

Chapter 6.

Bilingualism in Science Class: An Approach to the Identities of Bilingual Science Teachers

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Abstract

The phenomenon of bilingualism in science has become naturalized in our society. Even so, there is still a lot of work to be done for this process to be successful in school. The starting point of this chapter is the analysis and understanding of the identities of bilingual science teachers across various dimensions: their training, their actions, their struggles, and the way they conceive the process. The documentary review allowed us to identify some related works on said aspects, but the results show that, in our context, this path is still unexplored; therefore, we must work on its deconstruction in order to generate new knowledge that enriches the fields of English language learning and teaching (ELT) and science didactics, since it is not possible to speak of bilingualism and identities without taking into account the knowledge produced in these two fields.

Keywords: Bilingual science teacher, Identities, Bilingualism, Science education, English learning and teaching (ELT).

Who am I: My Researcher Positionality

Understanding current science teaching perspectives is crucial, as it informs how science teachers develop their identities and, ultimately, benefit their professional growth, which implies the changes that this field has undergone. This research focuses on understanding current perspectives on science teaching, emphasizing the profound insights gained into how science teachers construct their professional identities. This exploration not only illuminates pedagogical methods but

also recognizes the influence of individual experiences and perceptions in the classroom. With a specific emphasis on bilingual science education, the research is grounded in the unique perspective of the researcher as a bilingual science teacher. This personal experience motivates the exploration of how teacher identities, particularly in bilingual settings, impact pedagogical approaches. The goal is to bridge the gap between theory and practice by drawing on the lived experiences of bilingual science educators, contributing to the broader discourse on effective science education.

The starting point to approach the topic comes, naturally, from my researcher positionality, because my research interest arises from my personal experience. I am a teacher of Natural Sciences and Environmental Education who works with the Colombian State. I currently work in Soacha (Cundinamarca), a neighbor municipality of Bogotá (Colombia), I hold a Bachelor's degree in Biology Teaching from Universidad Pedagógica Nacional and a Master's degree in Communication and Education from Universidad Distrital Francisco José de Caldas; currently, I am a student of the Doctorado Interinstitucional en Educación (DIE) at Universidad Distrital Francisco José de Caldas, in the emphasis in English Learning and Teaching (ELT). In my work experience I can highlight my work as a bilingual science teacher in private institutions in Bogotá and as a virtual content editor, pedagogical advisor in science didactics projects, and monolingual biology teacher, as well as in different science teaching projects. My research interests include science teaching, bilingualism in science, and digital content analysis in the educommunicative field.

Profiling Bilingualism in Science and Identities of Bilingual Science Teachers

In recent years, Colombia has been developing a road towards bilingualism with the use and appropriation of the English language (Ministerio de Educación Nacional, 2004). Private schools have gone further and implemented the use of English in spaces other than the language class, which has led to the teaching of subjects such as biology, social sciences, and mathematics in English. In the United States, this practice is referred to as "dual language education" (or bilingual education), whereas in Europe it has traditionally been called "content and language integrated learning" (CLIL).

From my personal experience in the field of bilingualism in science, I can say that the teaching-learning process of Biology in English is not traversed by deep epistemological reflections, at least in the institutions where I have worked as a bilingual Biology teacher, as they only require an intermediate level of English.

To understand the phenomenon, I conducted a research profiling that includes categories such as bilingualism in science, bilingual science teacher identity, translanguaging in science class, CLIL, and use and appropriations of bilingualism in science class.

Within the framework of decolonial thought, and analyzing what is happening with science teaching these days, it is necessary to rethink the teaching-learning processes of biology in this new context. Therefore, it is necessary to analyze how science teaching has been perceived as part of colonization processes. Although the science field stemmed from a positivist and orthodox current of thought, its teaching must give rise to other epistemologies; for this reason, I consider it important to make a distinction between scientific practices and educational practices. This distinction is necessary because the way we do science cannot be the same as the way we teach it. In the first case, the object of study is precisely that: an object. In the second case, there is no object of study: there are subjects with whom we work. From that perspective, it is impossible to think about science teaching the same way scientific knowledge is produced.

