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Translation and the lingua franca in scientific communication

The case of the scientific community from Mexico

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Translation and the Lingua Franca in Scientific Communication: The Case of the Scientific Community from Mexico

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ABSTRACT

This thesis presents a study of the hybrid scientific discourse developed by a group of Mexican researchers in the area of materials science. The study focuses on the discursive characteristics (i.e. those derived from the interaction between Spanish and English in scientific academic discourse), and the non-discursive factors (i.e. local factors such as economic stability and scientific tradition in Mexico) that affect the visibility of research articles (RA) in international journals of the scientific community from Mexico. A second major focus of the thesis concerns a survey designed to obtain information about the publishing process in international journals, completed by a small group of Mexican researchers from two leading scientific institutions in Mexico, CINVESTAV Queretaro and the Physics Department from UNISON in Mexico. These research centres are located in two different cities in Mexico, Queretaro and Hermosillo.

Through the linguistic analysis of the hybrid discourse developed by Mexican scientists, this thesis inteds to study the influence of English as the lingua franca in scientific publication and the changes that such influence has caused in the written production of RA by Mexican researchers in Spanish as the L1 and English as the L2. Additionally, this thesis analyses the representation of scientific publications by Mexican researchers in international scientific databases in order to see what is the relation between the discursive and nondiscursive factors that affect Mexican scientists. The main goal of this thesis is to better understand the specialised discoursed used in materials science by Mexican researchers, in order to be able as a technical translator and proofreader to respond to the needs of the auhors and the field to help in the dissemination of their research.

Abbreviations

EAD – English Academic Discourse

EAP – English for Academic Purposes

ELF – English as a Lingua Franca

ERPP – English for Research Publication Purposes

ESD – English Scientific Discourse

IF – Impact Factor

I-M-R-D – Introduction - Method - Results - Discussion

NES – Native English Speakers

NNES – Non-native English Speaker

RA – Research Article

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Introduction: English as the Lingua Franca in Scientific Publication

As a technical translator, I have often struggled with the translation of scientific articles. I have been working as the technical translator and proofreader for a small group of scientists in materials science from two scientific institutions in Mexico, CINVESTAV Queretaro, in Queretaro Mexico, and the Physics Department from UNISON in Hermosillo, Sonora. As I continued to reflect on the strategies and the approaches applied in my translations, I started to realize how easy it is to fall victim to the interferences of my native language as well as from my own bias in terms of the status of Spanish, my native language, against English discourse as a vehicle for the dissemination of scientific knowledge. My work with this small group of scientists started in 2010, at that time, I ingenuously believed that writing for publication as a non-native English speaker (NNES) usually implied that the quality of writing and the style of the discourse produced by NNES were deficient when compared to the quality and style of native-English speakers (NES). Therefore, in order to compensate for those perceived discursive deficiencies in my writing and in the texts produced by my clients, I favoured English discourse in my translations by generalizing certain syntactic structures I identified in other research articles (RA) published in elite scientific journals, which I believed were written by NES researchers. While the RA translated and proofread by me were submitted successfully for publication, I was not aware of the effect that such a domesticating approach carried to the discourse of my clients.

As I continued with my studies in translation in a NES institution, I started to see that even though my discursive style is not the same as a NES, that does not mean that my control of the language is inferior to that of a NES. The more I continued interacting with my NES peers and writing in English, I started to prioritize clarity in my

writing rather than imitating a different style. At the same time, I started to note that editorial boards in international journals were becoming more flexible in terms of the type of discourse they accept for publication. Nevertheless, regardless of the increasing flexibility in the publishing and editorial international institutions, publications of RA by NNES, as is the case for scientists in Mexico, can still be a cumbersome process for many researchers.

It is for this reason that I became interested on researching how the production of RA by NNES scientists, as well as the translation process of such documents (Spanish-English and English-Spanish), is affected by the dominance of ELF in international scientific publication. In this thesis I focus on the study of the specialized discourse used by a group of Mexican researchers in the area of materials science. This interest came from observations I made in the texts produced by my clients. Feeling the pressure to publish their research in international specialized journals, my clients need to produce articles written in English, and my role is to either translate their articles into English or to proofread articles that were already written in English by them. In both instances I observed hybrid discourse derived from the inteaction of both languages, i.e. in RA written in Spanish as well as in Ra written in English, that heavily affected the clarity of the articles, which caused their publication to be delayed or made blocked altogether.

These days, English largely functions as a lingua franca and is widely favoured in international communication; this brings about many benefits in different spheres, principal among them the facilitation of “international understanding, global economic integration, growth and the modernization of developing countries” (Flowerdew 1999a:123). The development of science and technology in particular is aided by English as a Lingua Franca (ELF) in that effective interaction between the scientific

communities worldwide supports fast dissemination of specialized knowledge (Flowerdew 1999b:244).

Nevertheless, regardless of such benefits the use of a single language also has negative repercussions in at least two aspects: (1) the representation of the different scientific communities at the international level; and (2) the specialized discourse used by each of these communities. Studies conducted by John Flowerdew (1999a, 1999b), Françoise Salager-Meyer (2008, 2014), and Karen Bennett (2007) have focused on the disproportionate representation of the scientific community from the centre, mainly the native-English speaking (NES) scientific community vis-à-vis the non-native English speaking scientific community (NNES) in international scientific databases.

The terms NS and NNS, as noted by Davis (2004:431), can be interpreted in different ways. In the one hand, probably the most common definition is the one that sees a person as a native speaker of a given language only when they have been exposed to the language and the culture of the language from early childhood, allowing them to develop an “innate” intuition about the grammatical usage in both the formal and informal language, as well as the capacity to creatively write in areas such as literature (Davis 2004:435). This leaves persons that were not exposed to the language at early stages in childhood as NNS. Nevertheless, as noted by Davis, while native speakers “may be prepared to make judgements quickly about grammaticality, they do not necessarily aggree with one another” (Davies 2004:437). However, this view fails to consider that in higher registers of language, such as scientific language, even native speakers need training in the usage of the concepts and grammatical and stylistic constructions of a specializded discourse. Jun Zhao (2017:47) notes that many of the problems that NNES experience when writing academic articles in English are also experienced by NES due to “insufficient control of the language, muddy thinking,

inexperience with writing in general and with scholarly genre in particular". According to Canagarajah and Wuur (2001:8), since NNES researchers are multilingual instead of trying to master native norms, they are trying to appropriate the language "to suit their own values and interests". Moreover, since multilingual users do not classify their languages as being less significant than others, the label NNES can cast a status of defficiency for them, giving NES more power in language (ibid.). This, as further noted by Canagaraja and Wur, ignores the many advantages that multilinguals posses in terms of the usage of academic discourse that monolingual NES may not possess (ibid).

According to Davis (2004:37) the adult NNS can acquire the communicative competence of the NS, she/he can acquire the confidence necessary to membership. Leaving aside the matter of accentual difference. What is more difficult for the NNS is to gain the speed and the certainty of knowledge relevant to judgements of grammaticality. On the other hand, there is another view which says that since language is acquired in social interaction in the same way as culture, and is not an innate component such as gender as noted by Davies, a person can become a native speaker in the following ways:

> NS by birth,
> by virtue of being a native learner,
> by being an exceptionl learnes,
> through edication in the target language medium,
> through long residence in the adopted country
> (Hyltenstam and Abrahamsson 2000 in Davis 2004:438).

According to the definition offered above it can be said that Mexican scientists can be considered NS of English scientific discourse, given that they have been exposed to Enlgish scientific discourse throughout their training as scientists. However, given that this thesis focuses on the discursive peculiarities produced by Mexican researchers in

the scientific discourse while at the same time using standard English discourse as a reference, throughout this thesis Mexican scientists are referred to as as NNES.

Publications from NES scientists, particularly those located in developed countries such as the US and the UK, are more visible in international databases, whereas publications produced by NNES scientists located in developing countries are less represented. Such imbalance is even sharper in the case of NNES scientific communities located at a periphery and semiperiphery of scientific production, that is, in developing countries such as Mexico, where the scientific community experiences difficulties in the process of publication in international mainstream journals due to differences in the publication culture and the language (González-Brambila 2007:4), thus affecting their participation in international journals. Similar to the concepts NES and NNES, developed-developing and centre-periphery are concepts whose definitions can also be problematic. The term developing, as noted by Khokhar and Serujaddin (2015) is used to classify a group of countries that share similar attributes, and where people lives are similar. However, when considereing that countries in the periphery and the semiperihpery are not homogenous, that classification is disproportionate. As further noted by Khokhar and Serajuddin, when comparing statistics of countries that for the past five decades have been categorized as developing countries, an increasing dissimilarity can be noted. For instance, Khokhar and Serajudding use the results from international statistic of Mexico and Malawi, both countries categorized as developing countries. According to these statistcs the difference between the GNI per capita is considerable, with Mexico having a $9,860, and Malawi a $250. A similar difference is noted in the poverty line of both countries with 2.68% in Mexico and 70.91% in Malawi (Khokhar and Serajuddin 2015).

The terms centre and periphery are taken from the world systems theory developed by the sociologists Immanuel Wallerstein (1974). In this theory the countries around the world are divided into three categories, the core or centre, the periphery and the semiperiphery. According to this theory, the countries in the centre of the system have well established financial, political and technological areas. The centre dominates the countries in the periphery, who are dependent on the countries in the centre, due to the influences that the countries in the centre have on them. Countries in the semiperiphery on the other hand, share characteristics from both centre and periphery. Although the terms developing and periphery-semiperiphey may be ambiguous terms that do not entirely describe the specific situation of a country, the terms developing and semiperiphery are used along this thesis to describe the current situation in Mexico.

The low visibility of NNES publications by scientific communities in the periphery and semiperiphery of science in international scientific databases, as will be discussed throughout this thesis, is due to a combination of discursive and non-discursive factors that affect the context with which they interact day-to-day. However, given that the discursive factors are involved in the first stages of publication, the peculiar characteristics of the scientific discourse used by NNES scientists is considered a hindrance for the successful representation of their community in international publications.

According to Louis Trimble (1985:6), English for science and technology comprises the written discourse used in academia for professional purposes and occupational/vocational purposes. Abdelghani Remache (2007:39) suggests that the language used in science and technology can be divided into two types, depending on the objectives and the contexts in which the discourse is being used: English for

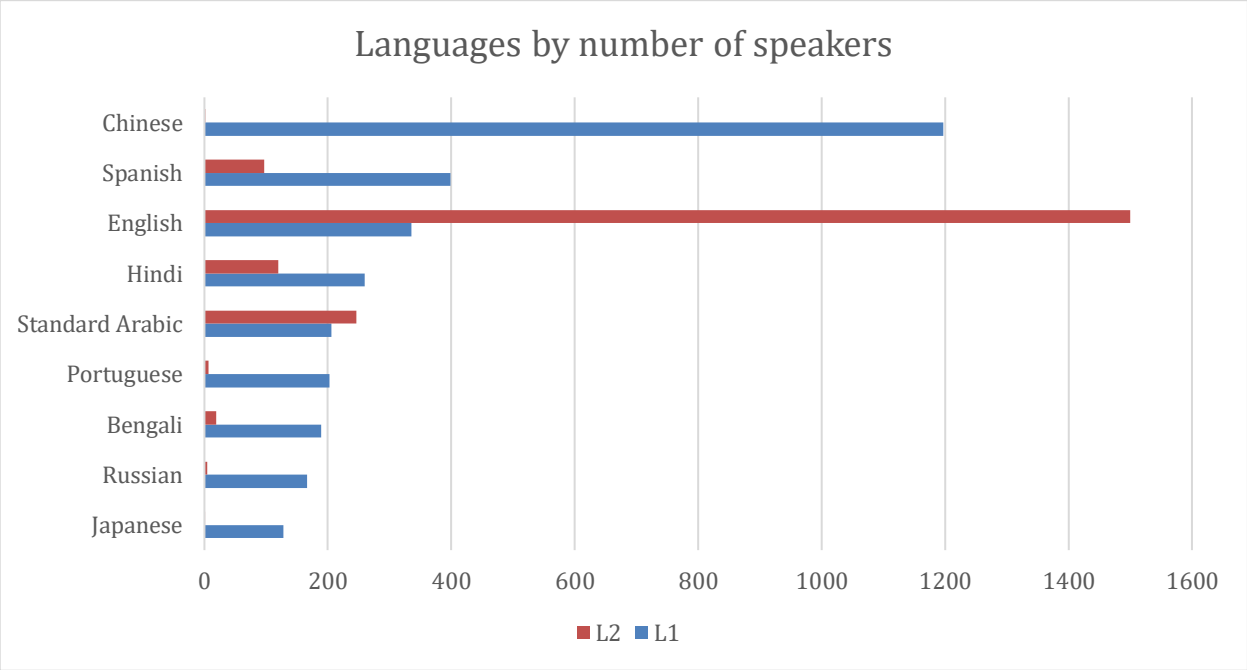
academic purposes (EAP) and English for occupational or vocational purposes (EOP or EVP) (ibid.). EAP comprises the written discourse used in higher education and research (Bennett 2008:60) in specific areas of study and disciplines, e.g. English for medicine, English for educational purposes, English for business, etc. (Remache 2007:40). While EAP is the discourse used in academic settings and specialised publications, EOP, on the other hand, refers to the language required for job training, used in a more practical context. EVP/EOP is used in a specific job or activity, e.g. English used by waiters, secretaries, hostesses, etc. (ibid.).

Given that the focus of this thesis is on scientific publications, any discussion regarding the use of discourse will be specific to the discourse employed in the hard sciences, i.e. scientific English. One of the particularities of scientific English is that, as noted by Remache (ibid.), compared to general English, that is, the informal discourse, written and spoken, used in every day life, it is more restricted in terms of the syntactic structures and tends to avoid lexical and stylistic ornamentation. This is due to the level of accuracy and conciseness required for the transmission of scientific knowledge; the discourse needs to be structured in a way which leaves no room for any misunderstanding or ambiguous communication (ibid.). Some of its characteristics include the use of formal register, passive voice constructions, short, concise sentences, as well as the following rhetorical structure: introduction – methods – results – discussion (IMRD). A more detailed description of the characteristics of English scientific writing and the implications of its use by NNES scientists, will be offered in Chapter 2.

As more NNES scientific communities participate in the exchange of knowledge at an international level, scientific English becomes the primary language for interaction; this involves almost all types of activities in science and academia (Foyewa

2015:35). Thus, it is common to hear that English has become the main language in international communication (ibid.). Indeed, the use of English around the world is so widespread that around 95% of its users are NNES – a percentage that is increasing every day. This means that only around 5% of its users are NES (Deng 2015).

According to data compiled by Tomas Christiansen (2015), among the largest languages of the world in terms of native language (L1) speakers, English is in third place, after Chinese and Spanish (see graph below).



Graph 1. Languages (as L1 and L2) by number of speakers in the world (Christiansen 2015:132)

However, English takes first place in terms of second language (L2) and foreign language users[1] across the globe. As noted by Christiansen, the graph above may not show the exact number of users of English as L2, given that views about sufficient proficiency in a foreign language differ greatly (ibid.). Still, the graph does show the

[1] Second language (L2) refers to a language that is learned in addition to the native language of a country given to its official status in the country. Foreign language refers to a language that has no official status in the political or economic system of a country, but it is chosen due to personal interests (Punchihetti 2013:3-4).

acceptance and predominance of English as an international language. Even though Chinese and Spanish may have the largest populations of L1 speakers, they do not have the same reach or influence as English as international languages (ibid.). According to Gibson Ferguson (2007:10), relatively few papers in the hard sciences are being published in languages other than English. Davide Giannoni (2008) notes that, between 1986 and 2005, publications in languages such as Spanish, German, French and Italian in biomedical areas fell to 3.8% of the global output (in Cianflone 2014:49).

As the use of English is expanding around the world, the varieties developed by its users have been a focus of study in academia, three main terms have been coined to refer to these varieties: World Englishes (WE), English as a lignua franca (ELF) and English as an international language (EIL). The following paragraphs discuss and differentiate these three main terms.

WE can be defined as including all the varieties of English used around the world. Braj Kachru (1985:12) visualizes the growth of English as an international language as three concentric circles. The inner circle comprises those countries where English originated and where it is used as the native language: the UK, the US, Canada, Australia, New Zealand, etc. The varieties of English used in these countries – particularly the UK and the US – are considered the standard for formal communication at an international level. The outer circle includes those countries where English is used as one of the official languages as a result of colonization by the inner circle states. Lastly, the expanding circle comprises those countries where English is used as a foreign language, and where it is often prioritised in foreign language teaching. This last circle is expanding every day, due to the cultural,

economic and political influence of the countries in the centre, particularly the US, brought about by globalisation.

As noted by Ishikawa (2016:2) while the spread of English in international level is often viewed as the spread of the standard English (i.e. American or British English), WE refers not only to the English as native language variations such as British or American English, but also to the "localised forms of English throughout the world", this is the varieties of English that are "educationally institutionalised, 'non-native', intra-community specific and indigenised varieties, each having its own linguistic norms". WE is developed through educational systems, in an area where the standard English is not the native variety for the majority. World Englishes has become the localised or nativised language by developing some linguistic features and rules of its own" (Ishikawa 2016:4).

English as a lingua franca (ELF) and English as an International language (EIL) on the other hand, are two terms that refer to English used in real-life communication across the outer and expanding circles, according to Kachru's paradigm. Although in many cases ELF and EIL are used as synonymes, Ishikawa (2016:6) notes that these terms were considered different. In one hand, ELF is defined as the language used between members from different linguistic and cultural backgrounds as a second language, this definition excludes NES (Mckay 2018:10). Ishikawa (2016:7) notes that ELF focuses on the interaction between members of the international community, which are located across the three circles in Kachru's paradigm. As further noted by Ishikawa, for ELF correctness does not depend on the superficial linguistic features.

EIL on the other hand, refers to the communication between both NNES and NES (Ishikawa 2016:6). According to Mckay (2018:11), EIL considers the language use in connection with the level of expertise, and listening competence of the users, as well as the intention in being understood. Given that the focus in this thesis is about the

variation of English that is used by a community that does not use English as their native language ELF is the term used to describe the language used throughout the thesis.

According to David Crystal (2007:5), a language can be considered a lingua franca, that is, as a contact language among groups from varied linguistic backgrounds to facilitate specific activities, i.e. international conferences, trade, etc., when it is being adopted or used by other countries in two main ways: (1) as one of the official languages in a country in specific areas, for example politics, media or education; (2) due to prioritization in foreign-language teaching: this is the language that is most likely to be taught at schools, and which can be considered a basic requirement in job applications and for obtaining a degree. As further noted by Crystal (ibid.:7), a language becomes an international language or a lingua franca in international communication in areas such as science, education, popular culture, and business, among many other areas due to two main reasons: (1) the politic, economic and military powers of the countries where it is spoken, and (2) due to the familiarity of the language derived from its influence on other languages. Without such characteristics it is impossible for a language to achieve the status of an international language or a lingua franca (ibid.). Indeed, the English language has achieved much more than did other languages in the past, which at different points in history were considered the lingua franca of their time, e.g. Latin, French, German and Arabic (Gordin 2015; Crystal 2003:5). Historical circumstances which arose close to eight decades ago facilitated the adoption of English in different domains of the social and political systems of various countries around the world. Since then, English has been adopted as a second language in more than seventy countries, including current dependent territories of the US like Puerto Rico, and other countries which have been influenced by British colonization (Crystal 2003:5).

