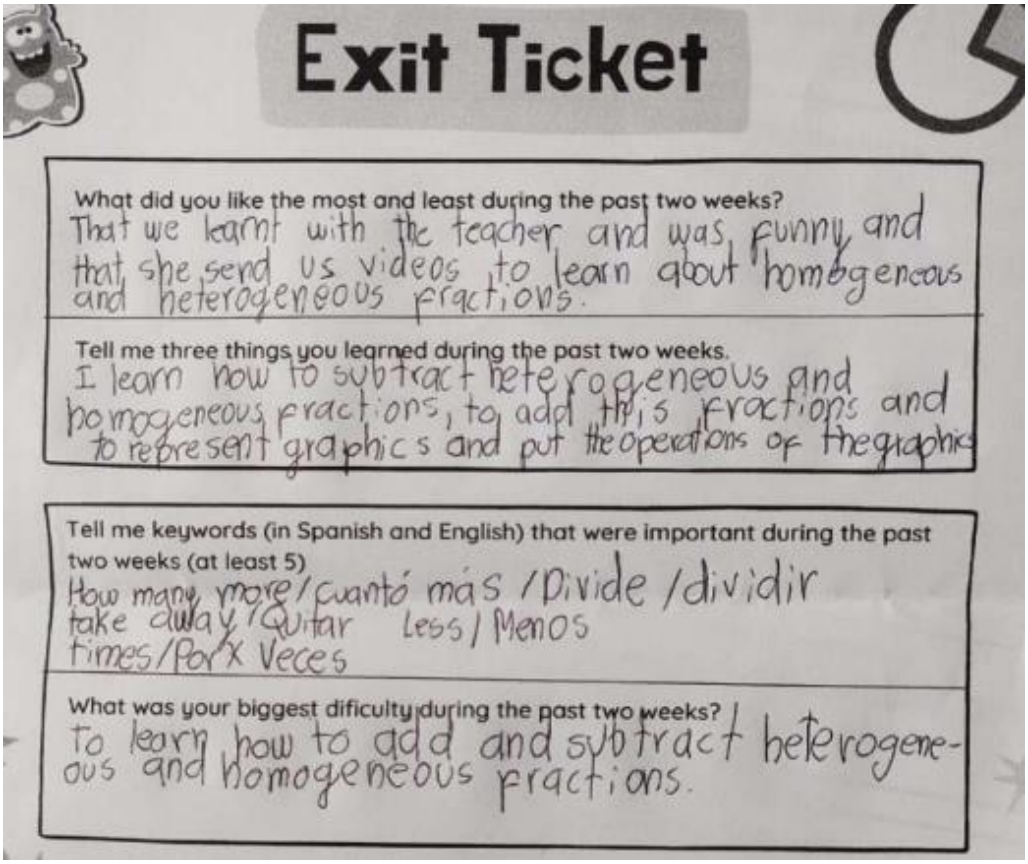
LET'S STARTED

1. Romeo buys two bottles of soda; one is Coca-Cola which contains 48.5 *ml* and the other is Manzana Postobon which contains 48.55*ml* Which bottle contains the most soda?
2. Miss Carolina spent $5.434 on gasoline in the morning. She spent $5.400 on gasoline in the afternoon. When did she spend more money?
3. Miguel is making a fruit basket. He wants to buy 5 pounds of fruit. He gets 1.37 pounds of grapes. 1.73 pounds of apples, 0.593 pounds of pineapple, and 1.307 pounds of oranges. Write the numbers in order from less to greater.
4. Jessica made $276.570 in commissions this week. Peter made $276.505. Who made more commissions in the week?
5. Write if the decimals are equal, greater, or less.

