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Translanguaging In Science Emergent Bilingual Classrooms

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TRANSLANGUAGING IN SCIENCE EMERGENT BILINGUAL CLASSROOMS

by

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Introduction

This chapter will develop the following concepts: firstly expressing the issue within science education regarding emergent bilingual students, secondly introducing translanguaging, thirdly personal interest in the topic, and finally the desired outcome of the literature review.

Science education is a key component of a well-rounded education that equips students with the skills and knowledge necessary to navigate the complexities of the modern world. However, science education has traditionally been taught in a monolingual manner, which often leaves bilingual students at a disadvantage (Freire & Feinauer, 2022; Suarez, 2020). In recent years, there has been growing interest in the potential benefits of translanguaging in the science classroom, as a way to support scientific inquiry and promote linguistic and cultural diversity, yet it is currently limitedly explored (Moreno Sandoval, 2018; Nasir et. al, 2014). This thesis paper explores the role of translanguaging in the emergent bilingual science classrooms, examining the theoretical underpinnings, development, and practical implications of this pedagogical approach.

The concept of translanguaging has gained significant attention in the educational field of applied linguistics in the last few decades through two books: Baker's *Foundations of Bilingual Education and Bilingualism* (g2001, 2006, 2011) and Ofelia Garcia's (2009a) *Bilingual Education in the 21st Century*. Through Cummins (2008) definition of bilingual education as well to Garcia, Skutnabb-Kangas, and Torres-Guzman (2006) bilingual schools, the terminology and pedagogies have been evolving with a focus on incorporating diversity of languages brought into schools by the students. Translanguaging challenges the traditional notion of languages as separate and distinct entities and instead emphasizes the interconnected and mutually reinforcing nature of languages (Creese, 2010; Esquinca et. al, 2010; Hornberger & Link, 2014). The term refers to the fluid and dynamic language practices of bilingual individuals who draw on their

entire linguistic repertoires, rather than adhering to traditional, monolingual language boundaries (Flores, 2020; Garcia & Wei, 2014). Friere and Feinouer (2022) provide an example of how monolingual ideologies occur in bilingual classrooms through the interactions between the teacher and students in their case study. This literature review explores the concept of translanguaging and its potential to promote linguistic diversity (Creese & Blackledge, 2010; Cummins, 2008; Garcia, 2009b; Mazak & Herbas-Donoso, 2015; Stevenson, 2015), social inclusion (Bosma et. al, 2021; Kirmaci et. al, 2018; Nasir et. al, 2014; Wei & Lin, 2019; Wei & Garcia, 2022), and communicative competence in science focus classrooms (Karlsson, 2019; Poza, 2018; Suarez, 2020; Suarez, 2022; Wong et. al, 2022). Specifically, it examines the role of translanguaging in the science classroom, where it has the potential to enhance scientific inquiry and support the linguistic and cultural diversity of emergent bilingual students (Licona & Kelly, 2019; Lemmi & Perez, 2023; Mazak & Herbas-Donoso, 2015). Throughout this literature review I will be using the term bilingual instead of multilingual due to a personal preference of commonly hearing the term bilingual compared to multilingual.

The field of translanguaging has gained considerable attention in recent years as an approach to promoting bilingualism and social inclusion (Lippi-Green, 1997) in educational settings. The analysis of research articles reveals that translanguaging can enhance scientific learning by providing students with a more comprehensive and meaningful understanding of scientific concepts (Carr, Sexton, & Lagunoff, 2007). Through the use of translanguaging, students were able to connect their everyday language practices with scientific concepts and ideas as described by Karlsson et. al (2019).