As discussed above, it is because of the way in which NES speakers, particularly from the US, have maintained their influence in areas such as politics, popular culture, academia, science and technology, that English is currently without a doubt the modern lingua franca in international communication. At this point, it is worthwhile to consider the concept of lingua franca itself. As noted by Gibson Ferguson (2011:280), the term is derived from Arabic [lisan al farang], which means 'the Italian language'. A lingua franca originally referred to a contact language that was used between Arabic and Western European speakers (Meierkord & Knapp 2002:9, in Ferguson 2011:280). This lingua franca, which was used mainly for commerce, combined structures and elements from different languages; furthermore, it was considered a somewhat neutral language, since it did not belong to a national territory or a specific community; indeed, it was a relatively stable language which did not undergo considerable variations (ibid.). It was not until particular speech communities started to adopt the lingua franca as their own that the language began to change, as was the case with Latin (ibid.).

In a similar way, ELF, a modern lingua franca, is used as a contact language by those who do not share a language or culture, as well as by those who choose English as their foreign language for communication (Firth 1996:240, in Seidlhofer 2005:339). Moreover, as it is continuously used by speakers with different linguistic backgrounds, ELF is also being shaped by its users. Therefore, ELF is not exempt from dialectal modifications by the many different communities that use it. For instance, NNES scientific communities have a particular way of using English scientific discourse, which differs, at times considerably, from the discourse produced by scientists who are NES. According to Juliane House (2013:281), because ELF is used by speakers from varied linguistic communities, it can be characterised by its "functional flexibility,

variability, and its spread across many different linguistic, geographical and cultural areas, and the fact that many linguistic items from different languages are integrated into the language" (Firth 2009, House 2010, in House 2013:282). ELF also functions as an intercultural communication tool, given that, as mentioned above, the number of NNES is significantly larger than the number of NES, and is ever increasing (ibid.).

It is very practical to have available a language that is flexible enough for speakers from varied linguistic communities to be employed for international communication. However, regardless of the extent of this practicality and availability, such usage can also carry negative effects for NNES users. The following paragraphs briefly outline three such negative effects that will be further investigated throughout this thesis.

Given the widespread use of English as the lingua franca in international communication many issues have arisen concerning the different usages given to English scientific discourse by NNES. Among such issues, and of particular interest to this thesis, is the alleged inadequacy of written discourse employed by NNES scientists in scholarly articles. As a consequence, this deficient written discourse (in terms of the standards required by international scientific journals) is linked to the obstacles of scientific publications experienced by NNES scientific communities, and particularly by those from more peripheral countries. Furthermore, as a consequence of this issue, NNES scientific communities from countries such as Mexico are not as prominent internationally as their counterparts from scientific and technological powers from the centre, i.e. the US, the UK, France and Japan. Many of the factors that contribute to this disparity, as will be discussed in Chapter 2, are mainly due to the non-discursive factors, such as economy, education system, politics, etc., which affect a range of the scientific communities in the periphery. Additionally, discursive factors derived from the

dominance of ELF in scientific production also contribute to the disparity between centre and periphery in scientific publication. It is worth mentioning, however, that even though the ELF/English discourse is dominant in the hard sciences, it has less of an impact in areas such as social sciences, arts, humanities, and law (Cianflone 2014:50). Researchers from these areas still have some flexibility to publish in their native language, as the topics for research and their practical applications are mainly rooted in the local culture and traditions of the native countries (Ferguson 2007, Fernández-Polo & Cal Carvela 2009, Larsen & von Ins 2010, in Cianflone 2014:50). Having said that, it must be noted that in the academic systems in English-speaking countries – particularly in the UK – publications in languages other than English often carry a significantly lesser weight and are less likely to be nominated as strongest outputs (for example, under the Research Excellence Framework).

According to Abdelghani Remache (2007:43), Scientific English or English for Science and Technology (EST) is commonly conceived by scientists as a communicative tool used to transmit universal specialised concepts in scientific discourse. For instance, Henry Widdowson (1975) notes that the universality of scientific discourse is seen in the fact that users from different linguistic communities employ “common universal sets of concepts, methods, and procedures, that are essential to scientific and technical discourse” (in Remache 2007:43). In this regard, Widdowson argues that when scientific discourse is only considered as a set of formal structures, where the application of the discourse is limiting as it disregards the communicative value, scientific discourse should be treated as “a way of using English to realize universal notions with scientific inquiry” (Swales 1985:70, in Remache 2007:43). Remache (2007:43) points out that acquisition of scientific knowledge also includes knowledge of universal concepts that are specific to scientific and technical

texts. According to Widdowson (1974), certain basic concepts of science are universal, regardless of the native language of the scientists. For instance, basic concepts referring to processes such as *green synthesis*, *Raman spectroscopy*, or concepts such as *quantum dots*, *nanoparticles,* in materials science that are used by scientists around the world do not change. Nevertheless, as will be discussed in Chapter 3, the conceptualization of such concepts by NNES scientists may differ due to cultural, historical and linguistic preferences (2007:107), which is thus reflected on the written discourse of the user. As further noted by Widdowson, these concepts form "deep cognitive structures" that can be used by various linguistic communities, and which scientists and technologists acquire through education" (Widdowson 1979:52, in Remache 2007:43-44).

I. The Effects of ELF in International Publication

There is no doubt that the use of a single language has facilitated communication between scientific communities around the world, in addition to enhancing the visibility of international scientific research to a wider audience, as English language journals are "primarily listed" in international scientific databases (Flowerdew 1999b:243). Many scholars have focused on the dominance of English discourse at international level and the potential negative effects that this dominance places on the varied NNES scientific communities around the globe, and particularly on those from the periphery. There is a growing body of literature that recognises such effects (Widdowson 1975; Durand 2006; Ferguson 2007; Remache 2007; Curry and Lillis 2004, 2010; Weiler 2011, Bennett 2007, 2009, 2013; House 2013; Canagarajah 2014; Salager-Meyer 2008, 2014) through the lens of translation studies, ESL, and linguistics. Such effects

comprise: 1) the detrimental impact on the specialized discourse of languages other than English, i.e. domain loss and linguistic interferences (Bennett 2009; Ferguson 2007; Gutiérrez-Rodilla 1998); 2) the unbalanced representation of NNES scientists at international level (Ferguson 2007; Canagarajah 2014; Salager-Meyer 2008); 3) the stigmatisation of NNES scientific communities, and particularly those in the periphery of scientific production (Flowerdew 2008); and 4) detrimental effects on the diversity of knowledge.

On the other hand, more recent attention has focused on the ecology of knowledge (Santos 2006, 2007, 2014), multilingualism and translingualism in science and academia (Yanaprasart and Lüdi 2018; Brinkshulte et al. 2018). As noted by Brinkshulte et al. (2018:153), transligualism refers to the use of multilingual resources, a term that is mainly used to describe pedagocial goals. Multilingualism on the other hand, refers to how the languages of a person influences the contexts and backgrounds.

According to these paradigms multilingual or bilingual speakers have many advantages. As Yanaprasart and Lüdi (2018:829) note, given that multilinguals have an increased perceptual awareness they can gain new insignts that can allow them to create new analogies and be more creative. Moreover, the perception of processes and objects changes, which results in a deeper and finer understanding of concepts, conceptual construction is enriched, multilignuals pay closer attention to words and deepens the conceptual reflection of the languages they use (ibid., 830). As noted by Brinkshulte et al. multilinguals have an enhanced language awareness, they have a more profound understanding of the “systematic nature of language, and explicit knowledge of semantics, lexis, and syntax in various languages”. A big advantage of multilinguals in academic writing, as noted by Brinkshulte et al, is that they are able to

choose expressions and structures purposefully from the languages they have according to the different contexts in which they can be applied. Multilingual writers are able to transfer their academic language strategies from one language to another (ibid., 153).

Canagarajah and Wurr (2011:3) note that multilinguals negotiate differences in the language in order to communicate, thus it is their communicative practices and strategies, not a shared grammar, what allows this communication. For multilinguals, these strategies are a form of resourcefulness that they use to manage unpredictable communicative situations. Multilingual speakers are open to unfamiliar codes, this in order to have clear communication they are continuously negotiating codes and resources (ibid.). As further noted by Canagarajah and Wurr, language learning is approached differently by multilinguals, this is, they do not look to master a language in all areas and functions, “they master the codes that are sufficient for the functions they want that language to perform” (ibid.,3). Moreover, Canagarajah and Wuur note that as multilinguals do not look to master languages in all areas, or the areas in different languages, their objective for acquisition is as repertoire building and not total competence, “Multilinguals prefer to develop a range of codes for a range of purposes” (Canagarajah and Wurr:3).

Therefore, multilinguals who use English in international communications or as contact purposes, do not adopt a common code such as standard British or American English. Based on their own code they negotiate strategies in order to communicate intelligibly their objectives (ibid., 4). Multilinguals have an integrated linguistic competence that is different from the monolingual competence. For multilinguals their languages complement each other in communication, thus as noted by Canagarajah and Wuur, the notion of one language interfering on the production of others need to

be reconsidered. According to them, the combination of discursive characteristics of two or more languages, is a creative process, that enables communications and offers possibilities to give multilinguals voice.

I.I. The Impact on Languages Other than English: The Discursive Aspects

Since national scientific communities need to interact with the global scientific community to share their findings, NNES scientists from around the world need to use English discourse. This allows them to build an international reputation in their area of specialisation in addition to helping the development of the knowledge production in their countries. Many scholars hold the view that the adoption of ELF, as well as the influence exerted by the scientific community from the centre through the standardization of the process of publication imposed by international elite journals, is having a detrimental effect on the specialised discourse of the NNES scientific communities from the periphery (Skuttnab-Kangas 2003; Ferguson 2007:10; Bornmann 2011; Cianflone 2012a, 2014, 2015; Fanelli 2012; Canagarajah 2014:14; van Dalen & Klamer 200;). According to this view the detrimental effect can be seen in the three following areas: 1) textual and rhetorical modifications of the specialised discourse of NNES scientists; 2) editorial bias; and 3) predilection for English over the native language.

The first issue implies the effect which changes have on the specialised discourse implemented by NNES scientists (Ferguson 2007:10; Canagarajah 2014:14; Cianflone 2015). The tendency to modify the rhetorical and textual structure of the native languages is derived from the growing pressure exerted by international and national institutions to publish scientific findings faster so that they are visible to the international scientific community. As a result, NNES scientists implement rhetorical

and textual structures from English discourse in their RA (Ferguson 2007, 2011; Salager-Meyer 2008, 2010, 2014; and Bennett 2010). Ferguson (2007:10) notes that said tendency has the potential effect of destroying the specialised domain from the native language of the linguistic community affected; indeed, this results in the loss of register of the specialised discourse in the native language of the affected community. Consequently, some refer to ELF as a “killer language” or a “predator language” (Skuttnab-Kangas 2003:33 in Ferguson 2007:14).

The second issue derives from the growing pressure exerted by international and national scientific institutions to publish in international journals. Editorial bias refers to the tendency of NNES scientists to implement certain characteristics in their manuscripts in order to influence the editors’ acceptance and thus secure publication (Guiu et al. 2011:1). Firstly, Cianflone (2014:50) notes the growing tendency of “scattering results in different publications in different journals” that is, the selection of different parts of data obtained from the research, and their subsequent publication in different journals. This, as further noted by Cianflone, is done in order to have a higher volume of publications (ibid. 52). Secondly, with regards to the register used in these publications, scientists are adopting standard expressions or structures that are commonly used in other publications authored by NES researchers, e.g. using “catchy” adjectives, attractive phrases, and discussing positive results over negative ones (ibid.). For instance, the linguistic analysis carried out in this thesis identified the use of expressions such as “state-of-the art” [estado del arte] in RA authored by Mexican researchers, as well as the use of modal verbs in passive voice structures such as “puede ser debido” (may be due), even when such expressions or structures are non-grammatical in the native language of the researchers. Chapter 3 will offer a wider range of examples and a more detailed analysis of such phrases. By doing this,

according to Cianflone (2014:50), the information in the text is de-contextualised, as the expressions used are sometimes not relevant to the information in the text, or they manipulate the message (Cianflone 2014:50; Ferguson 2007:14). Lastly, editors and researchers favour publications from the scientific community from the centre in their references (Curry and Lillis 2004, 2010; Salager-Meyer 2008, 2014; Canagarajah 2014) as a way to comply with the requirements of the journal, even when such references do not contribute directly to the author's original narrative.

The third issue refers to the status given to the native language of NNES scientists in comparison to the English language. According to House (2013:285) and Canagarajah (2014:12), as NNES scientists favour English in their RAs to secure publication in international journals, and due to the high status allocated to English discourse as the most suitable language for the communication of scientific knowledge, NNES scientists, as well as translators, are likely to neglect the differences in the discursive habits between English scientific discourse and their native language. As noted by Bennett (2013:171), during the writing process in English L2, or the translation process from the source language into English L2, both scientists and translators tend to favour certain syntactical and rhetorical structures from English as a way of making the target text intelligible for the target audience, without acknowledging the detrimental effect that these structures may have in the fluency of the text. For instance, in the case of the scientific discourse in Romance languages into English, the texts tend to be condensed into shorter sentences, the language and the vocabulary is "neutralized" (ibid. 175).

In addition to the effects mentioned above, the texts produced by NNES scientists include certain syntactical and rhetorical features that do not comply with the standard discursive requirements and traditional conventions of English scientific

discourse. Moreover, the prevalence and influence exerted by English scientific discourse is perpetuated given the fact that it is considered the most suitable discourse for the transmission of scientific knowledge, as it is argued that it already carries the adequate vocabulary and intrinsic characteristics for the transmission of scientific knowledge (Durand 2006:46, Gordin 2015), a notion that tends to be shared even by NNES scientists themselves. This point will be further developed in Chapter 4. The knowledge produced by the scientific and academic community from countries in the centre is perceived as the most reliable, while the contributions from countries in the outer and the expanding circles are disregarded due to the quality of the discourse used (Durand 2006:48). According to House (2013:285), the characteristics in the discourse of NNES scientists make the communication "less effective and more difficult to follow" for NES audiences. Moreover, this means that certain stereotypes of NNES users are fostered (e.g. incompetent researchers, untrustworthy sources or references of knowledge [Gibbs 1995:96]); indeed, this leads to a frequent rejection of their manuscripts for publication.

I.II. The Unbalanced Representation of NNES Scientists at International Level

As noted by Salager-Meyer (2008:122), there is a substantial disparity in terms of the "volume output" in international scientific publication, whereby the scientific communities from the centre, or authors associated with institutions in such countries, are widely represented in mainstream journals, while the NNES scientific community from the periphery, that is, developing countries, is underrepresented. As noted above, the frequent rejection of RAs authored by NNES scientists has given rise to an imbalance in the way the research from NNES scientific communities, particularly

those from the periphery, is represented in international publications. As noted by Ferguson (2007:10), this unequal centre-periphery representation can be seen in international scientific databases, such as Scopus and Inspec direct, as well as Scimago. For instance, Ammon (2003) notes that around 1995 articles written directly in English made up 87.2% of journal publications in the exact sciences field, while this figure was 82.5% for the social sciences field (ibid.). Currently, the statistics from international scientific databases show that the presence of articles written in English is even more dominant, both in the social sciences and the humanities, where English did not use to have such influence. However, although English is the dominant language in international publication, this does not mean that NNES are not participating in international communication. A more complex statistical analysis of the output of NNES scientific communities in international publications will be presented in Chapter 2 of this thesis.

The imbalance between the centre and the periphery in scientific production, as has been argued in the relevant literature (Hamel 2006; Canagarajah 2014), has a lot to do with power relations. For instance, Hamel (2006:96) notes that the dynamics in language and scientific development is closely related to the economic powers of the countries that they represent, since they are related to its industrial and cultural development. Moreover, science and technology are strategic components of the "cognitive capital in the present and future society of knowledge" (ibid. 96).

The relationship between scientific development and power, and the high status that the international scientific community attaches to the knowledge produced by the "elite" community shows, as noted above, the close relationship between knowledge production and power. Weiler (2011:486) highlights four main aspects that help perpetuate this knowledge-power relationship: 1) the hierarchies in the knowledge

order; 2) the legitimisation between knowledge and power; 3) the global division of labour in knowledge and power; and 4) the commercialisation of knowledge.

1) According to Weiler, there is an unequal status in both the domain of knowledge production and where this knowledge is produced. For instance, the natural sciences usually occupy a leading position, whereas the knowledge produced from areas such as social sciences or humanities, perceived as less exact forms of knowledge, as Weiler notes, have less prestige. On the other hand, the institutions where knowledge is produced are also arranged in a hierarchy where those located in countries from the centre are considered more prestigious, as they "organize the knowledge in terms of prestige, resources, and influence at national and international level"; in contrast, those institutions located in countries in the periphery, that is, developing countries, are at the bottom of the hierarchy (ibid., 486).

2) Again, in Weiler's view, both power and knowledge must be legitimatised, that is, both "need to have a claim to credibility" (2011:487). This is reflected, for instance, in how political decisions are taken into consideration when it comes to particular "bodies of knowledge", such as "environmental policies, decision on investments of public funds, etc." (ibid.). This confirms that knowledge and science have become the virtual currency that legitimises the power of the state (ibid.).

3) According to Weiler, the hierarchy in the system of the production of knowledge, such as the scientific publishing industry, also has an effect at an international level (ibid.). Given that it is not only concerned with knowledge production but also reflects the economic influence and the political power that maintains a relationship with the international power system (ibid.). Weiler uses as an example the influence that the World Bank has at an international level; indeed, the bank imposes a type of knowledge that any country or institution needs to acquire in order to interact

with the World Bank (ibid.) Similarly, the scientific publishing industry works by imposing a way in which scientific knowledge should be produced, through the discourse and rhetoric standards of international journals (more on this in Chapter 1). This way must be subscribed to by the scientific communities from countries in the periphery in the outer and the expanding circles if said communities are to be acknowledged by the scientific community from the centre.

4) Lastly, Weiler highlights the commercialisation of knowledge. The knowledge produced by the community from the centre (i.e. by NES) is more profitable for academic and research institutions in that the continuous production of up-to-date knowledge with potential applications in the industry attracts sponsorship for more research; it is also profitable for the industry which benefits from new applications of research. This produces a sense of dependency on financial sponsorship for the production of knowledge. At the same time, Weiler notes that the knowledge produced by the communities from the centre has more economic utility than the knowledge produced by the scientific communities from the periphery, as this knowledge answers to the needs relevant in developed countries (Aldana 2012:28; Canagarajah 2014:14). This is related to the costs of knowledge production and, as a consequence, the dependence of knowledge producers on financial sponsorship which, as Weiler notes, "has an economic and political agenda of its own" (ibid.490). The modern economy is extremely dependent on new knowledge, which has meant that the relationship between production of knowledge and economic profitability is almost indispensable and inescapable (ibid). This, as Weiler further notes, applies to both the knowledge generated in the hard sciences, and to the knowledge produced in the social sciences (ibid.).