1. 0.2 ≥ 0.8 2. 0.4 ≤ 0.5 3. 0.6 ≤ 6.0
4. 0.22 ≥ 0.17 5. 0.30 ≥ 0.10 6. 0.134 ≤ 0.137



APPENDIX D_EXIT TICKET WEEK 2



Exit Ticket

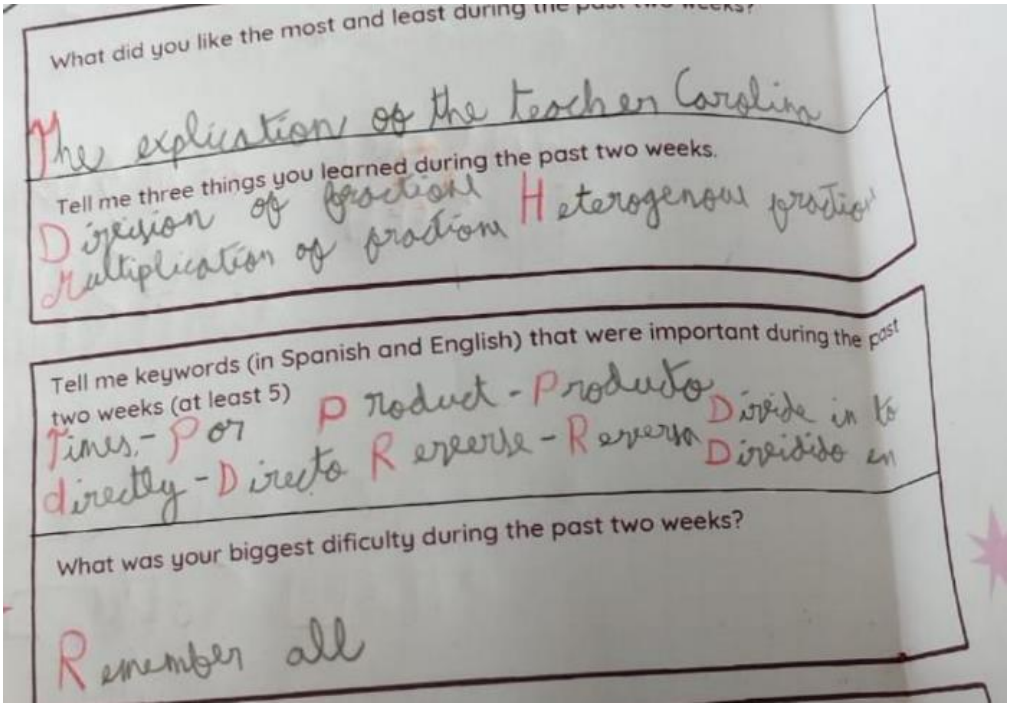
What did you like the most and least during the past two weeks?
That we learnt with the teacher and was funny and that she send us videos to learn about homogeneous and heterogeneous fractions.

Tell me three things you learned during the past two weeks.
I learn how to subtract heterogeneous and homogeneous fractions, to add this fractions and to represent graphics and put the operations of the graphics

Tell me keywords (in Spanish and English) that were important during the past two weeks (at least 5)
How many more/cuanto más /Divide /dividir
take away/Quitar Less/Menos
times/Por x Veces

What was your biggest dificulty during the past two weeks?
To learn how to add and subtract heterogeneous and homogeneous fractions.