Personal Views on Science Bilingual Education

As an individual with a background in STEM education, I have an established interest in this topic. I obtained a bachelor's degree in Biochemistry, and during my undergraduate studies, I encountered significant difficulties in communicating with my parents due to the language barrier that existed between us. While my education was conducted in English, my parents' native language was Spanish. Consequently, I often had to resort to searching for translations of scientific terms to effectively convey the material to my family. This issue of communication began within the initial stages of my education, although at the time I did not notice the impact it would have as I further progressed in the scientific field. Often the translations had similar writing/pronunciation, yet the instances were that was not the case, the conversation came to a standstill for various minutes until the correct translation was uncovered. Due to this reoccurring issue, I would find the need to re-learn all the material in order to include my parents in my progress of education. Through the formal integration of translanguaging in the science classroom, I believe that students will obtain a safe and inclusive learning environment. Instead of focusing on the monolingual ideology and incorporating the cultural linguistical aspect of bilingual students, I believe students will be more receptive to the material due to the matter of being acknowledged. This past year and a half I worked as an afterschool tutor who interacted with various students. The students who often asked questions were emergent bilingual students who were recently introduced to the English language but were expected to complete schoolwork in all English. The barrier for these students was not the material, it was the language, which created this misconception of emergent bilingual students needing help with the material. The students do not need help with the material, rather with the integration of a language they are just acquiring. I believe translanguaging is a step in the right direction into aiding students with the

challenge of being emergent bilinguals with linguistical skills that are yet to be explored and officially acknowledged.

Overall, this literature review seeks to provide a comprehensive overview of the research on translanguaging in the science classroom at middle school and high school levels and to highlight its potential as a pedagogical approach to promote scientific inquiry and support the linguistic and cultural diversity of emergent bilingual students. By synthesizing existing research and identifying openings in the literature, this review aims to contribute to ongoing discussions about the role of language in science education and the importance of promoting equitable access to scientific knowledge for all bilingual learners. Various case studies around translanguaging in STEM education have been conducted, yet there is no literature review to use as a guide to an introduction to the topic as of July 2023. This literature review is to be used as an introduction to the topic of translanguaging incorporation into STEM middle school and high school classrooms.

Review of Literature

The literature review follows a narrative review with a focus on conceptual organization. This chapter will develop the sub-sections of the current bilingual education, the origins of translanguaging, the incorporation of translanguaging into liberal art classrooms, and finally the impact and pedagogy of translanguaging in science classrooms.

Bilingual Education

When referring to bilingual education, it is stated as the use of more than one language in the classroom setting, currently referred to as bilingual education (Garcia & Wei, 2014). Traditionally, bilingualism and bilingualism are seen as additive learning practices, meaning to add vocabulary from various languages to a person's linguistic repertoire (Wei & Garcia, 2022). Martinez (2014), further highlights Stevenson (2014) notion that one's home language is central to feeling human and to the person's identity. Colombo et al (2018), argue that the term English Language Learners (ELLs) hinders students and changes their interactions subconsciously. Garcia (2009b) introduced the terminology of emergent bilinguals instead of English language learners in order to incorporate and acknowledge the linguistical repertoire of bilingual students. They propose changing the term to dual language learners, which in their view will open more opportunities to the students. Garcia (2009b) states, "In other words, to be reclassified, students must not only be able to comprehend and communicate effectively but also do cognitively demanding work in the content areas at the appropriate grade level in English" (p12). Besides the hurdle of being an "English language learner," students are separated based on their proficiency in English. The students need to pass a test at the end of the school year to measure their improvement in the new language until they are ready to be "introduced" to the other proficient

students. Cummin (2008), states language proficiency is through the acquisition rate of basic interpersonal communication and cognitive academic language.

Translanguaging

According to Lewis et.al (2012), translanguaging was introduced by Cen Williams in 1994 but has gained attention in the educational field of applied linguistics in the last decades through two books: Baker's *Foundations of Bilingual Education and Bilingualism* (2001, 2006, 2011) and Ofelia Garcia's (2009a) *Bilingual Education in the 21st Century*. Perceived as an act of bilingual performance and a bilingual pedagogy for teaching and learning, translanguaging creates a third space in which everything that is in the essence of emergent bilinguals is incorporated into the lesson and sometimes transforms monolingual communication into a mix of languages to include all the linguistic repertoire of the students (Creese, 2010; Martinez, 2010). In these third spaces, teachers and students interact, co-construct meaning, and understand one another (Martinez, 2014; Radke et al, 2022; Stevenson, 2014). Translanguaging is not a matter of a language-focused classroom, but something that should be shared between classrooms (Wei & Garcia, 2022). However, the inclusion of translanguaging is dependent on the teacher's ideological stance toward the use of multiple languages (Kirmaci et. al, 2018). But what makes translanguaging different from these other fluid languaging practices is that it is transformative and attempts to wipe out the hierarchy of languaging practices that deem some more valuable than others (Garcia, 2008).