I.III. The Stigmatisation of NNES Scientific Communities from the Periphery

The stigmatisation of the NNES scientific community is a consequence of notions shared by the global scientific community, such as the incomparable suitability of English discourse as the main tool for the transmission of scientific knowledge; secondly, it is also a consequence of notions such as the perceived "unrivalled" status of the scientific community from the centre as being the gatekeepers of the ELF and scientific knowledge. Moreover, as noted by Snell-Hornby (2010), NNES scientists without enough knowledge of the standards of language of the academic written discourse, e.g. discursive standards and rhetorical conventions, are excluded from or stigmatised within the global scientific/academic community (in House 2013:286).

As noted by Seidlhofer (2005:340), even though ELF is used and shaped mostly by NNES scientists, the native-English standards are still regarded as the main point of reference regarding what is considered correct or incorrect usage of English written discourse (ibid.). This, as remarked upon by Christiansen (2015:129), has led many to think that English is the only language that counts in international communication. Secondly, as ELF dominates the official spaces of international communication, it is seen, in the words of Philipson (2009), as the embodiment of linguistic imperialism, since it prevents others from using their mother tongue (House 2013:282). Finally, given that NES are, for the most part, considered the gatekeepers of ELF, this has created a politics of language that is structured as a hierarchy, in which the epistemic communities from NES in the centre, and the knowledge they produce, are more relevant or considered more "important" than the knowledge produced by NNES epistemic communities from countries in the periphery (Canagarajah 1996, 2006; Salager-Meyer 2014; & Flowerdew 1999a, 1999b, 2008). This will be discussed in more detail in Chapters 1, 2 and 3 of the present thesis.

I.IV. The Effects on the Diversity of Knowledge: The Displacement of Knowledge

According to Canagarajah (2014:14), the influences exerted by the dominance of ELF on the written production of NNES scientists mean that the data included in scientific manuscripts is displaced, that is, they are in a different narrative and responding to a completely different need than the original. NNES scientists are often led to disregard the local journals from their national or regional research centres; they stop contributing to the knowledge development of their local community. Furthermore, as the contribution is sought mainly to the "conversation in Western academic circles", local conversations are peripheralized and underdeveloped (ibid.). This is particularly detrimental to the development and diversity of knowledge production, as "local realities are interpreted in relation to discourses from the centre, furthermore, knowledge is developed in terms of the journals and institutions from the West" (Canagarajah 2014:14). This limits the possibility "of a knowledge that can challenge central disciplinary constructs" and that can consequently challenge the status quo, which "results in a self-confirming view of the world and reality that sustains the status of the privileged" (ibid.).

II. How is Translation Affected by the Dominance of ELF?

Scholars are constantly pursuing an understanding of the linguistic, epistemological and social phenomena involved in science and academia, and attempting to find ways to facilitate specialised communication, while at the same time fostering the heterogeneity of knowledge perspectives. As part of this pursuit, scholars in the areas

of translation studies and applied linguistics study the different linguistic groups within the different areas of knowledge in international academic and scientific communication that are affected by the dominance of ELF and the standard publishing requirements of international journals. In this respect, there are different views concerning the position of translation in the dissemination of scientific knowledge, and particularly translations into ELF. According to House (2013:287), the role of the NNES translator is delimited by two main notions: 1) the first is a very traditionalist view which says that the work of NNES translators is not equal to the work of NES in terms of quality and productivity; and 2) that translators can only translate into their native language, and not into English (House 2013:287). These two notions are mainly due to the characteristics, or lack of standard characteristics (more on Chapter 1), of ELF as a formal language in international publication, as the translation industry still considers translation into ELF to be a “dubious form of mediation”, given that ELF is shaped with the lexico-semantic characteristics added from the native languages of the NNES users that are in contact with ELF (ibid.).

According to Snell-Hornby, the use of ELF in academic and scientific texts can be counterproductive as it hinders the intelligibility of the texts since usually NNES “are likely to overlook communicative conventions such as lexico-grammatical and rhetorical conventions between English and other languages” thus making ELF less effective and difficult to follow for NES (in House:285). This, as Snell-Hornby further notes, affects the translation process as well, as NNES translators are likely to produce non-grammatical structures in English derived from the influence of their native languages. House (2013:286) on the other hand notes that ELF is a “fully functional tool that facilitates communication at international level”, and at the same time, given the use of ELF is ever increasing, it has also helped boost translation (ibid. 294).

Moreover, House notes that more than ELF having an effect on the process of translation, “unusual translations” or bad translations, as noted by Snell-Hornby, are due to inexperienced or incompetent translators (ibid. 285).

As noted above, there are many authors who have urged specialised translators to help mediate in the dissemination of knowledge in the context of international publishing. For instance, Bennett (2013a:94) notes that in a context where the cultural gatekeepers, i.e. editors and reviewers from international journals, are “unsympathetic” to the struggles experienced by NNES scientists, translators need to act as cultural mediators between the source text and the discursive and cultural expectations of the target audience. For this, the translator needs to be aware of the culture of both discourses, in order to “sensitively negotiate the construction of a text that is acceptable to both parts” (ibid.93).

III. Objective of the Thesis

The studies mentioned above outline, in broad terms, the many problems facing NNES scientists in the publishing process. Such problems highlight the importance of raising awareness of these issues and the effects caused by the dominance of the lingua franca. The present thesis intends to study the hybrid discourse delveped by Mexican scientists in materials science, in order to differentiate the linguistic characteristics derived from their native language (Spanish L1) and from English scientific discourse L2, as well as the discursive changes caused by the discursive and non-discursive factors that affect their production of RAs. Moreover, the present thesis intends to ascertain the effects caused by the discursive practices derived from the interplay of English L2 and Spanish L1, which are identified through the analysis of the discursive

and non-discursive factors, on the knowledge perspective of Mexican researchers. The thesis also intends to identify comprehensive methodologies for both writing and translation, focused on developing scientific manuscripts that, without disregarding the cultural discursive characteristics of the scientific community, can be accepted for publication. In order to do so, this thesis will address the following questions:

1. How are the different stages involved in the publication process of scientific articles affected by the dominance of ELF, ie. journal editors, NNES researchers and specialized translators?
2. To what extent is it possible to find a method that could facilitate and/or improve scientific translation and writing for NNES researchers so their articles can conform to the English Academic Discourse guidelines set by the core journals and editorials?
3. How does the dominance of ELF in scientific publication affect the construction of the epistemological process of Mexican/peripheral science?

The scientific community from Mexico, like many other NNES research groups on the periphery and semiperiphery of scientific production, is affected by the expanding influence of English scientific discourse, as well as by the knowledge perspectives of the dominant groups from the centre. As a developing country, researchers from Mexico cannot always count on having access to the most up-to-date tools, materials and literature. Furthermore, in most cases they have no easy access to the research networks from the centre, even though they are located near one of the largest powers in science and technology. Moreover, as NNES, and due to the lack of a proper specialist discourse of their own, they have been developing a hybridising

kind of scientific discourse in their manuscripts, which, as mentioned above, only hinders the process of publication of international journals.

IV. Overview of the Thesis

Chapter 1. English as a Scientific Language. The chapter focuses on the discursive and rhetorical characteristics of English scientific discourse. A distinction is made between the English used in science and the English used by NNES scientists. The final section discusses the dominant role of English discourse in science and the discursive and non-discursive factors that contribute to the obstacles of scientific publication in English international journals.

Chapter 2. The Non-discursive Factors Affecting the Scientific Community from Mexico: Publishing and Scientific Institutions. This chapter starts by offering an historical account of the beginning of science and scientific research in Mexico, from the colony up to the modern times. Furthermore, it provides a statistical analysis of the scientific output of Mexican researchers, both at national and international level. Data related to country rankings and languages used per discipline for publication overall are also presented there. The chapter ends with a discussion of how the non-discursive factors found affect the publication of the scientific community in Mexico.

Chapter 3. The Discursive Factors Affecting the Scientific Community from Mexico: Analysis of Writing and Translating for Publication. This chapter provides a linguistic analysis of research articles written by Mexican researchers, both in English and Spanish, in the area of materials science. The purpose is to identify the linguistic

chatracteristics of this hybrid discourse derived from the interplay between English scientific discourse and Spanish academic discourse. The chapter ends with a discussion of how these characteritics affect the scientific production of Mexican scientists, as well as how the discursive characteristics from the hybrid discourse are perceived by international audiences and academic gatekeepers.

Chapter 4. Translating and Writing in the Lingua Franca of Scientific Publication: A Different Perspective on Scientific Writing. This chapter reports on a survey conducted specifically for this thesis among a small group of Mexican researchers from two main research centers in the area of materials science. The objective of the survey was to find information related to: the struggles experienced by the scientists in the process of publication in international journals, the views of the scientists on the requirement of using a foreign language for the dissemination of their research, and their attitudes towards the role of translators as mediators between their native language and the target language for the publication of their research. This chapter ends by summarising the discursive practices identified in the corpus, that the scientific community from Mexico has adopted, identified throughout the thesis and what is the effect that such practices have on their knowledge/research. In concluding, it also discusses the approaches that specialised translators should adopt in order to offer translations in this area which can meet the expectations of both the NNES scientists and the gatekeepers of scientific knowledge.

Chapter 5. Conclusion. The conclusion of this thesis discusses the main findings identified in Chapters 1 to 4.

Chapter 1: English as a Scientific Language

"*Scientific languages are not born, they are made, and made with a good deal of effort*"

-- Michael D. Gordin, *Scientific Babel* (2015:29)

As suggested by the quotation above, there are no inherent characteristics to any natural language, such as more flexible structural properties or the size of its vocabulary, that would make that language more suitable for the transmission of scientific knowledge, or indeed for any purpose (Crystal 2012:9; Gordin 2015:81). The same holds true the other way round: just because a language does not exhibit characteristics that seem more appropriate for a specific area or purpose, that does not make said language less appropriate for achieving international status (Crystal 2012:9). Instead, as Gordin (2015:81) notes, languages are moulded by their users in order to meet their needs. Such needs include, for instance, the need for a specific vocabulary referring to particular concepts so as to avoid generalisations and ambiguities in the discourse (ibid.).

Over the years many popular but misleading beliefs have appeared regarding why a language should become internationally successful. For instance, it is quite common to hear people claim that a language is a paragon of quality in academic and scientific writing, or talk of its perceived aesthetic qualities, clarity of expression, literary power, or religious standing (Gordin 2015:81). It is often suggested that there must be something inherently beautiful or logical about the structure of English in order to explain why it is now so widely used (Crystal 2012:7). At different points in history many languages were favoured in international communication in science, despite their complex grammar, syntactical structure or perceived ease of learning, such as Greek, Latin, Arabic, Sanskrit, Esperanto, German, French, and English, Neverthelss, this is

not to deny that a language may have certain properties that make it more appealing for the international community. For example, we could point to the ‘familiarity’ of English vocabulary derived from the way English has, over the centuries, borrowed thousands of new words from the languages with which it has been in contact (ibid.9). This chapter offers a brief analysis of the rhetorical and syntactic characteristics of standard English scientific discourse and how this disocurse, in the pursuit of being established as the standard in international communication fails to accommodate NNES users in the global scientific and academic community.

In the same way as English discourse today is the favoured language in scientific and scholarly communication, many other languages earlier were in a similar position. Although currently the dissemination of scientific and technological advances at an international level largely takes place in one common language, it was very different decades ago: “Science, as a lived human activity, has always travelled within a highly constrained set of languages” (Gordin 2015:4). The former official languages of science have left traces that are visible to this day in the modern discourse of science. For instance, the legacy of ancient languages such as Greek, Latin and Arabic is still evident in the terminology used by modern scientists in areas such as chemistry, medicine, astronomy, biology and philosophy. Likewise, modern European languages such as English, German and French have also influenced the terminology of specific areas in science, medicine and academia in general. Scientific terminology, in this way, has a strong relation with the geographical location of the most influential scientific discoveries, as well as with the internal situations of these locations at different points in time, such as wars and conflicts, which also strongly influence the development of science and technology (Gutiérrez Rodilla 1998:40).

1.1. Brief Historical Background of English as the Favoured Language in Science

English began to be used by scientists in international scientific communication after World War II (Gordin 2015:293), when German was the dominant language used in international publication. According to Gordin, the main motivator for this shift was the political backlash against German. The German language was being “punished” as a result of the actions led by German leaders during the war (ibid.306). Nevertheless, although the political backlash permitted the shift to English, this is not the factor that facilitated the transition to English as the international lingua franca. Scientists and academics were the crucial component in this transition, as they were active components that favoured English over German for their publications (Ferguson 2007:13). Moreover, there are many more powerful factors that permitted English to become the modern lingua franca in the long term. For instance, since the scientific research base of the US remained untouched after World War II, which permitted its expansion to international territories, said expansion, according to Ferguson, “was enhanced by the immigration of scientists seeking refuge from the National Socialist regime” (ibid.12). Another factor that contributed to the expansion of the US and the shift from German to English as the “principal medium of communication in Europe” was the development of computer technology during and after the Cold War, as well as the organisation of research-oriented universities (ibid.13). For instance, around the 1950s, countries such as Finland shifted the language of education from Finnish to English; subsequently, in 1953, through academic exchange programmes, scholars from Finland could interact with US universities (ibid.).

As we can see, during the late 1940’s and 1950’s the researchers were active collaborators in the positioning of English as the lingua franca in scientific communication (Gordin 2015:306). As the English language carried economic and

political advantages, researchers chose to use it, rather than it being imposed on them (Ferguson 2007:13). In addition to this, after World War II the English language was strongly associated with science and concepts such as impartiality and objectivity; indeed, this may have led to English developing a sense of neutrality. This, in turn, caused researchers to favour English in scientific publications, instead of other European languages such as German or French. In this regard, the transition to English as the language of science was not due to intrinsic linguistic features of the language that make it more suitable than other languages for scientific communication, as is commonly assumed (ibid.).

Although English was the dominant language in science, during the Cold War in the 1950s and 1960s Russian also had a strong presence in international publications (Engber 2013; Foyewa 2015:35). However, the presence of Russian started to decline in the 1970s with the gradual disintegration of the Soviet Union. As a consequence, Russian was no longer present in international publications and English again became the dominant language in scientific publications. In 1975 English became the official language in 21 countries, and was recognised as one of the local languages in 11 other countries (Gordin 2015:307). As reported by Engber (2013), during the 1990s around 96% of scientific articles were published in English. English later became increasingly dominant in international organisations, and by 2004 it was the official language of 85% of the 12,500 international organisations worldwide (ibid.).

As a result of these discursive and non-discursive factors surrounding the work of scientists during the second half of the 20th century, English is nowadays the indisputable lingua franca in scientific publications. Its position is currently being reinforced by the continuous advances in technology, as well as the need for “fast, efficient international communication” (House 2013:281). Furthermore, English has

been privileged in computerised reference tools and the advent of the Science Citation Index, Impact Factor (IF) (Gordin 2015:309). English is therefore an indispensable tool for scientists, whether NES or NNES, in order to achieve professional growth, as publishing in English means that their research is visible to other scientists around the world, and particularly to the elite scientific community. As noted by Gordin (2017), English today fulfils a lot of the objectives that scientists in the late 19th century intended to achieve, such as allowing scientists from other scientific communities to share their scientific and technological developments with the global scientific community, in addition to all the advantages that come with being acknowledged at an international level. Nonetheless, although many benefits are offered to the global scientific and academic community by the use of English in most instances the benefits are not distributed uniformly (Wolfram 2017).

1.2. English Scientific Discourse: The Language for Science and Technology

As English became increasingly favoured by researchers from the international scientific community, and as they developed discursive varieties in the different branches of science, scholars began to focus on the use of specialised discourse in science, i.e. English for Specific Purposes (ESP). ESP comprises the discursive variations used in science and academia, among them English scientific discourse. The study of the specialised discourse is divided into different categories given the marked differences among them. For instance, the overall rhetorical style of English scientific discourse is different from the style used in the humanities and social sciences (Woods 2001:73). This discursive variety comprises other varieties

depending on the scientific discipline in which it is being used, as well as the purpose of the authors. For instance, scientific discourse may vary depending on level of expertise of the audience (experts in the area vs general public) and the type of journal where the text will be published (e.g. international vs local journals). At the same time, the terminology varies depending on the area of specialisation, as each field in science has its own way of conceptualizing particular concepts (this point will be developed in Chapter 3).

Furthermore, given the numerous variables that can be found in scientific discourse, it is almost impossible to describe it or to choose a generic type of discourse for the sciences. Scientific discourse however, is often understood as follows (definition offered by Flood 1957):

> Scientific writing is the transmission of clear signals to a recipient. Scientific writing needs no ornamentation. Flowery literary embellishment – metaphor, similes, and idiomatic expressions – are very likely to cause confusion and should be seldom used […]. Accuracy is therefore of vital importance in scientific discourse (qtd in Remache 2013:40).

The definition offered by Flood seems somewhat narrow, since it is not true that metaphor and similes are entirely disregarded in scientific discourse. In fact, as noted by Lakoff and Johnson (1980), technical language very often demands metaphors because the technical terminology used in scientific discourse is quite abstract, so that its articulation requires the use of imagistic constructions in order to express and understand them (Espinoza 2014:14). Moreover, as Mulhausler (1995:281-282) notes, everyday language as well as academic discourse “are dominated by a small number of basic metaphorical concepts”. Furthermore, the users of scientific discourse often

resort to rhetorical and discursive tools (as will be shown later in Chapter 3) that include highly abstract concepts and visual language. For this reason, the analysis of English scientific discourse in the present thesis focuses on the written structure of the research article (RA). The following section describes some of the conventional characteristics of the RA.

1.2.1. The Rhetorical Structure of the Research Article in English

English scientific discourse can be described in terms of the syntax and the grammatical structures employed by its users as well as in terms of the rhetorical structure of scientific texts, including e.g. the research article (RA), doctoral thesis, technical report, conference paper, and so on. Given that this thesis focuses on the specialised discourse developed by NNES researchers, any analyses presented here are based on the structures used in RAs. The main purpose of RAs is "to have scientific claims taken up and accepted by the wide scientific community, a process called the sociology of scientific knowledge" (Wood 2010:74). In order to accomplish this objective, RAs follow a rigid rhetorical structure which is encapsulated in the traditional format: *Introduction – Methods – Results – Discussion*, or I-M-R-D (ibid.). This format, as noted by Swales (2004:229), is shaped like an hourglass: it starts with the *Introduction* which outlines the broader context of the research and foregrounds references in the argumentation so as to indicate where the research is placed in terms of its contribution to the field. As the argumentation continues in the *Methods* and *Results* sections, the argument narrows down to the focus of attention; in these sections the main objective of the research is problematised and the authors specify their contribution. Finally, in the *Discussion* section, the argumentation expands again to the big picture, only this time the results of the research are the primary focus; they

are presented in order to confirm, compare or contradict the references presented in the introduction (Swales 2004:235). This traditional format, I-M-R-D, is normally the basic structure employed in the articles published by most international journals.