APPENDIX D_EXIT TICKET_WEEK 5



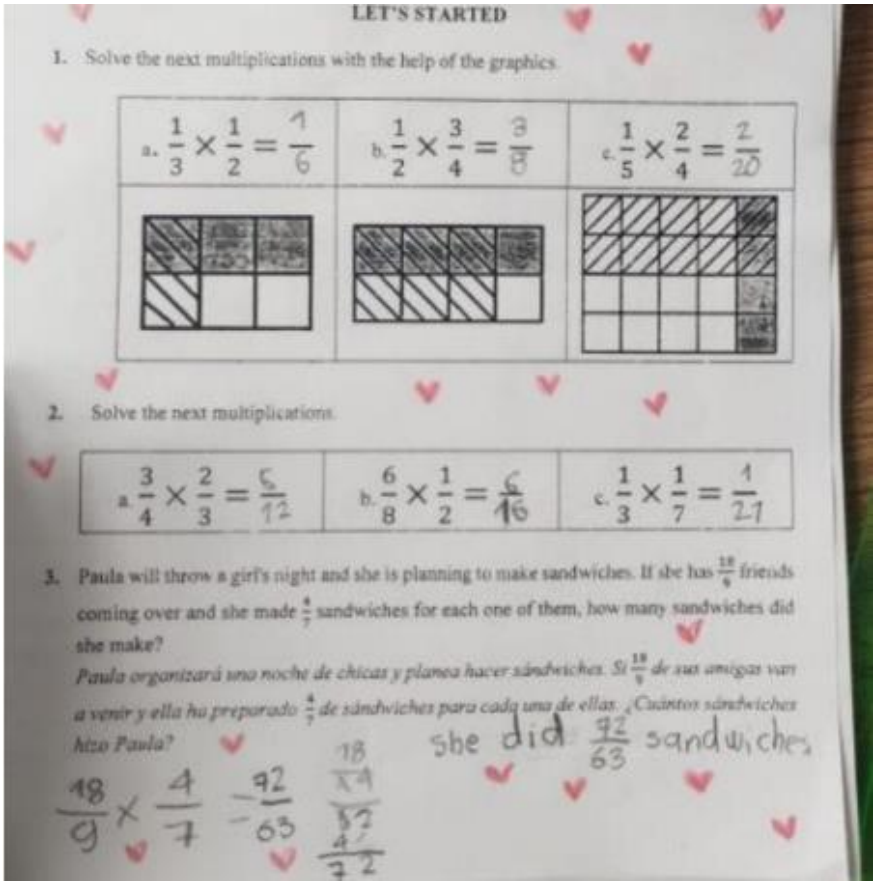
What did you like the most and least during the past two weeks?
The explication of the teacher Carolina

Tell me three things you learned during the past two weeks.
Division of fraction Heterogenous fraction
Multiplication of fraction

Tell me keywords (in Spanish and English) that were important during the past two weeks (at least 5)
Times - Por Product - Producto Divide in to
directly - Directo Reverse - Reversa Dividido en

What was your biggest dificulty during the past two weeks?
Remember all

APPENDIX D_QUIZ EVIDENCES



LET'S STARTED

1. Solve the next multiplications with the help of the graphics.

a. $\frac{1}{3} \times \frac{1}{2} = \frac{1}{6}$ b. $\frac{1}{2} \times \frac{3}{4} = \frac{3}{8}$ c. $\frac{1}{5} \times \frac{2}{4} = \frac{2}{20}$

2. Solve the next multiplications.

a. $\frac{3}{4} \times \frac{2}{3} = \frac{6}{12}$ b. $\frac{6}{8} \times \frac{1}{2} = \frac{6}{16}$ c. $\frac{1}{3} \times \frac{1}{7} = \frac{1}{21}$

3. Paula will throw a girl's night and she is planning to make sandwiches. If she has $\frac{18}{9}$ friends coming over and she made $\frac{4}{7}$ sandwiches for each one of them, how many sandwiches did she make?

Paula organizará una noche de chicas y planea hacer sándwiches. Si $\frac{18}{9}$ de sus amigas van a venir y ella ha preparado $\frac{4}{7}$ de sándwiches para cada una de ellas. ¿Cuántos sándwiches hizo Paula?