Translanguaging is defined by Otheguy et al (2015) as deployment of a speaker's full linguistic repertoire without regard to adherence to the sociopolitical boundaries of national languages. Translanguaging can be confused with "code-switching" (Hornberger & Link, 2012). Code-switching is when a clear distinction is made between two languages while

translanguaging is mixing the languages within one sentence. For example, code-switching can be represented by someone communicating in English followed by a sentence in Spanish, having a clear moment in which the language is switched. On the other hand, translanguaging refers to when a person speaks a sentence in English with a word in Spanish, not having a moment in which the switch in languages is noticeable. For example, "well due to condensation *llueve"* (Friere & Feinauer, 2022) the student uses translanguaging in their sentence to explain why it rains in the science classroom.

Translanguaging in the Classroom

Students bring their identities and experiences into the classroom from which they continuously relate to previous material. When students introduce their ventricular language, such as Spanglish, into the classroom to aid their understanding and expression of the subject content, they create a third communication space (Lippi-Green, 1997). Translanguaging is a new pedagogy introduced to the classroom setting within the last ten years. Friere and Feinauer (2022) poses an example of how a conversation with vernacular language takes place in the classroom. Throughout my experience in becoming an emergent bilingual, I often came across professors like Ms. Smith who states, "*en la hora de español no hablamos inglés y en la hora de inglés no hablamos español*" (p.1). Meaning when speaking, a person is allowed to only speak one language. Through this "white listening subject" (Flores & Rosa, 2019) ideology, the academic setting creates a barrier which prevents emergent bilingual students in using their linguistic repertoire.

Students often have problems obtaining access to scientific content due to the sophisticated nature of scientific language (Poza, 2018). The focus then is to shift from the content to the importance of language, simplifying the knowledge and decreasing the

expectations. The scientific lexicon transforms the student's life experiences into abstract entities, creating a blur between the languages (Carr et. al, 2007). Based on a study conducted at a primary school in Sweden, the students focused on the pronunciation of words and then on the definition instead of on the material (Karlsson et. al, 2018). Karlsson et, al (2018) provide a clear case study in which learning the language comes a priority with emergent bilinguals rather than the material due to the focus the academic work creates in specifying the answers to be in English. Once the expectation of answering all questions in fluent English was removed, the students expressed themselves using the mix of languages to provide a clear understanding of the material. In another study, emergent bilinguals expressed their preference for using the English language compared to Spanish when conversing about engineering although they have the desire to re-learn the content in Spanish when they travel back to Mexico (Perez & Johnson, 2020). The students in this case study focus on learning and practicing the material in English followed by the re-learning of material to include their local community in the acquisition of this new knowledge. Through lesson preparation, students visualize lesson objectives to improve their lexicon of science. In both case studies the focus from the students was the language acquisition rather than understanding the material.

Expanding on Carr et. al (2007), integrating the scientific lexicon into modern language is taken step by setting objects for individual lessons. Lesson preparation helps break down the lexicon for students who do not handle the sense of being overwhelmed with keywords of lessons (Lu & So, 2023). In order for science education to be just for emergent bilinguals, the educational system "must identify, value, and leverage students' complex communicative practices when investigating natural phenomena" (Suarez, 2022, p.4). Introduction of

translanguaging pedagogy starts with teachers relying on flexible bilingual practices by creating lessons that incorporate the students' community (Poza, 2018; Lemmi & Perez, 2023)

Methods

In this chapter, I will be explaining the process of acquiring information for the literature review and the steps to the organization. The use of translanguaging in science education is a topic of growing interest in bilingual communities. A thorough literature review was conducted to comprehensively understand the current research on this topic. Clear inclusion and exclusion criteria were established to ensure that the literature review included only relevant studies. The objective of the review was to determine the effect of translanguaging in the science classroom to promote scientific inquiry and support the linguistic and cultural diversity of emergent bilinguals. Following the identification of relevant articles, they were organized and summarized in a way that would allow for easy analysis and synthesis. By carefully organizing and summarizing the articles, the key themes, findings, and arguments of each study were identified, leading to a deeper understanding of the role of translanguaging in science education.