Each section of the I-M-R-D format, as identified by Swales (1990), has a hierarchical organisation composed of *moves* and *steps*. Moves, according to Swales, are functional or rhetorical units that perform a communicative function in a written or spoken discourse (ibid.229). Steps are clauses or sentences with a specific function that facilitate the main objective of a move (ibid.). Moves and steps, in the same way as the entire scientific discourse, vary according to the authors' area of specialisation. Due to the many variations found in RAs from different academic disciplines, numerous scholars in ESP have focused on specific sections of the I-M-R-D format from different academic disciplines, such as medicine (Nwogu 1997), chemical engineering (Peng 1987), computer science (Posteguillo 1999), biochemistry (Thompson 1993), and chemistry (Wood 1982, in Kanoksilapatham 2005:272). Similarly, this format has been subjected to a contrastive analysis of RAs published in languages other than English with those published in English, e.g. Spanish (Salager-Meyer 1998, 2010).

As stated above, the rhetorical structure of RAs differs greatly depending on the academic discipline and area of specialisation; that said, however, there are certain tools – or moves, as Swales call them – that tend to appear in the introduction of a standard RA regardless of the field. Swales (1990) identified three such moves: 1) establishing territory, 2) establishing a niche, and 3) occupying a niche. In the following paragraphs these steps are exemplified through the analysis of a RA written by a NNES researcher from Mexico in the area of materials science.

Move 1: Establishing territory. The author contextualises the article while providing background on the topic. This is usually accomplished through either of the following two steps: claiming centrality (step 1), or reviewing previous items (step 2).

Step 1 Claiming centrality:

Semiconducting single-walled carbon nanotubes (CNTs) are desirable materials for the active channels of field-effect transistors (FETs) because of their high current-carrying capacity high carrier velocity, and exceptional electrostatics due to their ultrathin body.

Step 2 Reviewing previous items of research. The author relates what has been found on the topic and who found it:

Room-temperature ballistic transport approaching the quantum conductance limit of $2G0 = 4e2/h$ = 155 μS was first realised in FETs containing single semiconducting CNTs more than a decade ago, demonstrating the exceptional charge transport characteristics of CNTs.

Realistic approaches for miniaturising CNT FETs to cutting-edge dimensions that are similar to or smaller than state-of-the-art Si FETs have been established for single CNT FETs with sub–10-nm channel lengths and covalently-bonded end contacts that enable aggressively scaled-down electrodes.

Move 2: Establishing a Niche. Here the author highlights a gap in previous studies that his/her research can fill. This objective can be accomplished through one of the following four steps: counter-claiming, indicating a gap, question-raising, or continuing a tradition.

Step 1 Indicating a gap:

Recent progress in the alignment of CNTs from solution and via chemical vapor deposition (CVD) processes demonstrates promising scalability; however, achieving the optimal packing density of CNTs in an array and a high conductance per CNT remain challenges.

Step 2 Counter-claiming:

The potential of silicon-based heterostructures in soft X-ray applications is well documented in the literature…. Various deposition techniques have been used to produce them. In particular, Pulsed Laser Deposition (PLD) looks promising because it satisfies the requirements of selectivity and performance for multilayers fabrication, layer-by-layer growth control. However, the properties of the film are difficult to predict… Therefore, the thickness control and optical properties of evolution using real time ellipsometry of SiNx … is the main object of this application.

(Pubished in *Superficies y Vacio* Soto et al 2001:25)

Step 3 Continuing a tradition:

Wastewater treatment processes are an alternative to reduce troubles caused by water pollution. In addition, if the treated water reaches the official standards, it can be reused in other activities, water gardens and parks and even for rivers. Therefore, it is important to guarantee a high efficiency for the wastewater treatment plants. For these reasons, wastewater treatmenr is an active research topic nowadays (Published in *Revista Mexicana de Ingenieria Quimica* Morales et al. 2010:219)

Move 3: Occupying a niche. The niche established in Move 2 is now complete, with the results obtained by the authors. According to Swales, this move can be accomplished through several steps, although either 1a or 1b is obligatory. These steps are as follows: outlining purposes (step 1a) or announcing present research (step 1b), announcing principal findings (step 2), and indicating the structure of the research article (step 3).

Step 1b Announcing present research:

Here, we report on quasi-ballistic CNT array FETs at a density of 50 CNTs μm−1 prepared through the deposition of highly-purified polyfluorene-sorted semiconducting CNTs from solution into aligned arrays on substrates via the scalable process of floating evaporative self-assembly (FESA) .

Step 2 Announcing principal findings. Presenting the main conclusions of the research:

The arrays achieve exceptional performance because of three factors. The (i) outstanding alignment and spacing of the CNTs in the arrays afforded by FESA and the (ii) postdeposition treatment of the arrays to remove solvent residues and the insulating side chains of the polyfluorene wrappers enable the realisation of highly-conductive electrical contacts to each CNT in the arrays and a highly-conductive channel.

As a result, the device conductance reaches 1.7 mS μm−1 at an *L*ch of 100 nm and as high as 0.46 *G*0or 35 μS per CNT. At the same time, the (iii) exceptional electronic-type purity of the semiconducting CNTs afforded by the use of polyfluorenes as CNT-differentiating agents leads to a high *I*on/*I*off.

The saturated on-state current density reaches 900 μA μm−1 and exceeds that of Si FETs when the two are compared at an equivalent gate oxide thickness and at the same off-state current density.

1.2.2. English for Academic Purposes: Syntactic Characteristics

In addition to the rhetorical structure used in a research article, as shown in the paragraphs above, the scientific discourse employed in RAs also displays syntactic characteristics that differ from the discourse used in other academic genres and disciplines. Nevertheless, there are certain fundamental characteristics of English discourse that are present in all discursive variations of EAP. According to Bennett

(2009), *English for Academic Purposes* (EAP) has an underlying hegemonic discourse among all disciplines (ibid.2009:40), that is, the discourse used in science and academia shares certain general characteristics regardless of the area of specialization. This conclusion is a result of an extensive analysis of the mainstream guidelines and manuals for academic writing, some of the manuals that she investigated include: "*Scientists must write: A guide to better writing for scientists, engineers and students"* (Barras, R. 2002), "*Academic writing: A handbook for international students"* (Bailey S. 2006), among other guides and handbooks from areas such as law, economics, and the social sciences. Many of these manuals and guidelines are available for students and young researchers. The list below shows the general principles of EAP shared among all disciplines (ibid.2009:44).

English for Academic Purposes (EAP)

- Clarity and coherence and conciseness;
- Vagueness and verbosity are to be avoided;
- Absence of figurative language;
- Impartiality and objectivity;
- Based upon a structured rational argument supported by evidence.

The first guideline shows the three characteristics prescribed by the majority of the guides and manuals: clarity, coherence and conciseness (ibid.). In RAs, such attributes tend to be perceived as a simplified or reduced discourse, distinguished by an uncomplicated syntax, rigid semantics and extremely concise language (Carrada 2006). These characteristics, it is argued, facilitate the transference of scientific

knowledge in the most intelligible and clear-cut manner in order to avoid any types of ambiguities (ibid.). Vagueness and verbosity are attributes that, according to the English academic style manuals, are to be avoided. When these traits are present, as is sometimes the case in texts produced by NNES researchers, the discourse is usually perceived as "bad prose" by the NES audience, and the texts are dismissed as "obscure, pompous, excessively abstract and pretentious" (Bennett 2009:50). Writers are thus advised to employ concrete and straightforward terms. Similarly, most of the manuals that were surveyed in Bennetts' study seem to recommend avoiding, as much as possible, figurative language, e.g. culturally-embedded constructions such as metaphors, similes and idiomatic expressions in order to prevent any type of confusion within the text (Flood 1954:9, in Remache 2013:40).

Even though these guidelines are undeniably useful tools in terms of the production of RAs in that they offer instruction that may be readily followed by inexperienced writers, they are oriented wholly towards what is considered "good" writing in English. That is, the overall underlying structure of the academic discourse among all disciplines and genres is built in a way that only accommodates the Anglophone method of constructing knowledge (Bennett 2009:52). This viewpoint is transmitted in the discursive habits of NES, such as idiomatic and rhetorical expressions (i.e. hedges, knowledge claims, ways of referring to the audience), use of vocabulary, and even in the structural framework of RAs, all of which are based only on the American or British English standards.

Given that the guidelines of English academic and scientific discourse are shaped to accommodate only one knowledge perspective, the main problem lies in the fact that the vast majority of the participants of academia and science around the world are not NES. As noted by Deng (2015), only 5% of the world's population are NES,

while the remaining 95% are NNES, and a large percentage of the NNES population use English as the preferred language for international communication. Members of the international scientific and academic community write in a wide variety of English discourses and styles, some of which differ greatly from the standard discourse described in the guides and manuals referred to above. According to Bennett (2009:52), the discourse developed by NNES conveys a different worldview that is communicated through the peculiar use of the grammatical structures and phrasing (a more detailed analysis of these peculiarities will be presented in Chapter 3); as in the case of NESs, these peculiarities are transmitted through the discursive habits of the writers.

The variations of English developed by the different linguistic communities around the world are described by the term World Englishes. World Englishes, as noted earlier in this thesis, refers to all the dialectal varieties of English that have been developing in other countries as a result of the expansion of the British colonial power and the influence of the US (Crystal 2012:59). The discoursal varieties used by epistemological or knowledge communities from countries in the central and expanding circles, such as the global scientific community, are also within World Englishes. Thus, the following section discusses the varieties of international scientific Englishes developed by the NNES international scientific community and how they differ from the standard discourse used by the NES scientific community

1.2.3. English: The Lingua Franca in International Communication

As English as a foreign language spreads within the countries located in the expanding circle, a new variety of English is developed – one that differs considerably both from the standard British or American Englishes, and from World Englishes developed in

the outer circles. This is international English or English as a lingua franca (ELF). What differentiates ELF from the other varieties of World Englishes is the context in which it is used. For instance, while World Englishes are employed as official languages in certain aspects of the political and social structure of the countries in the outer circles, ELF is used as a language that facilitates communication among NNES users at international level, and also facilitates the access to more information in academic spheres; this communication has the objective of advancing specialised knowledge (Tardy 2004:248).

In a similar way to EAP and World Englishes, as ELF is in contact with and is influenced by the discursive characteristics of the native languages of its users, it is difficult to find a specific definition of ELF. Indeed, ELF is usually characterised by a great variability and flexibility, which is what allows its users to accommodate the linguistic and rhetorical peculiarities of their native languages. As noted by House (2013): “ELF is negotiated ad hoc, varying according to context, speaker constellation and communicative purpose. It is thus individually shaped by its users” (House 2013:281). As such, ELF users are multilingual and multicultural speakers who employ English as a language for communication with those who do not share their native language(s); as further noted by House, each one of these speakers shapes the language “with different national, regional, local and individual cultural identities” (ibid.).

Moreover, given that the main objective of ELF is to communicate information efficiently and intelligibly, native-English standards are, in most cases, not necessarily the rule for its production (ibid.). In scientific publications, however, native English standards play a fundamental role. It is in this context that the discursive peculiarities

of ELF added by NNES researchers meet with some resistance from the international gatekeepers of scientific publication.

1.2.4. Culture in Scientific Discourse

Culture is another term whose meaning is difficult to define, as it can be interpreted in many ways. This term can be interpreted from including the traditions and habits from a specific nation or a community, to disciplinary or occupational groups.

Helen Spencer-Oatey (2008:3) defines culture as “a fuzzy set of basic assumptions and values, orientations to life, beliefs, policies, procedures and behavioural conventions that are shared by a group of people, and that influence (but do not detrmine) each member’s behaviour and his/her interpretations of the ‘meaning’ of other people’s behaviour.” In view of the different ways of conceptualizing the term culture, she offers a list of key characteristics of the term culture (ibid., 4-16):

1) According to Spencer-Oatey culture is manifested in three layers: observable artifacts, values and basic underlying assumptions.

2) Culture affects behaviour and interpretation of behaviour.

3) Culture can be differentiated from both universal human nature and unique individual personality.

4) Culture influences biological processes.

5) Culture is associated with social groups. For example:

- A national level.
- A regional and or ethnic or religious or linguistic affiliation, as most nations are composed of culturally different regions ans or rthnic and or religious and or language groups,
- A gender level.
- A generation level.
- A role category, e.g parent, son daughter, teacher, student..

- A social class level, associated with educational opportunities and with a person's occupation or profession.
- For those who are employed, an organizational or corporate level according to the way employeeds have been socialized by their work organization.

(Hofstede 1991:10 in Spencer Oatey 2012:9)

6) Culture is both and individual construct and a social construct.

7) Culture is always both socially and psychologically dsitributed in a group, and so the delineation of a culture's features will always be fuzzy.

8) Culture has both universal (etic) and dsitinctive (emic) elements.

9) Culture is learned.

10) Culture is subject to a gradual change.

11) The various parts of a culture are all, to some degree, interrelarted.

12) Culture is a descriptive not an evaluative concept.

As noted above, the term culture is indeed ambiguous as it can refer to any aspect of communication and interaction in a specific community or group of people. Even in connection to this thesis, as this thesis argues that the specialized discourse used in sciences is heavily influenced by the culture of the native language of their users. This means that the different scientific groups that publish their reaserch in international journals use scientific discourse in a way that transmits certain particularites from their discursive culture, such as rhetorical expressions, syntax, ways of making claims, the usage of certain technical terms, and even in the role of the author (e.g. as an authoritative figure vs the facilitator of information). Therefore, it is still difficult to define a single culture in the production of sience at international level, as not only there are differences in terms of the discursive cultures of the global scientific community, but this also includes the cultures or habits of a group of scientists depending on the area of specialization within science, the culture of the journal, the culture of the groups of scientists, the culture of the position of the scientists, etc. In view of the intricate use of

the term, this section discusses culture in scientific writing as part of the particular characteristics that different scientific groups from around the world add to their scientific discourse and how it interacts in international publication.

Contrary to the widely held view that scientific language is a native-culture-free code that only serves to transmit specialised knowledge without any association to the culture of its users, in actuality scientific discourse does carry cultural content (Polzl 2003, in Fiedler 2011:84). Among NNES users of scientific discourse, the cultural content of language may cause dramatic rearrangements in the syntactical structures of the standard discourse (Wood 2001:73; Gordin 2015:294-295), given that the culture of the users is considerably different from the cultural content in standard English discourse. According to Kastberg (2007), the cultural content is evident in several aspects of science, such as the structure of a RA, rhetorical expressions, the way that the specialised terminology is categorised, and even in the scientific theories. As Kastberg further notes, if cultural content was not a big part of scientific discourse, the same discourse would be composed in the same way in all languages.

According to Kastberg, scientific theories are man-made modes of explaining physical phenomena, which accommodate a specific perception of these phenomena; however, as noted by Santos (2008) and Bennett (2009), this perception can change. For said reason, scientific theories can be refuted by societal progress and can be made obsolete by advances in science (Kastberg 2007:105). This sociology of knowledge explains why certain scientific communities may elect to employ some methods and theories which are rejected by other communities.

The cultural content in scientific terminology is evident in the way it is categorised in different languages and different scientific communities, as noted by Kastberg; although the majority of the scientific terms are fairly universal, their

categorisation is unlikely to be universal (Kastberg 2007:106). For example, Gutiérrez Rodilla (1997:270) discusses the term *range* in English:

> The values of the sample range from 0.30 μm to 1 μm.
>
> Los valores de la muestra oscilan entre 0.30 μm y 1 μm.

She notes that Spanish has three different equivalents – namely *recorrido*, *amplitud* or *escala de variaciones* – for one single concept in English, selected depending on the context or the components of the sentence. It is not that the term range/rango is different in Spanish than in English, but the researchers from both scientific communities, due to cultural preferences, conceptualize the term differently. This is confirmed by the prototype theory in cognitive linguistics; even though the object is immutable, the perception varies according to the subject. It is important to note in this regard, that although the cultural content is an important factor in the incommensurability of scientific terminology between languages, other important contributors include the rapid emergence of technical concepts and expansion of the number of disciplines, as well as the fact that terms and procedures in one same area can become obsolete very fast, sometimes within one year (Kastberg 2007:106).

Evidence of cultural differences is presented in cross-cultural studies concerning the discourse used in RAs (Connor 1996; Bermudez-Fernández 1997; Gutiérrez Rodilla 1997; Fernández-Polo 1999; Flowerdew 1999a, 1999b, 2000, 2008; Ammon 2001; Kastberg 2002; Salager-Meyer 2003, 2008, 2011; Mur Dueñas 2007a, 2007b, 2007c, 2007d; Bennett 2009; Loi et al. 2010; 2015). These studies offer important insights in terms of the cultural content in academic/scientific discourse in the context of the variations in rhetoric and stylistics of RAs between different languages, in contrast with English discourse. Examples include the use of hedging expressions, the rhetorical structure of the RA, terminology, and calque of English-like

syntactic constructions, etc. An in-depth analysis of the writing styles of research articles written by Mexican researchers will be presented later in this thesis in Chapter 3.

1.3. The Hegemony of English in International Scientific Communication: Epistemicide, Epistemological Pluralism and Ecology of Knowledges.

The dominance of English in international scientific communication is evident as it is continuously favoured by NNES scientific communities around the world (Ferguson 2007:14). In fact, the hegemony of English has been increasing enormously over the past four decades, particularly in medicine and the hard sciences. To mention just a few examples, in the area of medicine, Benfield and Howard (2000) reported that the proportion of RAs in English increased from 72% in the 1980s to 88.6% in 1996 (Ferguson 2007:10). In chemistry, Sano (2002) showed that English publications in the journal *Chemistry Abstracts* rose from 54.2% in 1970 to 82.1% in 2000 (ibid.). The benefits that NNES researchers reap from the use of English for their publications are numerous; for instance, their research is more accessible to the international community, and such visibility to the international community facilitates collaborations in international projects, generates more funding for research, and aids professional growth (Flowerdew 1999a:123; Salager-Meyer 2014, 2015). However, as noted by Hamel (2007:53), the predilection of English by NNES researchers implies that other traditionally international languages, such as German, French, and Spanish, will no longer be considered languages of science.

Notwithstanding the benefits that the international scientific community may reap from favouring English in their publications, different positions exists regarding the effect of the dominance of ELF in science in academia. On one hand, a large body

of studies describe the predominance of a single language in international communication as having a negative impact on scientific production and on the specialised discourse in the native languages of researchers from the periphery and semiperiphery of the scientific community. Thus, while ELF is considered by many as a seemingly culture-free language with which its users aim to facilitate communication and the wide dissemination of knowledge, it is also described by some as a "killer language" (Skuttnab-Kangas 2003:33) or "a Tyrannosaurus rex, a powerful carnivore gobbling up the other denizens of the academic linguistic grazing grounds" (Swales 1997:374, in Tardy 2004:248).