In the review I conducted, I found works related to bilingualism in science and the identity of the science teacher, some of which were interesting and pertinent. Such is the case of Suárez (2020), who says that content must be learned beyond proficiency in English and proposes working in translanguaging spaces (García & Kleyn, 2016). Suárez acknowledges that this pedagogical theory has been widely developed in the socio-linguistic field, but that it is completely new in the field of natural sciences. Likewise, the author develops the idea of generating equitable learning spaces for all students in multilingual contexts and proposes that students should report their findings using their communication resources, without language limiting their participation. The author reveals his identity as a bilingual teacher with Latin American origin, his concern for language and science teaching, and the struggles in understanding students' learning of science, regardless of their communicative abilities in a given language. Surprisingly, the author recognizes that his struggles as a "translanguaging" teacher are still intense and that he is still seeking strategies to promote equity among his students. For the author, modeling in science is an extremely useful space to promote translanguaging practices.

Another interesting reference is Marco-Bujosa *et al.* (2020). From the viewpoint of a multilingual context, the work reflects on the identity of the science teacher and highlights that primary school teachers are not experts in science teaching; therefore, they have challenges when facing differential learning or students who do not speak English. The authors show their concern for the preparation of primary school teachers in science teaching, questioning the identity

of the science teacher. Likewise, the work of Maxwell-Reid (2020) argues that bilingual education in a monolingual context cannot use English in a static way; on the contrary, language must be dynamic and promote appropriations in students. The author criticizes the instrumentalization of English and the teaching of vocabulary in science class. Although the Colombian and Chinese contexts are quite different, they both share characteristics in the implementation of bilingual science education. The text also points out that prohibiting the use of the native language in class implies for students that English is the exclusive language to be always employed. Furthermore, the work of Amat *et al.* (2017) acknowledges that science teaching in English favors the learning of English, but not that of science. The study is concerned with the perceptions of primary school teachers of their university training and speaks of the fears that teachers face when teaching science in English.

The work of Heng & Tan (2006), who study the re-introduction of English in mathematics and science content to weave relationships with the globalized world, was carried out in the multicultural context of Malaysia between Chinese, Hindus and Malaysian people. It justifies the use of English in science and mathematics teaching but questions the loss of national ethnicity. The study also reviews the advantages and disadvantages of using English as the language of instruction in said fields.

Avraamidou (2014) studies the identity of the science teacher and reviews its construction and constitution, reflecting on the changing capacity of this feature. She takes James Paul Gee as a theoretical reference to work on the concept of identity and adds concepts such as personal stories, life stories, and narrative research. In her conclusions, she addresses the future paths in research on the science teacher's identity, where identity is proposed as a dynamic feature that depends on other aspects such as the context, for which she concludes that identity must be studied as a process. Moreover, Lee *et al.* (2008) aim to explore the impact of language on science education. They acknowledge the underemphasis on the relationship between language and science, particularly given the perception of science as a universal subject that supposedly requires minimal linguistic consideration. This underscores the significance of approaching science teaching through the lens of language ideology. Similarly, Belhiah & Elhami (2014) highlight challenges associated with teaching and learning science in English. They point out that students often face difficulties in simultaneously grappling with the English language and comprehending scientific concepts.

Within the Content and Language Integrated Learning (CLIL) category we can highlight the work of Evnitskaya & Morton (2011), who determine that the use of CLIL benefits the learning and appropriation of English. This idea is reinforced

in the works of Hughes & Madrid (2020) and Lo & Fung (2020), who argue that this bilingual perspective does not delve into the understanding of non-linguistic issues; on the contrary, they find that students have much deeper learnings in their native language. Numerous studies on Content and Language Integrated Learning (CLIL) are evident. Only Karabassova (2020), who reveals the concern for the training of teachers who carry out bilingual education process, and Campillo *et al.* (2020), who seek to understand the points of view on CLIL of primary school teachers in a monolingual context, reveal said identities.