Literature Search

To identify relevant studies for this literature review, a comprehensive search was conducted over several databases, including Google Scholar, JSTOR, and the academic database at the University of Texas at El Paso (UTEP). The search was focused on studies published between 2012 and now to capture the current research on the topic of translanguaging in science teaching and learning and to understand the evolution of this pedagogy. To ensure the most relevant studies were reviewed, a variety of search terms and keywords were used, including "translanguaging science teaching", "translanguaging science learning", "translanguaging in science classrooms 6-12", and "translanguaging in science middle school classrooms." By casting a wide net and using a range of search terms, a broad range of studies that address the role of translanguaging in science education, from early childhood to secondary school levels,

were found. Only articles on secondary education, middle school, and high school were accepted. Furthermore, through the reading of accepted articles, more articles were added as reference due to the detailed relevant information.

To ensure that the literature review included studies relevant to the research objective, its potential as a pedagogical approach to promote scientific inquiry and support the linguistic and cultural diversity of bilingual students was established as clear inclusion and exclusion criteria. The research objective is to highlight its potential as a pedagogical approach to promote scientific inquiry and support the linguistic and cultural diversity of bilingual students. Specifically, studies were included in the review if they explained the purpose and incorporation of translanguaging in science classrooms for all grade levels in bilingual communities. The search included studies published in both English and Spanish due to my fluency in both languages. However, studies that were excluded were those that did not investigate the potential of translanguaging to promote scientific inquiry while supporting linguistic and cultural diversity of emergent bilinguals, as these studies were not directly relevant to our research questions. There were some exceptions to this exclusion criteria, such as groundbreaking articles that paved the way for the research of translanguaging. To ensure the relevance of the studies, the articles were screened based on the abstract and keywords provided. If the abstract provided a main focus on another course subject, the articles were not used as they did not directly address the topic of translanguaging in science teaching and learning. By establishing clear inclusion and exclusion criteria, a focus on translanguaging pedagogy as an approach to promote scientific inquiry and supporting linguistic and cultural diversity of emergent bilinguals, the literature review will only provide relevant information.

Table 1

Criteria for article inclusion for the literature review

Exclusion Criteria	**Inclusion Criteria**
The article focuses on primary education only	The article is written in Spanish or English
The article is focused on translanguaging in liberal art courses	Peer-reviewed
Article is published in a language other than Spanish or English	Must include translanguaging in science education

Organization of Articles

Once the relevant articles were identified for the literature review, the articles are organized into separate Word documents depending on the content of the articles and an Excel spreadsheet was created to list and organize the articles. The tabs on the Excel sheet were labeled as “Second Language”, “General v. Science Focus”, “Journal or Book”, and “Year Published”. In the tab “Second Language” the articles were divided into groups regarding to which language is the first language to the language being acquired, e.g. Spanish-English. In the tab “General v. Science Focus” the articles were split into two groups, one which focused on translanguaging in the classroom and the other in which there was a focus on translanguaging in science classrooms. The second tab was created when articles which explained translanguaging in the classroom on other subjects in greater detail. In the tab labeled “Journal or Book,” the articles were divided to provide a visual to what journals provided a greater number of articles for this literature review. “Year Published” was created to create a timeline of how many articles were published on translanguaging with a focus on STEM material per year.

One Word document contained the summary of articles focused on translanguaging in education, another with bilingual education/ translanguaging, and another with translanguaging in science classrooms. The articles were downloaded and separated into three folders within a USB with the titles of “translanguaging,” “bilingual education,” and “translanguaging science” with the Word document full of notes of each article in the respective folder. The content of each Word document was as follows: the title, author, and a brief paragraph explaining the contents of the article. Additionally, notes were carefully annotated if any material was directly quoted from the article, including the page numbers next to the italicized quoted material. This provided an easy reference to specific sections of the article during the analysis and synthesis. The maximum number of articles per Word document is 15 due to the heavy content and easy computer and USB storage access. The total number of articles and books that will be used for this literature review is 39.

The initial search for articles did not provide the wide range that has been obtained, only seven articles were found regarding translanguaging in science classrooms. After a meeting with the librarian of the UTEP library (Urban-Flores, 2023), and a new understanding of how to use the databases provided by UTEP, there was a total of 17 more articles found. Other articles and books were provided by courses throughout my master’s program (Heiman, 2023; Medina, 2022; Koshleva, 2022).