According to this view, English discourse works in two main ways. Firstly, as noted by Bennett (2009), the dominance of English works to exclude any knowledge perspective produced by NNES researchers that differs from the Anglophone way of constructing any type of knowledge. This phenomenon is called epistemicide (Santos 2007; Bennett 2009). Epistemicide is a term coined by the Portuguese sociologist Boaventura de Sousa Santos (2005), and refers to the effects of globalisation in peripheral countries (Bennett 2007:154). More specifically, epistemicide pertains to the imposition of a knowledge perspective and the suppression of the other more vulnerable perspective, brought about by globalisation. The authors Moraes and Freire (2017:27) problematize the concept of global, which they note shows multiple associations that may be antagonistic. In the first instance, "global" can be related to concepts such as "big, exotic, contemporary, connected, open-minded, and welcoming" (ibid.). On the other hand, this same concept can also connote a subcontext that indicates dominance, social injustice, and the destruction of natural resources" (ibid.). Thus, while globalisation, can be linked to the production of more opportunities, betterment of life conditions, it can also involves the expansion of a

particular group around the globe that carries a specific phenomenon, such as the expansion of English as the lingua franca in international communication, which is transformed into the "winner of a struggle for the appropriation or valorisation of resources ….. for the imposition of a given international (dis)order" (Santos 2007:8). Such practices, as Santos (2007) suggested, have an effect on the local conditions of the local or "defeated" groups, such as the disintegration, oppression, exclusion and eventual restructuration as subordinate exclusion. Bennett extends this concept and relates it to what is currently happening in terms of the influence that English has in academic writing discourse; indeed, she defines epistemicide in this context as "the systematic destruction of rival forms of knowledge" (2007:154). Since the knowledge produced by a particular culture or community is deeply linked to the identity of its members, different linguistic and cultural communities have different ways of conceptualising the world and thus constructing knowledge. Bennett suggests that translators, as one of the main gatekeepers of Western academic culture, are important agents when it comes to remedying the potential epistemicidal effects in academic discourse; with regard to this, Bennett develops her studies from the point of view of the translator.

Secondly, as a consequence of the dominance of English discourse and the growing pressure on NNES researchers to publish in this language, the scientific communities from peripheral countries have started to develop a sense of stigma, due to their occasional inability to comply with the native English standards requested by editorial journals; said stigma hinders their transition to and visibility in the international scientific community (Goffman 1959; Flowerdew 2008). Furthermore, there is always the fear among NNES researchers in the periphery that their work will be ignored by the elite scientific community (Crystal 2012:16). Moreover, the stigma phenomenon,

as presented by Goffman, is a result of the sociology of scientific production. As noted by Flowerdew (2008), NNES add peculiarities derived from the influence of their native languages to the texts written in English; these non-standard English varieties are perceived as “indicative of negative characteristics such as laziness, lack of education, low intelligence, etc.” (Flowerdew 2008:80). This phenomenon is brought about by the relationship with editors and reviewers. For instance, when NNES researchers submit their manuscripts for publication in international journals, the editors and reviewers of these journals make comments to the authors or even reject the articles “on the grounds of poor language” (ibid.).

Epistemicide, as noted by Bennett (2007:154) works in different ways; for instance, in science and academia, it excludes knowledge grounded in ideologies that are different from those of the dominant groups – in this case the scientific community from central countries (e.g. US, UK). Thus, the knowledge perspectives of communities from the periphery of the scientific production are usually labelled as irrelevant and will, by and large, be silenced completely. As a consequence, as noted by Bennett (ibid.), the scientific communities from the periphery “will be starved of funding, they will remain unpublished, since their very form will be unrecognizable to the editors of journals and textbooks”; they will also be unable to be taught at schools and universities, thus ensuring their rapid decline into oblivion. Canagarajah (1996) noted that a significant factor in this hardship is the substantial differences between the written discourse of NNES in comparison with the native-like standards (see the list offered by Bennett [2009: 62]) required by the English-language journals; as a consequence, they tend to be ignored or undervalued by the editorial boards of these journals (Canagarajah 1996, 2002; Tardy 2004, in Ferguson 2007:20; Ammon 2000:1).

Such approach, however, has failed to give evidence of actual destruction of the knowledge perspective in science produced in the periphery and semiperiphery, particularly because differences in the knowledge perspectives in science are not very clear. Nevertheless, notwithstanding some epistemicidal effects caused by the dominance of English in terms of the knowledge perspectives of NNES research communities, there is still not enough evidence indicating the extent of the epistemicidal damage caused at deeper levels of knowledge construal; moreover, such evidence does not show that the dominance of English affects all the scientific communities from the periphery and semiperiphery in the same way, since, as noted by Salager-Meyer (2008:3), the periphery/semiperiphery is not homogenous and science is distributed in the countries in these areas in a very unequal way. The identification of the extent of damage present in scientific knowledge remains a current need, and particularly that in the scientific discourse used among experts, given that the most ground-breaking and specialised information is handled at this level, and in such discourse even the slightest modification may completely interfere with the actual intention of the information.

At the same time, there are two notions that refer to the diversity of knowledge perspectives in science and academia, these are epistemological pluralism and ecology of knowledges. Contrary to the viewpoint that sees the dominance of ELF in scientific publication as a tool used for the complete destruction of the knowledge produced by NNES scientific communities in the periphery and semiperiphery of science, ecology of knowledges and epistemological pluralism consider the dominance or presence of ELF in scientific production as the interaction between different knowledge perspectives in science that seek to compliment each other in

terms of the application that universal scientific theories and processes are capable of offering to the different communities around the world.

Miller et al. (2008), propose an epistemological pluralism, in which gaps in knowledge in diverse academic and scientific disciplines are filled. As noted by Miller et al. given that with globalization education and research are rapidly chanigng, disciplinary approaches are not well equipped to address the issues in “multiple academic divides”. This, according to Miller et al., is mainly due to the privilenging of a single epistemological and disciplinary perspective, as each one of these perspectives has a different way of conceptualizing how knowledge is constructed, as well as how it is produced and how it is applied (Roscher 2003, in Miller et all 2008:1). This has negative effects in the diversity of knowledges, according to Miller et al, as it limits the different perspectives in scientific and local knowledge (ibid). Thus, the notion of epistemological pluralism can hopefully “lead to the production of more useful scientific knowledge for the study and management of SESs (ibid.,2).

The way in which epistemological pluralism becomes useful in science is in that through multidisciplinary research, all researchers are investigating the same problem from their own disciplinary point of view. Epistemological pluralism, intends to solve the problems that cannot be effectively solved by a single disciplinary perspective, thus different disciplinary perspectives and knowledges can facilitate “a more complete understanding of the complexity of a single problem (Miller et al. 2008:2)

Similarly, the notion of ecology of knowledges, as noted by Santos (2007, 2014), refers to the diversity of knowledges there are in the different discplines. This theory acknowledges diverse types of knowledges, from social to the hard sciences, and considers the knowledges from these areas to be complementary rather than contradictory or irrelevant to each other (Santos 2014:189). Moreover, the ecology of

knowledges also acknowledges the different knowledges produced around the world. According to Santos (2007:67), the ecology of knowledges is based on the epistemological diversity of the world, the recognition of a plurality of knowledges beyond scientific knowledge which implies renouncing any general epistemology' (Santos, 2007: 67).

Santos (2007:4) identifies two extremes in the production of knowledge, which he identifies as abyssal thinking. Abyssal thinking consists on a line that divides one type of knowledge, which is considered the official knowledge, this is the one produced by the centre. On the other side of the line Santos distinguishes the knowledges that are not recognized by the centre, this is indigenous, peripheral knowledges or knowledges from the South. The knowledges from this side of the line are excluded from the focus. According to abyssal thinking, modern science or the official knowledge, has the power of deciding what is true and what is wrong, while the other types of knowledge, i.e. from areas such as philosphy or theology, or indigenous knowledges are excluded. The visibility of knowledge from the centre, is based on the invisibility of other forms of knowledge, i.e lay, plebeian, peasant or indigenous knowledges. As noted by Santos (2007) the knowledge produced in this side of the extreme is not considered real, indigenous or peripheral knowledge is considered as beliefs, opinions, intuitive or subjective understandings that may become materials for scientific enquiry (Santos 2007:4). According to Santos (2007:18) ecology of knowledges gives us a better view of the things we do not know, as well as what we know, and to be aware that the unknown is our own ignorance.

Santos further notes that if abyssal thinking is not recognized the abyssal lines will continue to reproduce. Therefore, he proposes post-abyssal thinking, which involves to think from the other side of the line, "precisely because the other side of the

line has been the realm of the unthinkable in Western modernity" (ibid., 26). Post abyssal thinking thus, confronts the monopoly of modern science, as it learns from the South through an epistemology of the South, with an ecology of knowledges. "The ecology of knowledges is founded on the idea that knowledge is inter-knowledge" (ibid., 26-27).

As further noted by Santos, ecology of knowledges sees the application of the different knowledges as interventions in the real world, as opposed to the traditional view that sees knowledge as the representation of reality (ibid., 201). Thus, the credibility of such knowledge is validated or measured by the type of intervention a particular knowledge has in the real world, and since one single knowledge cannot account for all interventions in the real world, "all knowledges are incomplete in different ways" (ibid., 201). In other words, according to the ecology of knowledges, the validity of the scientific reserch produced in the centre versus that produced in periphery would not have to be validated or discredited by the standards from the groups from the the centre, but rather from the real-world applications that the knowledge could have locally.

According to Santos, in the ecology of knowledge ignorance and knowledge interesct, this is gaining new knowledge may involve forgetting other. Therefore, in the learning process in the ecology of knowledges it is very important to compare the ignorances, or the knowledge that is being forgotten, with the knowledge being learned. Since scientific knowledge is a product of abyssal thinking, it is not distributed in a fair manner. Therefore, the real-world interventions tend to favour the social groups that have the access to the scientific knowledge, i.e. the centre. According to Santos (2007:31), if the abyssal thinking lines continue to be drawn, cognitive justice will not be successful.

Nuryatno (2003:26) and Moares and Freire (2017:29) note that the ecology of knowledges happens within a “paradigm shift”, where a new perspective of the world arises and which is eventually accepted by scholars and scientists over time. According to Moraes and Freire (2017), the paradigm shift happens as a “breach in normal science”, a term which Kuhn (1970:22) refers to as research that is based on past scientific achievements, which at the same time were produced by a particular scientific community, and is acknowledged as the base of their knowledge (in Moraes and Freire 2017:29).

As further noted by Moraes and Freire, currently, normal sciences function as the standard for research due to the success that it gained in their local application of a problem, this is “problems that are considered important by the group of experts”. Therefore, scientific revolution happens when this paradigm can no longer solve or approach the problems. Moares and Freire (2017) hold the view that the ecology of knowledges intends to overcome the barriers and prejudices that have hindered a better dialogue between the West, or the official knowledge, and the other types of knowledges that have been excluded. The ecology of knowledges is part of a paradigm shift, a revolution. It is part of a paradigm shift, a breach in ‘normal science’, showing that the existing paradigm does not function properly in many aspects, that it needs to include other worldviews, other knowledges (ibid.,40).

This section has reviewed the two notions regarding the potential effects of ELF in scientific publication, more specifically the effect that ELF has on the scientific production of communities from the periphery and semiperiphery such as the Mexican scientific community. While, as noted above, the dominance of the knowldge perspective from the scientific community from the centre has indeed hindered the visibility of the publications from scientific communities from the periphery and

semiperiphery, in order to support cognitive justice, it is important to acknowledge the complementary nature that the different knowledges of every scientific community bring internationally, and to focus on the benefits that their acknowledgement could bring in the diversity of knowledge and their further applications.

Although the paragraphs above allocate the poor visibility of publications from the scientific community from the periphery and semiperiphery to the use of ELF as the main language of communication as a result of the dominant and constant presence of the scientific community form the centre (i.e the US and the UK), there are other factors that also contribute to this lack of representation. These are discursive and non-discursive factors. The discursive factors refer to language change in the L1 of NNES scientists derived from the constant interaction between their L1 and ELF. The non-discursive factors pertain to the contextual elements of each scientific community and the impact which said elements have on the scientific production of these communities and how they are received by the international scientific community.

1.3.1. The Discursive Factors

The discursive factors are those that contribute to the impact that English has on other languages. Similar to the notion of ELF being a “killer language”, some authors view this impact as having negative effect on other languages, such as the loss of the status as scientific languages at international level, or in some loss of domains of knowledge (Ferguson 2007:7). Many scholars have presented contrasting analyses of the interferences of English discourse in different academic and scientific disciplines. For instance, Gutiérrez Rodilla (1998) studied the interferences of English discourse in

medical texts written by Spanish native speakers. She referred to the influences of English discourse as bad translations or adaptations. According to her, bad translations are performed either by professional translators or by the researchers themselves due to a lack of familiarity with the technical terminology of either language. She identified the interferences of English in the Spanish medical discourse at three main levels: 1) the lexico-semantic level; 2) the syntactic level; and 3) the orthographic-phonetic level.

Similarly, Bennett (2009) has studied the effects of the discursive interferences of ELF scientific discourse adopted and executed during the translation process of articles written by Portuguese scholars. She found that, as a result of the influence of English academic discourse exerted by the standard guidelines shown on page 50 above, NNES researchers and translators tend to view characteristics such as clarity, coherence, impartiality, economy and accuracy as being exclusive to English discourse. According to the view of ELF as a killer language, the association of Anglophone standards in terms of language usage and written production as the only means to generate outstanding research can have many repercussions in several aspects of NNES scientific communities. Firstly, as NNES attempt to imitate the Anglophone scientific style in their own writing, they disregard the incompatibilities of their native languages with the rhetorical tradition of English scientific discourse. Secondly, as their specialised discourse is no longer used, it subsequently deteriorates. However, this view fails to consider the many advantages that NNES scientists as multilinguals have in terms of the language usage in academic writing. For instance, as noted earlier in this thesis, multilinguals do not adopt the standard language for their writing, instead they negotiate strategies in both languages (L1 and L2) in order to communicate. Thus, ELF or their L1 do not interfere in their written

production. The combination of rhetorical and syntactic characteristics of the L1 and ELF, as noted by Canagarajah and Wuur (2011) is a creative process that facilitates communication.

Nevertheless, although NNES researchers negotiate strategies to use ELF in their RA, they also experience difficulties in writing for publication. Flowerdew (1999a) identified some of the most problematic aspects of scientific written discourse with which NNES researchers struggle. The results he obtained, even though they were localised to a specific academic community, can be applied to other communities from different linguistic backgrounds. In his study, Flowerdew surveyed Chinese scholars in terms of their perceptions and practices while writing in English for scientific publication. The main aspects of scientific writing summarised by Flowerdew (1999a:127) are listed as follows:

- Use of citations
- Making reference to published literature
- Structuring of argument
- Textual organisation
- Relating text to audience
- Ways in which to make knowledge claims
- Ways in which to reveal or conceal the point of view of the author
- Use of “hedges” to indicate caution, expected by the academic community
- “Interference” of different cultural views regarding the nature of the academic processes

As shown by Flowerdew above, the difficulties experienced in writing English for scientific publication are grounded in the difference between the rhetorical strategies used in their native language and those in English. Numerous differences in the patterns of argumentation have been found among many languages with respect to English. Taking the scientific discourse of Mexican researchers as an example, even though they tend to follow the standard conventions of scientific publication for their articles, there are certain rhetorical strategies from their native languages that they simply cannot avoid. Such is the case, for example, with hedging strategies and knowledge claims. In a contrastive analysis of the discourse used in medicine in Spanish and English, Salager-Meyer (2008) identified the notable rhetorical and stylistic differences between the discourse used by NES and native Spanish speakers in their writing. On one hand, English written discourse tends to be more straghtforward and objective - thus NES tend to structure their texts in a more linear and simple way. Spanish, on the other hand, tends to follow a more complex and convoluted structure – thus native Spanish speakers tend to elaborate their argumentation with the production of complex constructions and a rhetorical structure that do not seem to have a straight correlation in comparison with the simplicity of English. Thus, Spanish native speakers tend to produce texts with subjective and aesthetic attributes that favour the usage of more complex and convoluted sentences (Wood 2000). The marked differences in the style and rhetorics of the formal discourse of scientists thus interferes in the written production of texts in another language. A detailed analysis of the rhetorical and stylistic characteristics of Spanish in contrast with English is included in Chapter 3.

1.3.2. The Non-discursive Factors

The non-discursive factors refer to those local elements that contribute to the unbalanced representation between researchers from the centre and researchers from the periphery and semiperiphery of scientific publication. The distinction between the centre, periphery and semiperiphery in this thesis is based on the scientific publications and productions at international level. The countries in the centre are the developed countries, such as the US, the UK, Germany, Japan, France, Canada, China and India[2]. The countries on the periphery are the developing or industrial countries, such as El Salvador, Guatemala, Colombia, Cuba, Puerto Rico, Uruguay. The countries in the semiperiphery share characteristics from both the core and the periphery, such as Brazil, Argentina, Mexico, and Spain, among many others.

The main problem lies in the fact that researchers from peripheral and semiperipheral countries are considerably disadvantaged in terms of their access to, and visibility in, highly-ranked international journals (Salager-Meyer 2008). This imbalance, as argued in the literature, is due to several social and economic factors in the countries from the affected scientific communities (Ferguson 2007:7; Gibbs 1995; Flowerdew 1999a, 1999b; Salager-Meyer 2008, Curry and Lillis 2004, Canagarajah 2003, 2006, 2014; Ferguson 2007; Bennett 2009, 2013; Gordin 2015). With respect to the issues generated by the centralisation of scientific production, periphery and semiperiphery researchers may be affected in several ways. As Gibbs (1995:93) pointed out, researchers from the periphery and semiperiphery are susceptible to structural obstacles and subtle prejudices from the central groups, which prevent them

[2]Although China and India are categorised as developing countries, they are technological and scientific powers. For this reason, they are included in the centre of scientific publication.

from sharing their discoveries in the inner circles of sciences and even with one another.

In the first place, it has been argued that one of the main inequalities is the significant advantage that NES researchers from the centre have over NNES researchers, and particularly those from the periphery. This is due to NES researchers' native command of the English language, coupled with the discursive standards of scientific discourse; NES researchers have learned the language effortlessly and can therefore carry out their research without disruptions, thus making the publication process of their articles in mainstream journals much easier (Gibbs 1995:96; Gordin 2015:312). NNES researchers, on the other hand, have to invest extra time and money in language learning courses in addition to performing their routine research (Ferguson 2007:20; Flowerdew 2008:78). Additionally, given that most of the updated literature available is in English, NNES researchers take longer to assimilate the information in comparison to NES, consequently leaving them less time to carry on with their writing process.