She did $\frac{72}{63}$ sandwiches

$\frac{18}{9} \times \frac{4}{7} = \frac{72}{63}$

18 x4 72 4 32

APPENDIX D_STUDENTS GRADEBOOK

GIMNASIO BILINGÜE CAMPESTRE MARIE CURIE
AÑO ESCOLAR 2022
CURSO: 4C

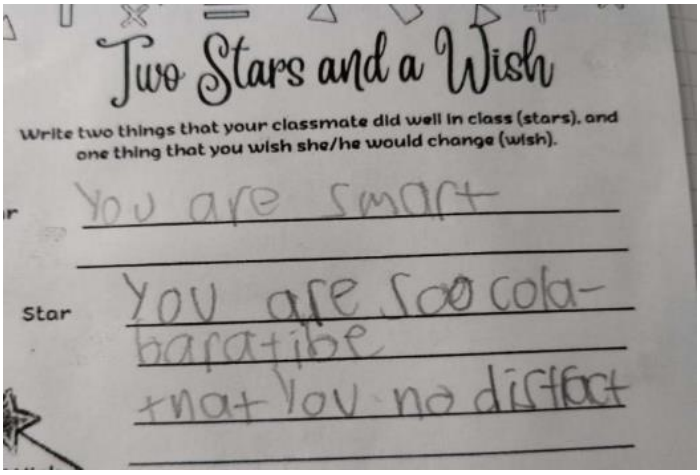
Nº	CÓDIGO	APELLIDOS Y NOMBRES	Worksheet 1 (1 POINT)	Worksheet 2 (1 POINT)	Worksheet 3 (1 POINT)	Total worksheets (3 points)	Tablet activity (3 points) WEEK 2	Quiz (4 points)	Bimonthly project (5 points)	Self	Peer	Final Exam	Final Grade
1	3045	Avila Hernández Salome	0,4	0,8	0,8	2	2,6	2,2	4,8	2	3	1	17,6
2	2713	Avila Puerto Juan Camilo	1	0,8	0,9	2,7	3	4	5	2	3	1,5	21,2
3	3048	Bernal Aponte Luciana	1	0,3	0,8	2,1	2,7	4	5	2	3	2	20,8
4	2208	Blanco Rodriguez Paula Camila	1	0,8	1	2,8	3	4	5	2	3	3,5	23,3
5	1988	Castellanos Calderon Tomas	0,5	1	1	2,5	2,9	4	4,5	2	3	3	21,9
6	2967	Castro Calderón Mártin Romeo	0,8	0,8	1	2,6	3	4	4,25	2	3	1,5	20,4
7	3120	Del Río Cárdenas Jerónimo	1	0,8	1	2,8	3	4	5	2	3	4	23,8
8	2224	Diaz Moreno Eluney Sofia	0,5	1	0,9	2,4	3	4	4,25	2	3	3	21,7
9	4020	Dueñas Rojas Silvana Salome	1	1	1	3	3	4	5	2	3	4	24
10	3056	Estevez Rivero Miguelangel	1	0,9	1	2,9	3	4	5	2	3	3,5	23,4
11	2983	Hernandez Claros Juanita	1	0,8	1	2,8	2,7	4	5	2	3	1,5	21
12	2234	Horta Amaya Ana Maria	1	1	1	3	2,8	3,5	5	2	3	1	20,3
13	2243	Moreno Garnica Laura Sofia	0,8	0,8	1	2,6	3	4	5	2	3	2	21,6
14	2994	Muriel Cortes Job Sebastian	0,8	0,5	0,9	2,2	3	3,1	5	2	3	2	20,3
15	3131	Neira Calderon Mariana	0,8	0,6	1	2,4	3	4	4,7	2	3	3	22,1
16	1982	Niño Roa Maria Paula	0,9	0	1	1,9	3	4	5	2	3	2,5	21,4
17	2995	Noguera Palacio Sebastian	1	0,7	1	2,7	3	4	5	2	3	4	23,7
18	2666	Pulido Sandoval Oscar Armando	1	1	1	3	3	4	5	2	3	5	25
19	2258	Roa Real Samuel Felipe	1	0,7	1	2,7	3	4	5	2	3	1,5	21,2
20	3066	Rodríguez Gómez Karen Natalia	0,8	1	1	2,8	2,9	3,1	4,9	2	3	2,5	21,2
21	2260	Rodriguez Leon Dana Gabriela	1	0,8	1	2,8	2,8	3,1	4,5	2	3	2	20,2
22	2264	Santos Rodriguez Sergio Andres	0,8	1	1	2,8	3	4	5	2	3	2,5	22,3
													0