Results

The chapter will develop the key ideas found in the literature review and the effect translanguaging has on promoting scientific inquiry. The chapter will be divided into sections of the differences when translanguaging pedagogy is incorporated into science classroom to promote scientific inquiry, the effect of translanguaging on the linguistic and cultural diversity of emergent bilingual students, and the literature exposure on translanguaging in science classrooms.

Translanguaging Pedagogy

According to Karlsson et. al (2019), translanguaging instruction facilitates understanding in science classrooms through student-to-student interactions and codeswitching. Through the use of translanguaging teachers can maintain classroom culture to redirect student behavior and respond to non-academic classroom activities (Licona & Kelly,2020). Radke's et. al (2022) case study provides a clear example of interactions students have in the classroom with translanguaging in a scientific context. The students naturally incorporate their first language into the discussions and follow through with their classmates in understanding the material. Students rely on the translanguaging process to make new connections between languages and content (Poza, 2018) by providing access to knowledge through the language (Infante & Licona, 2018). Translanguaging pedagogy emphasizes the overlapping of languages rather than separation for both the teachers and students. (Creese & Blackledge, 2010). Creese and Blackledge describe the knowledge and skills from practicing translanguaging as:

> *"Use of bilingual label quests, repetition, and translation across languages. Ability to engage audiences through translanguaging and heteroglossia. Use of*

> *student translanguaging to establish identity positions both oppositional and encompassing institutional values. Recognition that languages do not fit into clear bounded entities and that all languages are "needed" for meanings to be conveyed and negotiated. Endorsement of simultaneous literacies and languages to keep the pedagogic task moving. Recognition that teachers and students skillfully use their languages for different functional goals such as narration and explanation. Use of translanguaging for annotating texts, providing greater access to the curriculum, and lesson accomplishment."* (2010 p.112-113)

Effect of Translanguaging on Linguistic and Cultural Diversity

The scientific curriculum focuses on providing relevant experiences to learners, providing how language is a living identity (Flores & Rosa, 2015), language should also be relevant in the classroom. When reading about translanguaging, social linguistics is a topic included in many articles (Bosma et. al, 2021; Perez & Johnson, 2020; Wei & Lin, 2019). Although social linguistics is a political representation in the language (Lippi-Green, 1997), it is a possible determining factor to oppression (Flores & Rosa, 2015; Wei & Garcia, 2022). Garcia (2008) introduces the term "white listening subject" to describe the ideology of how, in the case of the United States, English is considered the recognized official language for any media of communication, unconsciously excluding any other language. Students who study engineering refer to English as "the language of power and education," stating how they privileged English to Spanish due to the matter being taught in English (Perez & Johnson, 2020). In a Latino dominant classroom, students in middle school correlate English to success in education although they have a preference in Spanish (Stevenson, 2014).

Although the highlight of mentioning such controversial ideology is to promote inclusion of community culture into the classroom (Mazark & Herbas-Donoso,2015). In the article written by Esquinca et. al (2014), the importance of including culture into education is noted through the interactions of students on the U.S.-Mexico border. The teacher in the case study by Esquinca (2014), provided tools for students to construct meanings in science content between the languages of Spanish and English and expand scientific inquiry. Furthermore, the concept of translanguaging is a global tool with no language limitation. The articles used in this literature review were obtained through various journals from various parts of the world, see figure one for details. The articles' second language varied depending on the location of said article. Through the wide range of languages, figure two provides a representation of languages used for translanguaging on various case studies.