As noted by Canagarajah (1996) and Salager-Meyer (2008), many of the factors that contribute to the disparity in scientific publication are derived from the socio-political context of peripheral and semiperipheral countries. For instance, since the scientific communities located in the centre, including both NES and NNES, are economically advanced, research is considered a priority; as such, these scientific communities have better access to material in order to carry out their research, in addition to better resources for L2 language learning. On the other hand, scientific communities from the periphery and semiperiphery tend to have unstable economies, do not invest in research, do not have tradition in research and its publication, and

have poor access to materials as well as fewer resources for L2 learning (Salager-Meyer 2008:123).

Another factor related to this hardship, as noted by Canagarajah (1996:473), is the conventions followed by the publishing industry which, as he further states, are "deeply involved with the politics of knowledge production". The politics of knowledge production is based on a hierarchical organisation, which allocates higher and lower ranks in the knowledge order (Weiler 2009:496); simply put, in the centre-periphery dichotomy, the knowledge produced by groups from the centre is in the higher ranks, whereas the knowledge produced in the communities from the periphery is in the lowest ranks. As Canagarajah further stated, the editorial boards from international journals perpetuate the hegemony of the knowledge from the centre by incentivising the English written standards for publication. This results in the exclusion or suppression of the knowledge of the periphery/semiperiphery-based scientific community (Canagarajah 1996:443).

Research centres and universities in the periphery and semiperiphery also play an active role, although inadvertently, in the perpetuation of the knowledge perspective form the centre. As noted by Curry and Lillis (2004:680), this happens through the implementation of reward systems to promote publication in highly-ranked international journals, given that through their local journals their research cannot have the same impact. As further noted by Curry and Lillis, these systems have been counterproductive in various ways: firstly, they diminish the value of local publications, placing the highest value on international journals. Secondly, as the priority is given to the Impact Factor (IF) and number of publications, many cases of duplicate publications have been reported, as well as cases involving the neglect of issues relevant to the local community (Gibbs 1995; Curry and Lillis 2004:680; Salager-Meyer

2008; Sotelo-Cruz 2014). A third effect of this phenomenon is the neglect of the local journals which, as described by Hebe Vessuri:

> fall in the vicious circle of neglect and prejudice: domestic journals did not gain prestige and international circulation because scientists published their best results abroad, but Latin American researchers published abroad because domestic journals did not take their results to the scientific world (Hebe Vessuri, in Gibbs 1995:95).

The Impact Factor (IF) of journals, as mentioned above, also has a detrimental effect on the scientific community from the periphery and their local journals. According to Alberts (2013), IF is increasingly misused, as scientists are now being measured based on the IF of the journals they have published (2013:787). Consequently, researchers from periphery and semiperiphery scientific communities, as they favour publication in international journals, their research is not available to their local scientific community. Thus, the development of the journals in the periphery and semiperiphery is affected, as they disregard important research from fields that are not as important (Alberts 2013:787). Such metrics, as pointed out by Alberts (ibid.), have a detrimental effect on scientific innovation "because they encourage scientists to work with areas of science that are already highly populated, as it is only these fields that large numbers of scientists can be expected to reference one's work, no matter how outstanding".

Specialised or technical translators also have an influential role in scientific publications. As noted by Bennett (2013:2), this influence comes from the fact that the main role of a translator is to present foreign knowledge to a new audience that is often based in a completely different epistemological paradigm from the target audience, in

a way that the audience can identify themselves with and thus accept the knowledge. Given the many structural and discursive differences produced by NNES researchers, it is often the case that the source text has to be modified. The modification of the source knowledge involves reformulation of the “epistemological infrastructure” which is eventually replaced with the epistemological infrastructure from the NES or target audience (ibid.). Accordingly, this is a process that, as noted by Bennett, involves a degree of epistemicide (ibid.).

The greatest threats posed by the effect of the discursive and non-discursive factors in the scientific output of NNES researchers from the periphery and semiperiphery of scientific publication have been discussed by several authors. According to Bennett, the knowledge perspectives that are completely different from the dominant one, i.e. those of the scientific communities from the periphery and semiperiphery of science, are disregarded; this means that the scientific periphery/semiperiphery-based communities are at risk of losing funding, remaining unpublished, and being in a position where the valuable knowledge produced by them will not be taught at universities (Bennett 2007:154). This may cause the knowledge perspective from these communities to fall into the category of lost science (Bennett 2007; Salager-Meyer 2008:125).

As a consequence, and as alluded to by Gibbs (1995:93) and Curry Lillis (2010:282), global scientific knowledge may be deprived of critical knowledge and different perspectives. A clear example of this is offered by Gibbs (1995) in the area of medicine. Indeed, the author pointed out that the study of localised viruses is rejected in elite journals on the grounds of it not being relevant for central research; consequently, in the event of the outbreak of a disease, previous knowledge about the disease will be unavailable for researchers in the centre, since the journals are not

indexed in international databases. Regarding this, Gibbs pointed out that “[t]he only way to understand that process and its effects is to publish work from local researchers” (ibid. 94), this is by the recognition of the knowledges from other countries and disciplines through an ecology of knowledges, as proposed by Santos (2006).

In second place, as noted by Ferguson (2007:15), there is the threat of loss of domain in other languages as well as loss to the standardised languages of the NNES scientific communities. Because of said point, as the number of publications of scientific RAs in English continues to grow, this will generate “register atrophy” among the local scientific community, in which the language’s discursive resources will deteriorate (Gunnarsson 2001, in Ferguson 2007:15). As the register deteriorates, Gunnarson adds, English discourse patterns will replace the local languages and, as a consequence, researchers will not be able to conduct science in their native languages, thus affecting the scientific output of these scientific communities (in Ferguson 2007:15-16). In addition to this, while peripheral countries are deprived of the application of scientific research, the benefits which the tradition in scientific research provides to the economic development and financial stability of the country are not materialising (Salager-Meyer 2008:7). Similar to the register atrophy of languages different from English, as NNES researchers are choosing English as the main language in which to publish their results, other languages with a strong history as languages of science, such as French, German or Spanish, are increasingly losing their appeal (Hamel 2007:60).

When weighing the effects of the discursive and non-discursive factors that affect NNES scientific publication, it could be argued that the non-discursive factors outweigh their discursive counterparts (Ferguson 2007:33). Ferguson made some interesting observations in this respect. Firstly, given that the unbalanced

representation of NNES science in international publication is mainly caused by the socio-economic contexts in the centre-periphery dichotomy, the focus is taken away from the distinction between NES and NNES researchers. Secondly, the visibility of RAs written by NNES researchers is increasing (ibid.32); this trend contradicts the possibility of a lost science domain in which unpublished or blocked NNES researchers are doomed to fail. Moreover, as further noted by Ferguson, many of the obstacles experienced by NNES authors with scientific discourse (see list offered by Flowerdew earlier) are also experienced by NES writers (ibid.33).

This chapter has reviewed how English became the favoured language in international scientific publication, after many other languages were used in a similar way as the main vehicle of scientific and academic communication. As noted above, the predilection of English as the main language in international scientific communication, and its consequent influence on other linguistic groups within the global scientific and academic community, is a result of the economic, political, military and academic stability of NES countries (mainly USA and UK), which has allowed the language to be perceived by others as proof of academic superiority. Nevertheless, as has also been mentioned throughout this chapter, such influence can also affect the NNES scientific community in that the research of NNES scientists from the periphery and semiperiphery is not as visible or is not considered to have the same status at international level as the research produced by NES scientists and those from scientific communities from the centre. Moreover, as noted above, NNES scientistis include modifications in their scientific discourse through negotiations between strategies in ELF and their L1, which are made in order to improve communication. In other words, these are conscious and intentional modifications, rather than them being unconscious result derived from the interference of ELF.

Having considered how the influence of ELF affects the scientific community from countries on the periphery, we will now pass on to discuss the non-discursive factors – that is, the factors outside language – that impact upon the Mexican scientific community.

Chapter 2: The Non-Discursive Factors Affecting the Scientific Community from Mexico: Publishing and Scientific Institutions

"Cada tipo de sociedad requiere un estilo de ciencia propio"
[Every society needs its own scientific discourse style]
-- Varsavsky (1972, in de la Peña 1987:41)

As mentioned in Chapter 1, the scientific community from the periphery and the semiperiphery struggles in international publishing due to discursive and non-discursive factors surrounding each community. As a result, the scientific output from these communities is not well represented at an international level. The scientific publications in international journals from these groups are remarkably unequal in terms of the visibility received by NES or NNES scientists, as scientific databases include mostly output from research centres in countries from the inner circles of scientific production, as the work of such research centres is usually perceived as the most advanced and relevant (Canagarajah 1996; Curry and Lillis 2004; Salager-Meyer 2008).

Nevertheless, it is important to note that although the scientific communities from the periphery and the semiperiphery are affected by the dominance exerted by the scientific community from the centre, as well as other non-discoursal factors, these factors and the effects they have are not the same for every community, since, as noted by Salager-Meyer (2008), the communities and the circumstances in which science is produced are not homogeneous. For instance, the socio-political, academic or linguistic circumstances that affect scientific production in Mexico are not the same as those in Spain. Indeed, this is regardless of the similarities that both countries share linguistically. For the purpose of the present thesis, the analysis in this and the remaining chapters will focus on the scientific community from Mexico.

The scientific community of Mexico, occupying a semiperipheral position, is affected by the dominance of the scientific community from the centre in the neglect of their publications by international journals. This is, scientific publications in the hard sciences from this community are almost invisible in international journals. As a consequence, Mexican scientists' research is not being acknowledged by their peers in international circles and may run the risk of falling into the lost science domain. Secondly, given the continuous pressure exerted by international journals to follow "trendy" research topics in order to be considered for publication, many researchers are beginning to disregard topics that are better suited to answering the needs of their local communities; as a consequence, Mexican researchers may begin to favour the dominant knowledge perspective over their own.

This chapter reviews the relation between the non-discursive factors in the scientific production of Mexican researchers and how they affect their community at the international and national levels. The chapter is organised in the following way: Section 2.1 provides a chronological summary of the history of science and scientific production in Mexico, beginning with the Colony – the period in which science as we know it today was first introduced to the country – and ending with the modernity of science in the country. Section 2.2 provides an analysis of the present circumstances, from a socio-economic perspective, that contribute to the current position that the Mexican scientific community occupies at the international level. Section 2.3 offers statistical data showing the contribution of Mexican researchers in specialised areas in international journals. Lastly, Section 2.4, in concluding the chapter, puts forth the effects that the non-discursive factors cause in the scientific community from Mexico.

2.1 Science in Mexico

As noted by Aldana (2012:26), the scientific and technological standing of a country is crucial for its economic and social development. Simply put, the economic, financial, health and sanitary benefits that scientific and technological advances bring about for a country are fully determined by the involvement of the community in the scientific and technological development. For instance, countries such as the UK, Germany and France are categorised as developed countries due to the reciprocal relation between the scientific community, the government, and the community in general that is evident in those countries. Conversely, the scientific and technological development in Mexico remains remarkably small, therefore, it is still categorised as a developing country. According to Aldana (ibid.), due to the unfortunate underdevelopment of science and technology in Mexico, in comparison with the countries in the centre of scientific production, over the years there has been an increase in serious repercussions for the socioeconomic aspects of the country (ibid.).

Scientific and technological development in Mexico is restricted by many factors that surround its state of affairs: firstly, it may be argued that given the way in which scientific knowledge and the scientific paradigm were imposed on the country, there is a certain lack of a scientific culture. This point works at two levels, the first of which concerns the scientific community and the lack of discursive tradition in research, while the second pertains to the society of the country in terms of their involvement in, or understanding of, science. Secondly, attention must also be paid to the broken relationship between the scientific community and its impact in the national society, and particularly when it comes to the goals or interests of the government of the country (Aldana 2012:26).

With regards to the lack of scientific culture, it is important to mention as well the cultural incompatibility between the ideology of the society of Mexico, which is mainly rooted in religious beliefs and superstition, with the objectives and ideology of the scientific community and science itself; indeed, as noted by Aldana (ibid.) there seems to be a disconnect between the society of the country and a lack of trust in the benefits and the impact that scientific development can bring about for the wellbeing of the Mexican society. For instance, CONACYT[3] (2009) carried out a survey in Mexico concerning the perceptions of science and technology shared by Mexican citizens; the following are the results generated by the survey: 86.3% of the respondents stated that, when it comes to solving problems, they have more trust in religious faith and magic than in science; 57.5% stated that scientists can be potentially "dangerous" due to the type of knowledge they possess; and 50% expressed the feeling that science and technology generate an artificial and dehumanising way of living (Aldana 2012:27). This way of thinking about scientific development, coupled with the financial instability in the country, has serious repercussions in the short and long term alike (ibid.).

Mexican scientists, on the other hand, lack a discursive and practical tradition in terms of research and knowledge production, particularly when it comes to the hard sciences. According to de la Peña (1987:40), much of this is attributed to the fact that technical institutions were introduced in Mexico around five decades ago, as a result of the demands generated by industrialisation as a consequence of the Mexican revolution in the second half of the twentieth century; this was not the result of a process of evolution in the thinking or the ideology of Mexican scientists, but instead a result of the needs of external groups from countries in the centre, such as the USA, France, and the UK. According to Tamayo (2009:205), although many of these

[3] Consejo Nacional de Ciencia y Tecnología (National Council of Science and Technology)

institutions were dedicated to the creation of new knowledge, in most cases they were committed to receiving and disseminating the scientific knowledge that was created in developed countries – particularly the knowledge produced in France. Therefore, the concept of knowledge production in Mexico is based on imitating and copying knowledge produced and already processed by external academic and scientific communities.

In a study on the training of scientists in Mexico, developed and carried out in the early 1990s by Fortes and Adler-Lomnitz (1994:161), it was also identified that the scientific communities from Latin America suffered from a shortage of resources and a lack of established mechanisms for recognising scientific achievement. This, as further noted by Fortes and Adler-Lomnitz, is reflected in the fact that higher education institutions focus on teaching students how to use knowledge, rather than produce it. For instance, higher education institutions in Mexico, such as UNAM[4], are based in an authoritarian system whereby students are taught to accept truths rather than to question them (Paradise 1978; García and Vanella 1992, in Fortes and Adler-Lomnitz 1994:161). As also stated by de la Peña, this way of conceiving knowledge is so deeply ingrained in Mexico that even universities do not consider scientific and technological research as a priority. This way of perceiving knowledge production in Mexican universities is very well expressed by Wiberg in the following quotation (2001:352): “En los grandes centros se hace ciencia; en los países en desarrollo se aplica”. [Science is created in elite research centres (centre), and is applied in developing countries (periphery and semiperiphery)].

With respect to the involvement of the national community with science and the lack of support that the scientific community receives from the government of the

[4] Universidad Nacional Autonoma de México (National Autonomous University of Mexico) One of the leading public universities in the country.

country, ever since the European encounter with Mexico, the development of science and academia has not been stable, mainly due to the social movements caused by this intervention that took place during the first century of the independent Mexico (Tamayo 2009:205). According to Arechiga (1995), the scientific development of Mexico is characterised by brief moments of progress followed by social or economic cataclysms – a condition with which the field of science is still struggling in Mexico even today. According to Tamayo (2009:200-201), social and financial instability in a country are detrimental to its scientific and technological development, as the priorities of the country are no longer focused on the development but on the survival of the community:

> When a country faces difficult times the priorities of the society are reduced to only survival and the vindication of basic human rights, or even to the freedom of each individual; the highest and most specific values of human beings, such as knowledge production and theorization, are hidden or are expressed in its minimum; nevertheless they do not disappear. Because of the violent, arbitrary and violent development of the Mexican history it is outstanding that science and technology survived. (Tamayo 2009:200-201)

Science, as we know it today, emerged in Mexico around 500 years ago, with the arrival of Spanish conquistadors to the Americas. As shown in Chapter 1, during this time, developed countries in Western Europe already had established scientific and academic traditions and discourses. Thus, the introduction of scientific knowledge in

Mexico happened more as an imposition of a new paradigm rather than as a natural process. Ever since scientific knowledge was presented in Mexico, scientific and academic institutions in the country have been focused on the assimilation of knowledge produced by foreign institutions instead of producing new perspectives (Aldana 2012:26).

What follows is an account of the introduction of science as we know it today, and how it evolved following its first implementation, throughout the history of Mexico. The respective sections cover: the Colony (16th to 19th century); independent Mexico (Early 19th century); and the twentieth century (Pérez-Tamayo 2010:12). The following paragraphs present a summary of these periods, and the main events that represent the non-discursive factors that contribute to the current situation in Mexico's scientific community.

2.1.1 The Colony: 16th to 19th century

According to Pérez-Tamayo (2010:41), the colonial period in Mexico (1521–1821) represents the starting point of the historic development of Mexican science, given that in this period the knowledge that the indigenous civilisations developed was assimilated by European science. Indeed, through the Spanish colonisation of the Americas, the indigenous civilisations, such as the Aztecs and the Mayans, had already achieved great advances in astrology, architecture, botanics and pharmacopoeia (Todd et al. 2009:25,); despite this, however, their knowledge is not categorised as science in modern terms (Pérez-Tamayo 2009; López-Austin 2009). According to López-Austin, this is due to the fact that the knowledge produced by the indigenous civilisations was based in religious beliefs and magic (in Pérez-Tamayo 2010:11-12):

> in the pre-Columbian world science, as we know it nowadays, did not exist. When truth (knowledge) is known because it came from the Gods, there is no place for questions about nature, a factor that is crucial for the beginning of science.

With the arrival of the Spanish conquistadors, the knowledge gathered by the indigenous civilisations was assimilated by European researchers, mainly in the areas of botanics and pharmacopoeia; at the same time, the knowledge was subjected to the argumentative paradigms of Western science (Todd et al. 2009:25; Pérez-Tamayo 2010:19). The first scientific publications in Mexico emerged during this period around 1570-1630 (ibid.); the most represented areas at this time were medicine, astronomy, botanics and zoology.

These publications were slowly putting forth new scientific hypotheses, although they were always within the guidelines established by the Catholic Church (ibid.19-20). Indeed, the Catholic Church had so much power during this time that much of the development in science and technology was hindered by superstition, censorship and prosecution derived from the dominance of this institution (ibid.31). The worldview of the colonial period was characterised by “a mixture of renacentist ideals and free thought, combined with conservative tendencies that promoted repressive structures from the middle ages” (Todd et al. 2009:53).

According to Pérez-Tamayo (2010:20), researchers started to organise groups with others who shared their scientific paradigms; these groups developed new mind-sets that challenged the status quo of the period. The scientific and academic communities in colonial Mexico were generally integrated by individuals from the middle class, mainly ‘criollos’, who received much of the support from the Catholic Church (Pérez-Tamayo 2010:22). This community was also constituted by Mexican mestizos (this is mixed-race), as universities accepted the sons of Indian caciques from

the beginning of the establishment of such institutions (Fortes and Lomnitz 1994:13). The members of said groups contributed to teaching, as well as in the dissemination of scientific and technical knowledge and the publication of regular issues covering a diverse range of topics (ibid.). Thanks to the initiative of these researchers, scientific and academic publications were produced in a simple language, in order to include the general public and keep them informed. For instance, in journals such as *La Primera Gaceta General* (published in 1666) and *El Diario de México*, scientists were concerned with cultivating and educating the society in order to "transform their reality through science" (ibid. 22).