It should be noted that there are few studies on the identity of the bilingual science teacher, the study of bilingualism in monolingual contexts, and the epistemological relationships between the teaching-learning of science and the teaching-learning of languages. These issues will be addressed in the next section.

Problematizing the Identities of Bilingual Natural Science Teachers in Monolingual Contexts

Within the context of bilingualism in Colombia and the way bilingual science teachers' identities in Bogotá are configured, I will conduct a study that covers various aspects of identity, since one of the main axes of my research deals with the identity of the bilingual science teacher. This is a broad research context due to the many aspects that can be analyzed in identity traits. Since the methodology is a multiple case study, I will work with teachers who work in bilingual private schools. However, teacher training programs will also have to be reviewed because, in terms of identity, it is necessary to review the pedagogical and didactic bases that teachers receive in their undergraduate programs and to check if they reflect on issues related to bilingual education. Likewise, the work will be conducted in a monolingual context, where most of the population uses only their native language (Spanish). This will allow us to think of bilingualism from a unique perspective when compared to other countries where the population speaks more than one native language.

The research will take place in private schools that work with science from a bilingual perspective. Since educational practices can also constitute a feature of science teachers' identities, we will have to review what are some of the practices that occur inside and outside the classroom. The purpose is to identify how the relationships between these two conceptual bodies take place (teaching-learning of English and teaching-learning of science), and how this configures teachers' identities. In the same way, it is essential to understand how the bilingualism process occurs within institutions, what are the teachers' theoretical bases and how they unwrap in these processes, and what are their struggles and their perspectives on the bilingual process in science teaching. Another key aspect in science

teachers' training programs is the nature of this training before assuming the bilingual process. In addition, we must know if teachers carry out any pedagogical or epistemological reflections on the process, if dialogues occur between school faculties for the construction and constitution of the syllabi, which universities have bilingual training programs for teachers and, if so, how they train them. Thus, there are two axes to analyze in science teachers' training: 1) the practices within bilingual institutions; and 2) the lived experiences of the teachers who assume this process.

From the profiling, it is possible to interpret that there are certain processes of science teaching that tend to normalize: for example, processes such as bilingualism in science in Colombia, identities in bilingual science teachers, and the epistemological relationships between English Learning and Teaching (ELT) and Science Learning and Teaching, have not received much academic attention, despite the fact that current job offers for teaching subjects such as Biology ask for bilingual teachers. Sadly, there are currently no studies dealing with these categories.

The concepts related to bilingualism in science have not been widely developed in the literature. In most of the investigations, the concern falls on how to generate equitable opportunities for multilingual students; therefore, it is necessary to generate research on other aspects related to bilingualism practices. One of these aspects is the identity of bilingual teachers: in Colombia, it seems that it is enough to speak English to teach it, and even more, to teach other topics such as Natural Sciences and Social Sciences. However, we need to ask the following questions: what is this identity? How is it constructed? How does it transform itself? How does it interact with other identities? What is its role in bilingualism processes? The Colombian case adds unique features to these questions, since it is possible to think, for example, about which social classes receive bilingual education and for what purpose. In the same way, it is necessary to think about why science teaching is conducted in English and how this is connected to teacher training, from which a question arises: where do bilingual science teachers acquire these skills? I consider, then, that there has been a reformulation of what it means to be a science teacher, and which has not arisen from the academy, because, although studies exist on the identity of the science teacher, there has been, so far, no work on the subject from the perspective of bilingualism.