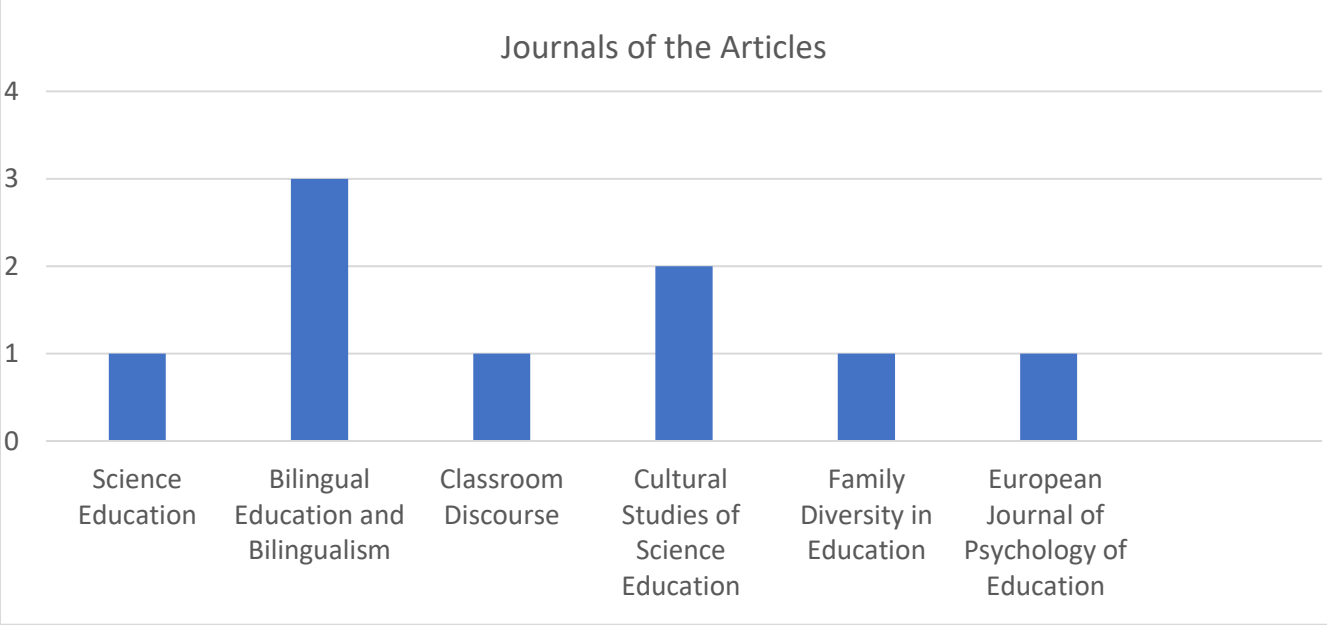

Figure 1

The graph creates a visual representation of the articles used and from which journals they were obtained.

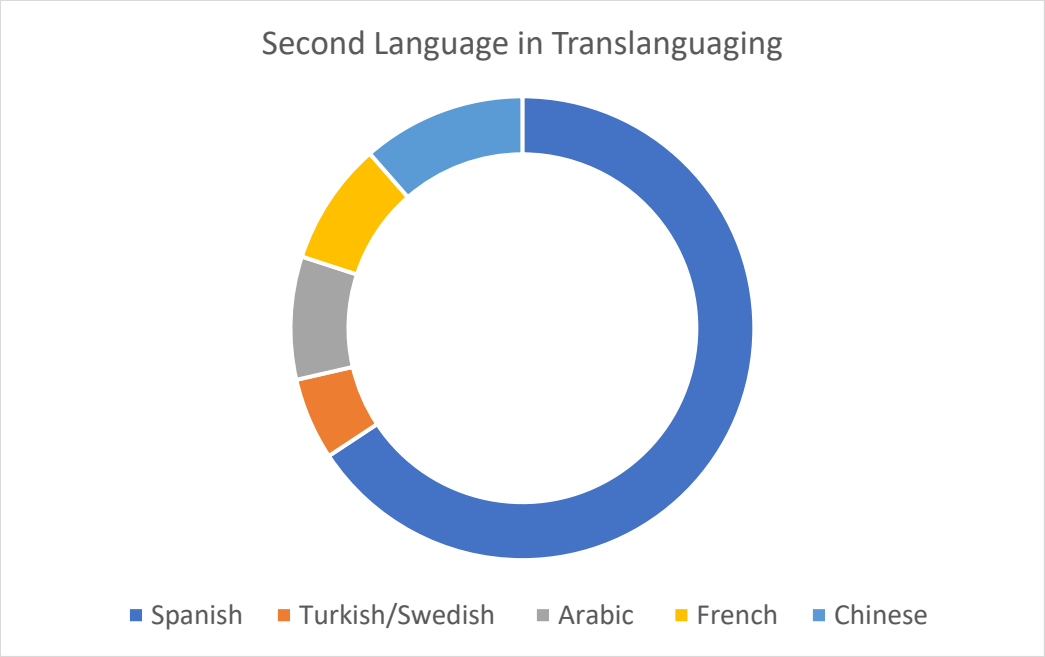

Figure 2

This graph aids to provide an understanding of translanguaging in all languages creating a global perspective.