However, despite the initiative and agency of the small scientific and academic community in the colonial period, Mexico (or New Spain) lacked formal scientific institutions; before the 18th century, any academic, scientific or technical activity happened at the universities. Universities were ruled by, and highly dependent on, the Catholic Church. By the end of the 18th century the Spanish monarchy had founded scientific institutions, and from then on the sciences started to grow among academics and professionals, many of whom were self-taught. According to Pérez-Tamayo (2010:22), academic and professionals had sufficient materials in their libraries, which included many of the works produced by European scientists, regardless of how unorthodox they may have been according to the beliefs of the time. These materials arrived in Mexico despite the great power exerted by the inquisitorial censorship from New Spain; furthermore, the arrival of foreign engineers (mainly from Germany) also helped the acquisition of scientific knowledge by influencing Mexican professionals in areas such as metallurgy, engineering and hydraulics, or cartography (ibid.).

2.1.2 Mexico, an Independent Country: Early 19th Century

The early 19th century was a period during which, despite the economic and political instability in which the country found itself, scientific and technological development was beginning to be acknowledged as a crucial tool for education and knowledge production (Pérez-Tamayo 2010:44). In the opinion of Pérez-Tamayo (2010:45), colonial academics and professionals are characterised by a conflictual mindset; on the one hand they considered the knowledge produced by the old universities of the country as the absolute truth, but at the same time they recognised that the universities needed to be modernised, particularly in terms of the teaching techniques and the required writing style. For them, it was evident that the scholastic tradition of Mexican science taught at universities was not only antiquated when compared with the science generated in developed countries from the centre, but was also useless for the development of a new country (ibid.)

In the 19th century scientific journals were produced in other colonies of Latin America, i.e. Costa Rica, Colombia, Paraguay, Argentina, Brazil (Lafuente 1998:9; Díaz 2017:7), for the dissemination of science; this benefitted the New Spain (Todd et al. 2009:74). Moreover, the 19th century saw a peak in the development of scientific production; during that period many specialised societies and research institutions were founded, while the production of scientific publications multiplied, and amateur researchers evolved to be professionals in their areas (Azuela and Guevara Fefer 1998:79). The government was also more involved in the development of science and technology, as it helped to fund scientific and academic institutions and promoted the dissemination of their work (Pérez-Tamayo 2010:45). This was executed in the reform of 1833 which recognised education as the backbone of progress. With this in mind, the government took over the responsibility of educating the people, and thus the

responsibility of improving their morality and quality of life. In order to achieve this, the government had to limit the participation of the church in education and its control over the people's lives; from this point on education became secular, while at the same time religious scholarship was still recognised and respected (ibid.67). The Spanish imperial government was also involved in the creation of the new scientific institutions; unfortunately there is no information available concerning the results of these initiatives (ibid.).

Moreover, as the importance of the history of science began to be acknowledged, researchers started to compile the work conducted in the past at different scientific institutions of the country; such works are listed below:

> El Instituto de Geología, datos históricos, Química en México ayer, hoy y mañana, Historia de la Facultad de Química, Relación histórica de los antecedentes y orígenes del Instituto de Biología, Herbario Nacional de México, and Historia del Departamento de Biología de la Facultad de Ciencias[5]
>
> (Todd et al. 2009:84).

The majority of the academic institutions from the 19th century - e.g. medical academies - were organised following the models of the renowned academies in Paris and Madrid; nevertheless, these institutions were focused on applying the research conducted in developed countries, and preparing students for their tests, rather than on generating new research (Pérez-Tamayo 2010:64). Scientific journals during the 19th century were published regularly; many of them enjoyed a long life, particularly

[5] The Geology Institute, historic data, Chemistry in Mexico yesterday, today and tomorrow; History of the School of Chemistry; Historic relation of the sources and origins of the Biology Institute, National herbarium of Mexico; and History of the Department of Biology in the faculty of Sciences.

La Gaceta de Mexico, published by Academia de Medicina, available even today (Pérez-Tamayo 2010:89).

The liberal government of this period boosted scientific development; however, due to the financial situation of the country at that time, it was not possible to undertake projects of high impact. Nevertheless, despite the guerrillas and armed movements, many scientific institutions were created, and the government further supported those that already existed (ibid.91). New scientific societies such as *La Sociedad Mexicana de Historia Natural* (The Mexican Society of Natural History) were also created in this period.

According to Pérez-Tamayo, scientific research in Mexico in the 19th century was directed towards the configuration of a national science that would ultimately solve the social and political needs of the time. For instance, the reform from 1833 sought, as its main objective, to secure a place for the Mexican scientific community in international circles (ibid.112). As a consequence, the exchange of knowledge as well as technical and scientific concerns between Mexico and Europe gained popularity, even though the main objective in European countries was still colonial expansion (ibid.).

By 1821 Mexico was a nation independent from Spain in the social, scientific and academic aspects (Saldaña 2009:120). As Mexico was established as an independent Republic, the scientific community also emerged in a broad range of disciplinary branches (Pérez-Tamayo 2010:112). Additionally, a national consciousness, that is an awareness of the national identity in the country, was developed by the local scientists, which allowed them to interact with the international scientific community without losing their identity (ibid.). The following quotation from the scientist Andrés Manuel del Rio expresses the sense of hope that the scientific and

academic community from Mexico felt regarding where the new changes were going to take them: “During our time as servants of the Spanish crown our enlightenment was behind in comparison with the European enlightenment, fortunately now we will be able to catch up with them (Diaz and de Ovando 1999a:522, in Saldaña 2009:120).

Nevertheless, due to the outdated social, political, economic and educational structures left by the colony, not much development could be seen. This, as further noted by Saldaña (ibid), had repercussions in the way the citizens acted towards the development of the country. Furthermore, two main political groups were formed, namely the liberal group and the conservative group. Both groups had particular viewpoints regarding the development of science and technology (ibid.121). The conservative group supported traditional education, which was ecclesiastical and private, while the liberal group supported public education serving to promote social mobility, including research centres (ibid.121–122). Throughout the independent period, the areas of science and education were debated based on the ideals of these two groups.

In the second half of the 19th century scientific training in Mexico was private once more; research had no support from the government. This situation motivated the construction of academies and scientific societies, formed by scientists themselves, with the objective of disseminating their work. These new groups and societies lacked resources necessary to function, and thus their publications were irregular and had a short life (ibid.131). Proper scientific publications were scarce in the country; some of the scientific societies were sponsored by private institutions or the government but only for short periods. The societies were able to obtain sponsorships when some of their members had good connections with powerful groups in the government; on very

rare occasions were such sponsorships given permanently by the government (ibid.132).

Other societies were created with the purpose of disseminating the assumptions and concerns of the enlightenment movement, such as *Ateneo Mexicano* (1840), whose mission was to “provide the country with the necessary information to learn scientific and art values through free public conferences and the publication of the journal” (ibid.). Other journals regularly included scientific and technical publications, in addition to literary and political texts, making this “erudite style” one of the main characteristics of this period (ibid.).

By the middle of the century, science depended on sponsorships from private institutions and the government. Although numerous amateur (self-taught) scientists sought to develop science and technology, many of these movements were isolated, and were generally fruitless (ibid.). The scientific associations modernised science production in Mexico, as they pioneered the growth of new ideas, values and behaviours, which went against the dogmatism and authoritarianism of the church and the state; this new mindset fostered the participation of free individuals according to the norms of the institutions and the discipline they worked in (ibid.170). Additionally, thanks to the development of the scientific associations, the transition from amateur to professional science was consolidated as the main result of the progress (ibid.).

However, by 1870, this progress and growth had to be paused once again, with the beginning of revolutionary movements and their corresponding economic and social instability (ibid. 171). By 1876, research and education were still oriented to instilling the stimulus of “illustration movements” in the society, as well as to the training of liberal professionals, however, this happened with an amateur character (ibid. 176). During the government of Porfirio Diaz, science did not have much political impact;

moreover, the academic and scientific institutions did not possess the characteristics that could transform their cognitive objectives into well-defined political interests. Porfirio Diaz was neither a supporter nor an enemy of science and technology as such; his government wanted science to have a political impact in order to make the country more governable, as he understood it (ibid. 180-182).

According to Saldaña (in Pérez-Tamayo 2009:188), publications such as *Las Memorias de la Sociedad Científica Antonio Alzate* constituted a new way of writing science in Mexico. This publication only included works that were rigorously revised by a board of specialists. These were the first articles in Mexico directed at the specialised audience. During the Porfiriato (that is, the government of Porfirio Diaz), science experienced significant growth; for instance, there was a noticeable increase in the number of research institutions focusing on economics, the military, and politics. Scientists and academics in Mexico developed a new way of conceiving knowledge as new theories were continuously disseminated and updated the scientific community achieved a certain degree of visibility at international level in certain topics; the number of specialised publications and their international dissemination grew, as did the number of associations and congresses. Indeed, Mexican science grew in both quantity and quality (ibid.188).

2.1.3 The 20th Century

Between 1910 and 1950, Mexico experienced four phases of deep and radical change: 1) the end of the Porfiriato, 2) the Mexican Revolution, 3) social stability, and 4) the transition of the political power of the civil military. These changes had a fundamental impact on the scientific development of the country (Pérez-Tamayo 2009:200).

During the first half of the 20th century the panorama in Mexico, as described by Pérez-Tamayo (2009:293), was conflicting and complex. That is, the attitude of the state regarding science and technology was indifferent, hostile and negligent. The involvement of the government in the development of science and technology was inconsistent because a national politics of science and technology, in the long term, was never established; indeed, even though the government proclaimed several projects for the development of science and technology, these were never put into action (ibid. 294). The Mexican state made few attempts to coordinate and promote the development of sciences in the country; such attempts were made at the beginning (during the Porfiriato), in the application of such initiatives, and in the short term (ibid. 2010:202). According to Pérez-Tamayo, these initiatives had a weak effect for two main reasons: firstly, they had no long-term visions and did not tackle priority areas; that is, they only had a symbolic character. Secondly, the state never believed that science could contribute, in a significant way, to its main interests, which were political control and economic development. As further noted by Pérez-Tamayo (2009:245-246), this happened even though developed countries such as the US and European states had already shown, three centuries before, clear examples of the fundamental role that science and technology play in the economic transformation of the society of a country.

In the second half of the 20th century, science developed in Mexico at a greater speed than hitherto had been seen in the history of the country (ibid.258). The main societies or associations that are nowadays considered the key institutions of science and technology in the country were created in the first half of the 20th century. For instance, CONACYT (Consejo Nacional de Ciencia y Tecnología) was created as a political mechanism to establish dialogue between the scientific community and the

Mexican state (ibid.); this was a result of the rejection of the scientific community of the government, derived from decisions taken by the government, and particularly those with regard to a student movement in 1968, that culminated in the savage killing of students in Tlatelolco on October 2nd 1968 (ibid.). During the early years, CONACYT had no impact within the scientific community of the country; most of the efforts of the state/government were directed at structuring CONACYT as a bureaucratic institution, which resulted in excessive spending, as the government was using 60% of the budget for internal administration (ibid.262).

Nevertheless, according to Pérez-Tamayo (2009), the development of science and technology in the second half of the 20th century was further complicated by four main factors:

1) The multiplication of research centres, and the incompatibility of this growth with the actual needs of the country. Even though the 20th century saw the growth of many research centres in Mexico, which led to the creation of more job opportunities for scientists and technicians, this was not enough, as the growth was not a result of the involvement of the government, but instead of the natural evolution of the society, which became more educated and therefore more conscious of their needs (ibid.).

2) The lack of private investment. The contributions from the private sector in the scientific and technological development of the country continued to be void; its participation in spending for science and technology did not surpass 10% in total. Furthermore, the budget was directed towards covering short-term projects that had no competitive character, and above all were purely commercial (ibid. 296).

3) The utilitarian approach to scientific knowledge. According to Pérez-Tamayo, the fundamental problem of non-scientists in Mexico was, throughout the 20th century, that they treated science and technology as if they were only mediums or instruments with which to solve specific problems and to promote the economic development of the country, rather than as an important part of of the economic, social and political aspect of the country that could boost the wellbeing of the country (ibid.297).

4) Lastly, the popular ingrained beliefs of Mexican society. Mexican society is composed of different groups, divided by their educational background and cultural differences. The magic-religious thinking, as mentioned earlier in the thesis, is still prevalent at all economic levels in large sectors of the population. As alluded to by Pérez-Tamayo, introducing scientific thinking in a community like this is difficult since it implies abandoning supernatural thinking and adopting a new rational thinking, with a strict adherence to reality (ibid.298).

In this way, the attempt to achieve scientific and technological development is recent, because scientific tradition in Mexico only started a century ago (ibid.299) as opposed to the long history of scientific tradition shared in European countries. Initially, the scientific community from Mexico was very small; there was no visible possibility of growth, and the financial resources were lacking, while the country's productivity was also limited to only reproducing anything that came from developed nations. The situation improved notably by the second half of the 20th century, despite the negligence and sometimes hostility of the state (ibid.).

Currently, in the 21st century, according to Scimago Journal & Country Ranking (SJCR, 2017) Mexico is listed in the second position of the most productive countries

in scientific publication in Latin America with 22,954 publications. The first place is occupied by Brazil with 73,697 publications. According to Latindex, the research centres and universities of the country are considered among the most influential in Latin America[6]. At international level, however, the scientific output from Mexico is perceived in a different way. According to SJCR (2017) Mexico is listed in the 28th position based on the output of scientific articles. The number of scientific articles published from Mexcian researchers corresponds to only a 3.6% and 4.5% of the number of documents published by the US and China, respectively, the two leading countries listed in the ranking (see table 2.1 bellow).

Country	↓ Documents
1 United States	626403
2 China	508654
3 United Kingdom	191830
4 Germany	170114
5 India	147537
6 Japan	123043
7 France	115747
8 Italy	110402
9 Canada	100810
10 Australia	
11 Spain	
12 Russian Federation	
13 South Korea	
14 Brazil	
15 Netherlands	
16 Iran	
17 Switzerland	
18 Poland	
19 Turkey	
20 Sweden	39976
21 Taiwan	35185
22 Belgium	32181
23 Malaysia	31043
24 Denmark	27010
25 Austria	24826
26 Portugal	24188
27 Czech Republic	24059
28 Mexico	22954
29 South Africa	22501

Table 2.1 SCImago Journal & Country Ranking (2017). Ranking of countries per publications in indexed journals.

Moreover, there are currently 100 Mexican journals from different subject areas indexed in the SCImago Journal & Country rank (2017). Only four of these journals are in the areas of materials sciences and physics: *Revista Mexicana de* Astronomia y

[6] http://www.latindex.org/latindex/descripcion [Retrieved 19 February 2019]

Astrofísica (RMAA, Mexican journal of Astronomy and Astrophysics), *Revista Mexicana de Física* (RMF, Mexican Journal of Physics), *Superficies & Vacio* (S&V, Surface and Vacuum), and *Artes de Mexico* (AM, Arts of Mexico). The highest impact factor (IF) shown in this list is 0.596 (by *RMAA*). When compared with the IF of journals produced in the centre, such as *Nature Nanotechnology* (UK) with 20.612 IF, a disparity is evident.

Although the low IF and the scarce production of scientific publications from Mexican scientists may be at first perceived as a reflection of the low quality of the research produced by the local scientific community of Mexico, there are many factors, as will be discussed in the following section, that impede the visibility of Mexican science at international level.

2.1.4 Limitations of the Scientific Community from Mexico Today

The factors that affect scientific development in Mexico currently are not too different from those that affected it fifty years ago. Mexican researchers, along with other NNES scientific communities from the periphery and the semiperiphery, are at a disadvantage when it comes to having their research published internationally and being acknowledged by the international scientific community. As noted above, the Mexican scientific community lacks a strong scientific culture as well as a scientific writing and publishing tradition. Simply put, given that the scientific community in Mexico developed later than some, and due to the archaic educational systems on which the universities base their teaching approach, basic scientific attitudes and values such as writing and critiquing theories, which are necessary for carrying out research activities, are acquired late in the researchers' academic careers (Fortes and Adler-Lomnitz 1994:161).

In addition to the historical factors already presented, there are other contextual factors caused by the governmental institutions of the country or by the local scientific community itself that affect scientific production in the country. Such aspects include: neglect of research topics with local applications, limited resources, lack of support from the industry, poor investment, and limited scientific network. Let us deal with each of these in turn.

2.1.4.1. Neglect of Research Topics with Local Applications

In this category there are two main direct factors contributing to said practice by Mexican researchers: the first of these is the influence exerted by local universities, at which the knowledge produced by scientific and academic communities from the centre is perceived as the absolute truth and the ultimate knowledge production style to aspire to. Although the trends set by the scientific community from the centre serve as a good point of reference in terms of the level of scientific development to aspire to, such imitating practice ends up being counterproductive. This, as noted by de la Peña (1987:41), is because as the knowledge produced internationally is produced in a completely different context, the relevance to the population which this knowledge serves is no longer applicable. According to Bernal (1979), science was developed naturally in countries from the centre, in response to the local need of the central societies (in Adler-Lomnitz 1994:161). Conversely, in peripheral and semiperipheral countries, such as Mexico, science did not result from internal development but was an imported cultural product (Fortes and Adler-Lomnitz 1994:160–161).

This is further reinforced by the increasing pressure exerted by local scientific and academic institutions to publish in international journals. As noted by Pickinson (1977), approximately 95–98% of scientific and technological research that is

published in international journals is focused on the application of science and technology in the developed world (in de la Peña 1987:41). As a consequence, Mexican researchers are foregoing research topics that are relevant locally, and are instead choosing topics that are relevant to the international scientific community in order to be publishable in their journals. This, as further detailed by de la Peña, has meant that most of the research developed around the world (around 95%) is focused on enhancing the quality of life of the already-privileged community, instead of dedicating the scientific and technological resources to solving bigger problems that affect a larger part of the population around the world (ibid.).

It is worth mentioning that the publishing process in the hard sciences in Mexico is considerably different from publishing in social sciences and humanities (ibid.), as the discursive and publishing traditions in the latter are stronger, due to the tradition in the social sciences, which associates the Latin American social sciences with maturity and prestige (ibid.).

2.1.4.2. Limited Access to Resources

A significantly detrimental problem that the Mexican scientific community faces every day is that the majority of the time they are forced to undertake their research without sufficient resources in terms of network participation, which enable the mobilisation of resources that are essential for English-medium publication, particularly in mainstream journals. These resources include making connections, obtaining bibliographic/research material, collaborating in research writing, receiving rhetorical/linguistic support, and securing publishing opportunities (Curry and Lillis 2010:282). As a consequence, the scientific community becomes dependent on

collaborations with international communities from developed countries, which can facilitate well-equipped laboratories (Aldana 2012:28).