APPENDIX D_TRANSLATION FROM SPANISH TO ENGLISH OF THE INITIAL AND FINAL PERCEPTION QUESTIONNAIRES

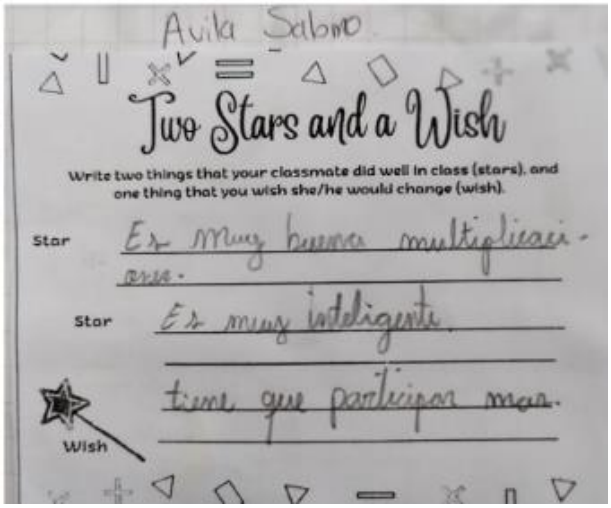
TRANSLATION FROM SPANISH TO ENGLISH OF THE INPUT QUESTIONNAIRE

ID	Enter your full name.	How old are you?	How many years have you been in school?	Do you find math class interesting? Yes/No/More or less Why?	What's the hardest thing for you in math class? You can choose more than one option.	What do you like most about math class? You can choose more than one option.	Would you like to use Spanish more often in class? Yes/no/more or less Why?
1	Juan Camilo Ávila Puerto	9 years	4 years	Yes because we can learn more and the teacher uses fun strategies to learn	Topics (fractions and their operations, mixed numbers, equivalences, comparison of fractions);	Your teacher's explanation in English; The activities proposed by the teacher; That you have to express yourself in written and verbal form in English; Operations.;	Not because we are in a bilingual school
2	Salome Avila Hernandez	9 years	4 years	More or less because sometimes we can come up with a lot of theories but it can also be a bit boring and sometimes I don't understand	Comprehension of the information as it is in English; That you have to express yourself in written and verbal form in English;	Your teacher's explanation in English; Topics (fractions and their operations, mixed numbers, equivalences, comparison of fractions); Operations.; The activities proposed by the teacher;	More or less and sometimes we can't understand some words or explanations but English is also very important and sometimes Spanish and English are needed
3	Luciana Bernal Aponte	9 years	3 years	Yes, because you learn different fun things	That you have to express yourself in written and verbal form in English; Carry out the activities individually;	Work collaboratively; Topics (fractions and their operations, mixed numbers, equivalences, comparison of fractions);	Yes because sometimes you don't understand some words in English