I think that in the field of linguistics there have been conceptual, epistemological, didactic, and pedagogical developments that could help science teachers to understand what it means to teach their content with a language other than their native language. However, this knowledge must be analyzed as a whole. In the case of science teachers, I think they have been involved in an epistemological

displacement because they feel that their knowledge of the science field is placed in second place and proficiency in English, particularly the speaking abilities, is given first place, regardless of how English is used in a science class. Proof of this are the studies mentioned in the previous section and which show that the use of English in science class does not promote deep learning, but instead, it seeks a communicative instrumentalization in memory terms and the use of scientific vocabulary. Therefore, it is necessary to think about how to evaluate learning from a bilingual perspective, how teachers see themselves within this evaluation, and how they feel about facing this new challenge, which forces them to change their identities to adjust to the labor market supply. As described in this chapter, many times science teachers take the risk of applying to bilingual science teaching positions —some have the required skills while others are developing them—, so it is interesting to review how the process occurs within institutions and analyze how these processes configure identities or how teachers' struggles resist them.

There are currently many bilingual schools in Bogotá, but some of them lack the proper academic development in bilingual education, particularly in the fields of natural sciences, social sciences, and mathematics, which are offered frequently in English. I consider that “bilingual” education processes have been normalized in the city and that the current science teaching training programs in universities, while offering different English language levels, reveal the absence of epistemological bets on bilingual education. I believe the question of the identity of bilingual science teachers should dig deeper into the question of the type of knowledge created in these practices. From my point of view, it is impossible to think that the use of another language for teaching does not change or reconfigure identities. Perhaps we as science teachers have neglected what happens at the social level with our practices and its direct repercussions on the processes and actors at school. Likewise, studies on the identities of pre-service teachers and in-service teachers have not been worked on and I believe that we have here a long way to go. From my personal experience I can say that in the teaching process there is a particular development of specific attitudes and skills, which are often typical of the working world. Likewise, there is a normalization in the profile of the science teacher: it seems it would be normal for them to be bilingual and to teach their content in another language, but in truth, teacher training programs have not reflected on this and, therefore, have ended up normalizing this teacher profile. I believe it is necessary to destabilize these “normalities” and question their origin, process, and objectives.

Nowadays, the process of bilingualism in Colombia is only developed from the viewpoint of English Language Teaching (ELT); however, it has other possibilities

at hand, such as the use of other modern languages or even native languages. A question arises here: what characteristics does the English language have to be considered as the language for communication within science classes? It is well known that English is the language of globalization and that there is a utopian need to make Colombia into a bilingual country (and I say “utopian” because, although English has entered our society from the North American culture and its audiovisual products, there are not many Colombian scenarios where there is a need to establish communication exclusively in English). Then, do schools intend to become the scenario where the use of English is mandatory? From my experience, I anticipate an affirmative answer. In schools, teachers are forced to speak English all the time, even outside the class, and students who communicate in Spanish in science class are penalized. It would be necessary, then, to think the extent to which this process should be bilingual, and the use of the native language be forbidden. Another concern arises here: the exclusivity of the use of English.

The Colombian context presents singularities that are not present in other countries. One is that we use only one language for communication (monolingualism). As I mentioned earlier, bilingualism in science has been widely studied from a multilingual perspective (contexts where students speak more than one language), but it has not been studied much in contexts where only one language is spoken. This context could well be Latin America, where most countries have Spanish as their main language, which gives the topic of bilingualism other characteristics: it is not the same, for example, to think of bilingualism for students who have different mother languages and their own cultural backgrounds, and bilingualism for students with the same mother tongue and with similar backgrounds; both are different types of bilingualism from their origin, intention, and methodology.

One essential aspect of this study is the use of English in monolingual contexts. Few studies are concerned with understanding what it means to be bilingual in a context such as Colombia, and even more, what it means to receive a bilingual education in the field of science. I believe there could be a very profitable encounter between two epistemologies, which can dialogue and create paths that emancipate bilingual education and prevent it from becoming an instrumental education, allowing teachers and students to understand natural phenomena and approach new challenges from the basis of both national and foreign cultures, therefore promoting a dialogue of knowledges. In some studies on the use of bilingualism in monolingual contexts, there is a concern about the loss of national identity when using a foreign language in content learning, which extends to deep content understanding; in the Colombian case, this is a

big concern. When we ask ourselves why it is necessary to teach science through bilingualism critically, much less in terms of decolonial thinking, we need to remember that the Colombian nation recognizes various native languages. A decolonial practice would be, in this context, to learn science in native languages (as opposed to English) or even giving rise to different modern languages, but then we have to ask ourselves the following: how does bilingualism benefit the teaching-learning processes of science? What languages are conducive to teaching science content?