Literature Exposure on Translanguaging in Science Classrooms

Throughout the search of literature, when searching for articles regarding translanguaging, most articles and study cases were based on art and literature subjects. When using the keyword "translanguaging" in the EBSCO database, from 2012-2023, 720 articles appear. When using the keywords "translanguaging classroom" in the EBSCO database, from 2012-2023, 106 articles appear. When using the keywords "translanguaging science classroom" in the EBSCO database, from 2012-2023, 7 articles appear. Due to translanguaging being introduced within the last 14 years (Garcia, 2009a; Creese, 2010) as a research focus, few articles were written within the science focus. For a visual representation of the distribution of articles on translanguaging with a focus in a classroom environment, figure three was created. Compared to

ELAR based articles, translanguaging is in the beginning stages of being explored in science classrooms.

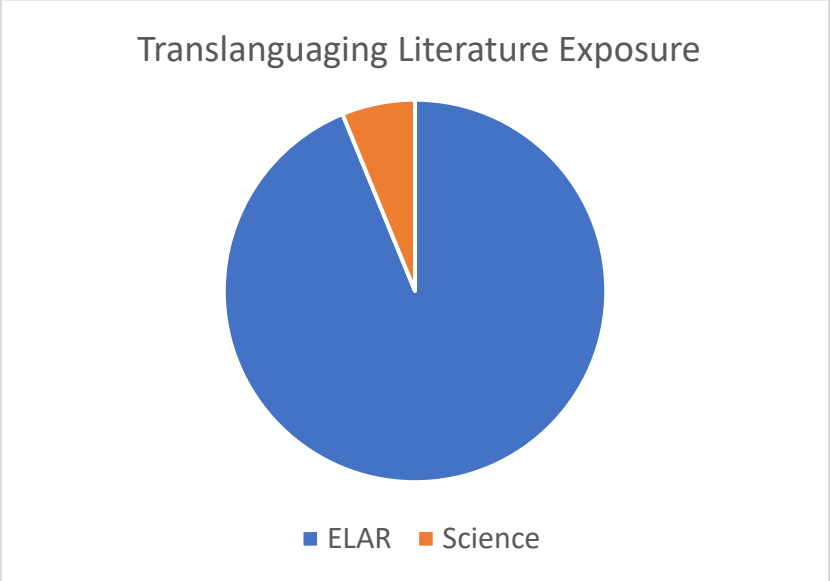

Figure 3

Articles written about translanguaging in the classroom.

Note: The figure represents the results found in the EBSCO database as of July 10, 2023.

Continuing, the timeline of translanguaging is dated to 2009 by Garcia who is the first to use the terminology in literature. For the purpose of this literature review, articles which only spoke about translanguaging were used for background, yet articles focused on science classrooms were published starting 2014 (Masak & Herbas-Donoso, 2014; Stevenson, 2014). The years in which had a significant impact in this literature review are 2014, 2018, 2020, and 2022, as shown in the timeline below.