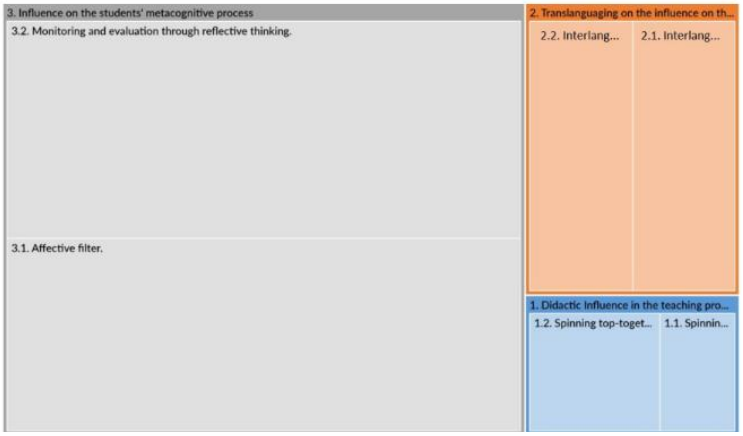
APPENDIX D_TWO STARS AND A WISH_WEEK 2



APPENDIX D_TWO STARS AND A WISH_WEEK 5



APPENDIX E_HIERARCHICAL MAP CYCLE 1



APPENDIX E_HIERARCHICAL MAP CYCLE 2

APPENDIX E_HIERARCHICAL MAP CYCLE 3

APPENDIX E_MATRIX CODING CYCLE 1

Nombre	Archivos	Referencias
1. Didactic Influence in the teaching process of mathematics and language	1	22
1.1. Spinning top alone strategies for cross-linguistic flexibility, laying background knowledge, cultural and metalinguistic awareness.	1	8
1.2. Spinning top-together strategies for cross-linguistic flexibility, laying background knowledge, cultural and metalinguistic awareness.	1	14
2. Translanguaging influence on language learning and mathematics competency.	1	46
2.1. Interlanguage for metalinguistic awareness in math performance.	1	23
2.2. Interlanguage for writing and speaking skills	1	23
3. Influence on the students' metacognitive process	3	166
3.1. Affective filter.	3	78
3.2. Monitoring and evaluation through reflective thinking.	3	88

APPENDIX E_MATRIX CODING CYCLE 2

Nombre	Archivos	Referencias
1. Didactic Influence in the teaching process of mathematics and language	1	27
1.1. Spinning top alone strategies for cross-linguistic flexibility, laying background knowledge, cultural and metalinguistic awareness.	1	4
1.2. Spinning top-together strategies for cross-linguistic flexibility, laying background knowledge, cultural and metalinguistic awareness.	1	23
2. Translanguaging influence on language learning and mathematics competency.	1	39
2.1. Interlanguage for metalinguistic awareness in math performance.	1	20
2.2. Interlanguage for writing and speaking skills	1	29
3. Influence on the students' metacognitive process	3	97
3.1. Affective filter.	3	41
3.2. Monitoring and evaluation through reflective thinking.	3	56

APPENDIX E_MATRIX CODING CYCLE 3

Nombre	Archivos	Referencias
1. Didactic Influence in the teaching process of mathematics and language	1	4
1.1. Spinning top alone strategies for cross-linguistic flexibility, laying background knowledge, cultural and metalinguistic awareness.	1	2
1.2. Spinning top-together strategies for cross-linguistic flexibility, laying background knowledge, cultural and metalinguistic awareness.	1	2
2. Translanguaging influence on language learning and mathematics competency.	1	6
2.1. Interlanguage for metalinguistic awareness in math performance.	1	3
2.2. Interlanguage for writing and speaking skills	1	3
3. Influence on the students' metacognitive process	3	93
3.1. Affective filter.	3	47
3.2. Monitoring and evaluation through reflective thinking.	3	46

APPENDIX F_RESEARCH PLAN

TIME / MONTH / ACTIVITY	2023 - I					2023-II						2024-I				
	FEB	MAR	APR	MAY	JUN	JUL	AGO	SEP	OCT	NOV	DIC	FEB	MAR	APR	MAY	JUN
Characterize population, problematic, and pertinence of research.																
1. collect data – international exam (flyers)																
2. collect data (results from the 3 first terms in math)																
3. collect data (students thought about math class)																
Theoretical background - review theoretical literature.																
- Monoglossic perspectives (materials, strategies, and assessment) - CLIL - Translanguaging (principles)																
- Participatory action research. - Mixed method approach (sequential, concurrent, & transformative)																
Design pedagogical and didactic strategies based on translanguaging principles - micro curriculum adaptation (worksheets, supporting materials, activities, summative and formative assessment tools)																
Implement translanguaging principles in the micro-curriculum of a math content area - Apply worksheets, supporting materials, activities, summative and formative assessment based on a adapted micro curriculum																
To analyze students' interactions and perceptions focusing on their experiences within the classroom - - apply formative assessment (week 2 and week 5) - observe class interaction among students during the activities proposed.																
To determine the influence of pedagogical and didactic strategies based on translanguaging principles in the learning process of a specific bilingual content area classroom - apply a questionnaire and reflect upon students' perceptions.																
- analyze the data obtained by the comparing the results of the 4th terms with the first, second, and third term. - Identify findings, construct conclusions, and elaborate suggestions. (Investigation closure).																

List of Tables and Figures

Tables

Figures