Another feature of bilingualism in science that must be studied is the epistemological principles of the process. As I mentioned earlier, it is necessary to generate an encounter between the fields of English Language Teaching (ELT) and the field of Science Didactics. Although we know little about this relationship due to the processes of normalization, which assume that teaching sciences in English simply requires translating the content, it is not common to teach content bilingually in a language different than the native language. There are research questions within the ELT field that have not been considered in the realm of science didactics, and, conversely, there are unaddressed questions in science didactics that have not been explored in ELT. These two fields could mutually benefit from each other. I do not assume there is a relationship of superiority between the mentioned fields; on the contrary, I want to recognize that they are different, but not independent, lines of study, since both are concerned with the teaching-learning processes. I consider that from these two fields of research, another line of research could arise: the problematization of science teaching of science. From a bilingual perspective, this new line of research could look for intersections, encounters, and disagreements, aiming to arrive at a proposal of bilingualism that finds its meaning in the pedagogical work of teachers, without generating domination practices inside or outside the classroom and creating new possibilities of understanding instead of creating communication barriers, where students and teachers are heard. The bet is ambitious, but necessary, because the processes of bilingualism must be based on theoretical-pedagogical principles, which are constantly changing, and the epistemological relationship between language and science has not been extensively studied in the literature. Both fields have elements that, if put into dialogue, could generate new teaching-learning strategies that go beyond vocabulary or memorization, enriching the identities of science teachers.

Reflecting on all this configures our position as teachers and our connection to knowledge, and helps us to analyze what happens in science teaching in English, the struggles of science teachers in the workplace and the ways in which they configure their identities; all this can be studied within the field of English

Learning and Teaching (ELT). This research proposal is important because the number of colleges and schools adopting the teaching of content in English is increasing globally. Furthermore, I intend to discuss whether or not it is appropriate to adopt this type of teaching practice and enrich the field of ELT with a perspective that includes other ways of being a teacher in a foreign language, a perspective that allows us to think of English as the way to teach other content. Therefore, I aim to broaden the discussion on science teaching and learning beyond the use of English and to ascertain whether English is the destination or the means when universities propose bilingual science programs. Similarly, it is crucial to understand the characteristics of teaching natural sciences through bilingualism, as it has the potential to reshape science education itself. In addition to being a current issue, its relevance is of interest to the fields of science didactics and ELT education because science is a subject studied compulsorily in schools, which means that all Colombians have some connection to this subject.

In consequence, I seek to understand the phenomenon of bilingualism in science and how the identities of science teachers are configured within these practices in the Colombian context. This research will help to generate spaces for dialogue between the fields of ELT and Science Teaching and Learning through the analysis of science teachers' training processes in the Colombian monolingual context, to generate our own views of what it means to be a bilingual science teacher. For this, I will use the decolonial perspective (Castro-Gómez, 2005) and the epistemologies of the south (De Sousa Santos, 2011) to analyze and understand if there is an instrumentalization of language in science classes and how this configures science teachers' identities.

Purpose of the Work: Defining the Problem

There is a lack of studies on the phenomenon of bilingualism in science in Colombia. This is why little is known about the identities of science teachers who conduct these processes, their types of training or their fields of study, and even more, the pedagogical and epistemological bases they use to conduct this process. I find that bilingualism has been widely studied in multilingual contexts where students speak more than one language, but in monolingual contexts, such as Colombia, the topic has not been studied in depth. Therefore, my research study seeks to reveal the identities of bilingual science teachers based on their training, practices and relationships with other fields of knowledge. I consider that this research is fundamental to the practice of science teaching and the ELT field, and that there is still much work to be done in understanding the phenomenon of bilingualism in Colombia. This is why it is crucial to conduct research in this field so that it may have a real-time impact on school practices.

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