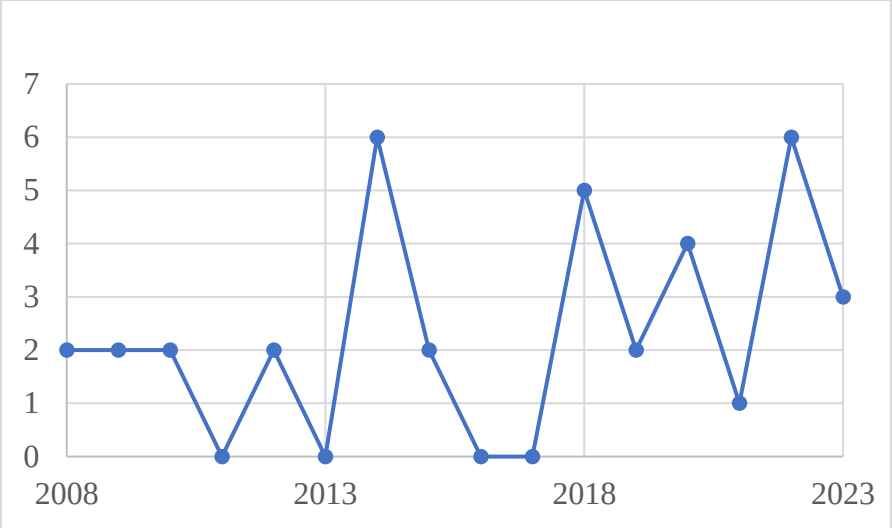

Figure 4

Timeline of articles used throughout the literature review.

Note: Articles not included in the figure are Lippi-Green (1997), Garcia (2006), and Carr et. al (2007).

Discussion

This chapter of the literature review will serve as a closing statement and comprehensive summary of the results inferred followed by questions to further investigate and incorporate translanguaging into the science classrooms. In this section, I will incorporate my own opinion and ideas combined with how the ideals were changed throughout this literature review.

According to the literature, the incorporation of translanguaging into science classrooms depends completely on how the teachers introduce the pedagogy to the students. The introduction of translanguaging instructions should be modified based on the level of bilingualism of the students (Karlsson et. al, 2019; España & Herrera, 2021) considering the surrounding community as well (Friere & Feinauer, 2022). Although translanguaging pedagogy has been recently included in science education (Masak & Herbas-Donoso, 2014; Stevenson, 2014), there is still room for improvement and additional steps on incorporation. The literature review provides examples of students who use their whole linguistic repertoire without limitations and excel in improving scientific inquiry through meaningful connections between scientific content and their daily lives. Through the freedom given to students by expressing themselves using all of their linguistic repertoires, emergent bilinguals can approach the material with fewer challenges (Infante & Licona, 2021). Furthermore, students are able to express ideas and communicate with fellow classmates in discussions without stopping to think about the direct translation of the scientific lexicons and promoting scientific inquiry (Suarez, 2020).

Translanguaging does create great opportunities for emergent bilinguals, however, due to the lack of research there exists a frame of error. The introduction of translanguaging in the classroom is completely dependent on teacher experience and students' reception of material. In various articles (Lu & So, 2023; Mazak &Herbas-Donoso, 2014; Poza, 2018; Wong et. al, 2022)

the authors mentioned how translanguaging was introduced by the teachers experience and the students' willingness to this new ideal. Translanguaging is not used throughout the whole lesson, but rather as an additional tool for students' necessities in material and language acquisition. Furthermore, there exists a notably missing literature in translanguaging in science classrooms compared to ELAR steamed articles. The informational analysis to correctly determine the inclusion of translanguaging is not available for academics to create a lesson plan currently. Translanguaging in the classroom has provided positive and negative feedback based on when translanguaging is used. Students surprisingly pushed back on the inclusion of translanguaging at first, yet at the end of the case studies the students provided feedback on how the inclusion improve understanding and where it would lead to scientific inquiries.

Conclusion

In conclusion, translanguaging is an additive linguistic tool for emergent bilingual students in the science classroom due to the inclusion of identity and promoting scientific inquiry though the removal of language barrier. Translanguaging is a tool not used throughout all the lesson, rather only used for specific parts to improve material acquisition. Research concerning translanguaging in science classroom is not as explored compared to translanguaging in ELAR classrooms, providing a need in this field of study.

Future research can be conducted on teacher preparation for emergent bilingual students with a focus on how to create a third-space environment instead of relying on the teacher's experience. In various articles (Lu & So, 2023; Mazak &Herbas-Donoso, 2014; Poza, 2018; Wong et. al, 2022), the authors mention how the introduction of translanguaging to the classroom is completely dependent on the teacher, with no previous training on translanguaging. Heiman et. al (2022) have started to explore the subject of the incorporation of all-inclusive Spanish language, such as the term Latine, to classrooms who already have introduced translanguaging in classrooms. The use of all-inclusive Spanish language has been introduced within the last three years, providing a need for future research.

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Vita

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