Nevertheless, although scientific collaborations are a meaningful and necessary process in scientific production, due to the many advantages that they bring to the advancement of science, the socialisation process of Mexican scientists occurs, as noted by Aldana, in “adverse conditions” when compared to the process of scientists from central countries (Adler-Lomnitz 1994:161).

2.1.4.3. Poor Investment and Poor Support from Industry

One of the main characteristics of developed countries is the huge monetary contributions made by the government, the industry and private investors which, as noted by Aldana (2012:27), are a crucial part of scientific development. In central countries such as Japan or the US, approximately 60 to 75% of scientific research is sponsored by private industry, and therefore the knowledge produced by their scientific communities tends to have a direct application in, and give support to industry. For instance, according to the Organisation for Economic Co-operation and Development (OECD), in 2008 in the US, 67.3% of the financial contribution to scientific and technological development came from the private sector, whereas 27.05% was provided by the government; the rest was given by universities and non-profit organisations (ibid.).

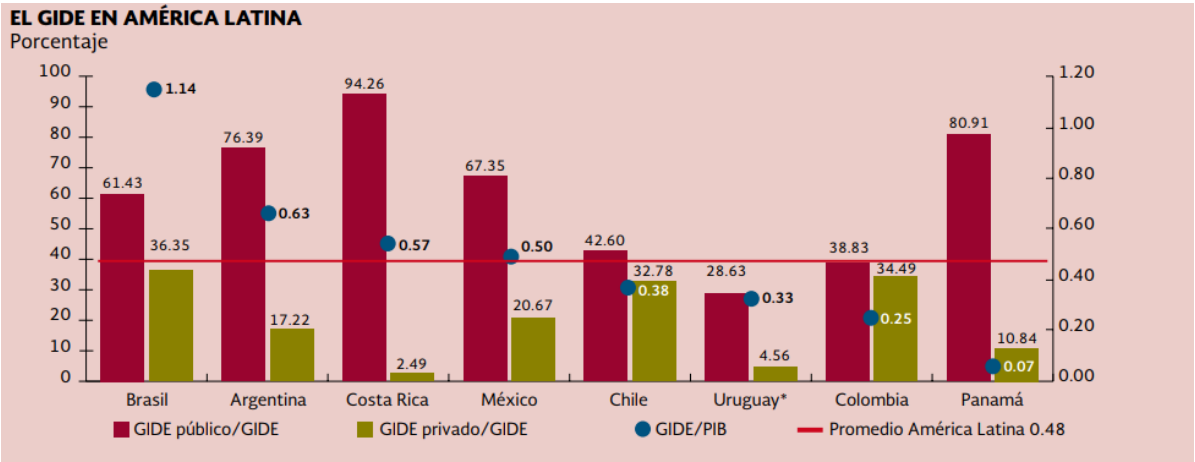
In Mexico, however, financial contributions from the public and private sectors are limited. The majority of financial contributions dedicated to scientific and technological development come from governmental organisations, whereas contributions from the industry are almost non-existent, as members of the latter prefer to buy technology from developed countries instead of investing in their own country’s

development (ibid.). According to data on investment in science and technology in Mexico (RICYT 2009), investment in scientific and technological development in Mexico received less than 0.4% of the gross domestic product (GDP), whereas countries such as the US dedicate around 70-120 times more GDP to scientific development (ibid.). In terms of how this budget is spent, according to de la Peña (1987:40), around 90% of basic science is sponsored by and performed at universities, and thus research in Mexico is directed towards academic science, without necessarily having a direct application in problem solving. As a consequence of having an academic science, the tendency to favour foreign topics for research without any real application in the local region is further perpetuated (ibid.).

Another significant detrimental factor that is currently damaging the development of science and technology in Mexico is the fact that, even though the financial contribution from the national public and the private sectors is already low, the science and technology sector is also experiencing gradual cuts every year. For instance, according to a report from CONACYT, during the year 2016 the foreign private sector contributed less than 30% to scientific and technological development, whereas in other countries the contribution was above 50% (CONACYT 2017:15). This is a response to the lack of confidence arising from the financial and socio-economic instability that the country is experiencing currently.

According to more recent data the budget dedicated to scientific development (GIDE) in 2016 totalled 97.785 million Mexican pesos, which equates to 5 million pounds sterling. This means that the contribution decreased by 3.55% in comparison with the investment dedicated in 2015 (CONACYT 2017:16). The gross domestic

production (GDP or PIB[7] in Spanish) in 2016 was 0.50%; please see graph 2.2 (blue dot).

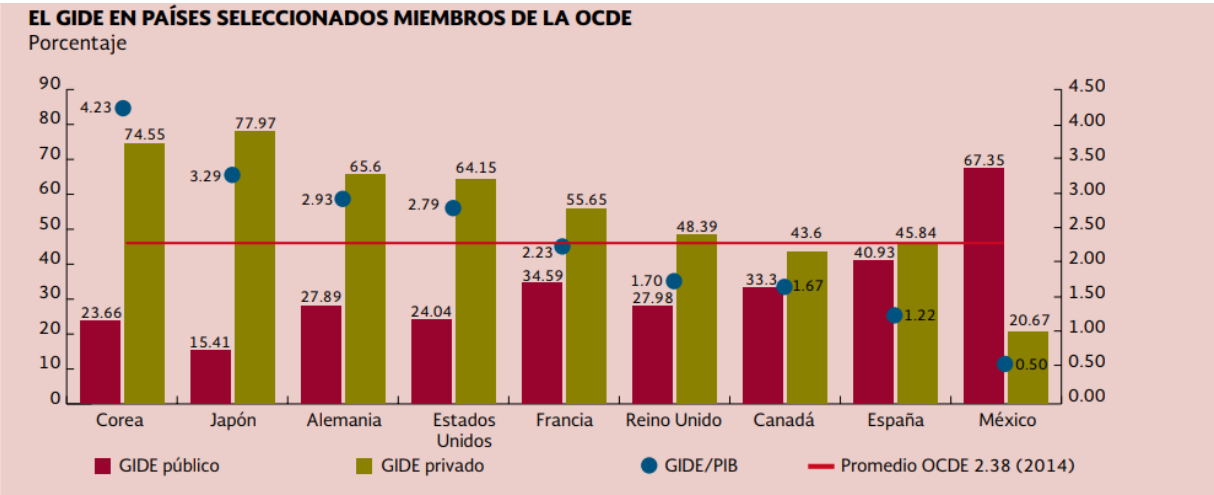


Graph 2.2 GDP Investment in Latin America, 2016 (CONACYT 2017).

The blue dot in-between each column is our focal point. This point shows the percentage of the GDP (PIB in Spanish) that was dedicated to scientific development in the year 2016. According to CONACYT, the investment of 0.5% of GDP was one of the highest investments for scientific development in Latin America, placing Mexico below Brazil (1.14%), Argentina (0.63%) and Costa Rica (0.57%) (ibid.).

At the international level, on the other hand, the investment dedicated to the development of science and technology remains one of the lowest in comparison with countries in the centre of scientific development and members of the OECD; please see Graph 2.3 (blue dot).

[7] PIB=Producto Interno Bruto



Graph 2.3. GDP Investment. Contrast Between Mexico and Countries in the Centre of Scientific Production (CONACYT 2017)

As shown by Graph 2.3, the average percentage of GDP (PIB in Spanish) dedicated to scientific development in central countries is 2.23%. The country that dedicates the highest percentage is Korea with 4.23%, while the country dedicating the lowest percentage (as shown by the graph) is Mexico, with 0.50%.

As we can see from the data presented in this section, the already (and increasingly) low involvement of the private and public sectors in scientific and technological development in Mexico means that the development of the country is at a standstill (Sergio Alcocer, in Hernández-Borbolla 2016).

2.2 Scientific Publication: National vs International Journals

At present, the most important methods used by the international scientific community in the evaluation and validation of scientific development are focused mainly on the production of RAs (Salager-Meyer 2015:16). Through the dissemination of scientific publications, and their subsequent referencing, the scientific community all around the world has the opportunity to shape the professional careers of individual researchers

as they grow into established and distinguished scientists (ibid.). As further noted by Salager-Meyer, research institutions, universities and even entire countries can also benefit from scientific publications (ibid.), in that increasing scientific production attract funding from private and public sectors and from foreign institutions, and at the same time the development of new projects in these centres could eventually contribute to the development the country. Thus, there is a growing tendency towards the creation of specialised journals in the institutions from the centre and the periphery of scientific production.

Nevertheless, a significant barrier imposed by scientific and academic journals is that they are organised hierarchically (Guédon 2010, in Salager-Meyer 2015:16). That is to say, in a way that is similar to how scientific communities, depending on the context in which they develop and practice, are valued and recognised in the international scientific community, scientific and academic journals are valued in the same way by the international scientific community. For instance, in regard to the scientific community from Mexico, despite having experienced substantial growth in the past fifty years, there is still growth to be experienced in the publishing tradition of the country's scientific and academic journals, if Mexico wishes them to be classified among mainstream journals published by the elite scientific community, i.e. those from countries in the centre of scientific production.

Scientific journals are categorised according to the region where they are produced: there are mainstream journals, which are those produced in countries from the centre, and peripheral journals, produced and published in countries from the periphery and semiperiphery of science (Guédon 2010, in Hamel 2015:17).

Mainstream journals – also called "reputable", "high-ranking" or "elite" journals (Salager-Meyer 2015:17) – are considered the most influential in the scientific world;

they publish the best research (ibid.) on topics that are considered most relevant to the international scientific community. These journals are indexed in international databases like the social Science Index (SCI), the Social Science Citation Index (SSCI); most of them publish exclusively in English (ibid.) and follow a well-established written style for scientific publication, which makes them the point of reference in scientific writing for the rest of the scientific community. Mainstream journals enjoy strong financial support of the private and public sectors in their countries, which allows them to be published uninterruptedly. The fact that these journals are more accessible for bigger audiences increases the visibility of the authors/researchers and research institutions internationally. Indeed, publishing in these journals means that the work will be accessible for a broader audience, and as a consequence opportunities to network with peers in the centre will increase (Curry and Lillies 2004; Anderson et al. 2007; Canagarajah 2015; Salager-Meyer 2015). Appearing in prestigious journals is now so important that it has become a necessity for researchers in order to gain a better reputation both in local and international institutions; moreover, this brings financial advantages for researchers, such as promotions and sponsorships for projects, etc. (Salager-Meyer 2015:17; Canagarajah 1996:442).

Peripheral journals, on the other hand, are smaller-reach journals which publish on topics that may be considered less relevant to the interests of the international scientific community when compared to those found in mainstream journals. These journals are not usually indexed in international databases. There are a number of factors that contribute to the poor visibility of Latin American researchers in the mainstream rankings. Salager-Meyer (2008) suggested that such factors comprise: a perceived low quality of the articles published in local journals, and their extremely low IF; a lack of continuity in the publication of the journals; financial restrictions from the

governmental authorities of the country; “lack of funds to run the journals, lack of competent editors and reviewers, problems related to publication ethics, etc.” (Salager-Meyer 2015:15). Factors such as the poor quality of manuscripts and inconsistency in publication patterns mean that journals from peripheral countries are seen as unreliable sources of scientific knowledge, and thus international databases do not include them in their rankings. Furthermore, it has been reported that, as the local journals are considered unstable in terms of helping academics to grow as researchers or scholars, national researchers rarely publish in these journals, and send their best work to highly-ranked international journals (Salager-Meyer 2008:123). This represents an obstacle for local journals published in the periphery.

As a result of having low financial contributions from the public and private sectors due to financial instability in their home countries, the publication of these journals is inconsistent; furthermore, the quality of the research papers may be perceived as deficient in comparison with the discursive quality of the publications from mainstream journals (Mendoza 2006; Lee and Lee 2013; Stegemann 2013; Sotelo-Cruz 2014, in Salager-Meyer 2015:19). The World Association of Medical Editors (WAME) (2006) developed a study focused on the factors that contributed to the lack of visibility of “small” or peripheral journals; the results showed that many factors affected the production of these journals, such as publication frequency and regularity, arbitration process, presence in libraries and databases, and the impact factor. The study also showed that particularly journals from Latin American countries were tremendously underrepresented in Latin America, as shown in the databases from indexed journals analysed in the study (Stegemann 2015:1). The languages of publication in these journals tend to be the native languages from the countries in which they are located, and thus access for the international community to those publications

may be limited (Pérez-Tamayo 2006; Salager-Meyer 2015). In the hard sciences, however, the language of publication has changed in recent years. Due to the lack of visibility that publishing in Spanish brings to the journals at international level, many local journals have started to publish only in English, while others accept publications in both languages (ibid.). Table 2.4 below shows the language used in publication according to the scientific or academic field.

Languages used in scientific publication, national and international level				
N	Group	Sciences/Disciplines	Usage of English	Type of register
1	Hard sciences	Physics, mathematics, chemistry, biology, etc.	Almost total dominance of English	A generalized specialized discourse with formulaic characteristics
2	Natural sciences, applied sciences,	Applied biology, medicine, engineering, IT, etc.	English is favoured, but does not dominate the area	Universal specialized discourse
3	Social sciences	Sociology, economy, anthropology, psychology, linguistics	English is the leading language, but other languages are widely used as well	The specialized discourse is rooted in the native language of the researchers.
4	Humanities	History, geography, literature, philology	Predilection for the native languages, although English is also sued.	The specialized discourse is rooted in the native languages of the users.

Table 2.4. Languages Used in Scientific Publication in Mexico (Hamel 2005)

As shown in the data above, Spanish is still dominant in the humanities, although English is always present. Although all the activities in the social sciences happen mostly in the native languages of the researchers, English is being increasingly used by them. The natural sciences and the hard sciences, on the other hand, are completely monopolised by English publications. As noted by Hamel (2005:35) in the table above, at one extreme end of the table in the hard sciences, English dominates international communication as well as the reception of knowledge, whereas Spanish

has a very weak presence. At the other extreme end of the table, in the humanities, Spanish is the dominant language.

For instance, the Mexican journals *Journal of Mexican Chemical Society* and *Revista Mexicana de Física* are two well-established journals that started to publish articles in English and Spanish in order to attract submissions from international researchers and to gain more visibility. However, recently the visibility of Latin American journals has increased, with the switch from native languages to English and the digitalisation of the journals, e.g. databases and electronic libraries such as BIREME and SciElo, which include journals that may have over 50 years of circulation and some even 100 years (Stegemann 2013:1).

The restriction of financial resources and the poor infrastructure of peripheral and semiperipheral countries pose significant obstacles for the development and growth of local scientific journals, given that their production is sometimes not a priority (Pérez-Tamayo 2010:8; Salager-Meyer 2015:22). Thus, the regular publication of issues is interrupted. According to Sotelo-Cruz (2014:7), scientific journals in Mexico do not usually include a budget dedicated to covering editorial expenses; for instance, more than 95% of editors receive no payment, or do not receive support from their institutions, e.g. training programmes or the material necessary to undertake editorial activities.

Furthermore, it has been argued that the articles submitted to Mexican journals frequently show a lack of written skills on the part of the authors (Salager-Meyer 2015:24). As stated by Sotelo-Cruz (2014:7), very often the articles submitted are "poorly written, with deficiencies in format, content, illustrations, references and originality, and do not comply with the journal's guidelines". Although in many instances the discourse and format of the articles of Mexican researchers may be of a poor

quality, this is not necessarily the rule, since one may be able to find, in these journals, exceptionally-written articles with impeccable attention to format and style. Sotelo-Cruz (2004) tested the quality of RAs written by Mexican researchers in terms of their written quality, impact, originality of the research, and their applicability in the field of study. The results of this study showed that, in the same way that in journals from more developed scientific communities there can be both good and poor writing; in other words, there is no evidence that the research reported in peripheral journals is either better or worse than the research produced in the centre (ibid.).

On the other hand, the performance of editors is another problem in the publishing process of Mexican journals. Being a journal editor in Mexico is not a profitable job position, nor is it indeed an activity for which one receives any type of training (Pérez-Tamayo 2010:8; Sotelo-Cruz 2014:6; Salager-Meyer 2015:26). A majority of those in charge of editing articles in many journals are renowned researchers, either from the local scientific community or from foreign countries, who have experience in publishing RAs. These researchers usually volunteer to edit journals, are invited, or are assigned this position by their institutions (Sotelo-Cruz 2014:6). Despite the lack of financial support and regularity of production of Mexican journals, and the lack of training of the editors in scientific discourse (in Spanish or English), the editors commit, as much as possible, to meeting the international standards (set by foreign international journals such as the American association) of quality and content for the editorial and review process of local journals (Stegemann 2013:1).

As noted by Sotelo-Cruz, in many cases it is difficult to deal with the professionalism or the involvement of the editors/reviewers. For instance, Mexican editors/reviewers often fail to return articles in a timely manner, and do not separate

their own perspective from the research; indeed, they may sometimes reject or judge an article based on the affiliations and memberships of the authors, rather than focusing on the contribution and quality of the research (Pérez-Tamayo 2010:8; Sotelo-Cruz 2014:7). In other cases, editors/reviewers are pressured by pharmaceutical companies or the editorial itself to publish research that serves their interests (Sotelo-Cruz 2014:7). As a consequence of these practices, in many cases it is difficult for editors/reviewers to find quality articles to fill a whole issue, which may also contribute to the irregularity of publication of the journals.

It is interesting to weigh the pros and cons of publishing in either mainstream or local journals; on the one hand, while publishing in local journals means that researchers help strengthen and develop such local journals, they also risk hindering their personal growth by giving up visibility and impact at international level. On the other hand, publishing in mainstream journals gives more visibility to the researchers' work, but at the same time jeopardises the stability of their own journals as well as risking the neglect of topics that have impact at international level (Stegemann 2013:1). Emphasis is often placed on the bigger advantages that come with publishing in the mainstream journals, in addition to the increased exposure to the international scientific community, such as "academic and peer recognition, career advancement opportunities, admission to prestigious institutions, funding for future research or financial backing for articles in open access journals, among others" (ibid.). Indeed, because of these advantages, Mexican researchers tend to disregard their local journals and submit to mainstream journals. As further noted by Stegemann, Mexican authors are not willing to submit to local journals due to the risk of not being cited frequently enough; as a result, only around 10% of the research of the national

scientific community is published in local journals, with the rest being sent to mainstream international journals.

The “outflow of domestic research”, as Salager-Meyer (2015:21) points out, is an increasing trend that has restricted the development of peripheral journals. According to Aldana (2012:29), this again is a consequence of the strong dependence of Mexican researchers on the scientific knowledge from the centre; Mexican scientists these days tend to favour publications in prestigious magazines such as *Nature* or *Science*, and disregard local journals. The hegemony of English academic discourse, as noted by Hamel (2005:38), is a significant component that has allowed the scientific community from the centre, particularly the NES community, to take control of the international publishing process; this includes the differentiation of the preferred topics of research from those that should be excluded from the journals. According to Hamel, and based on his experience as an editor in several scientific journals, RAs diverging from the native-English discursive standards and reflecting a different cultural perspective from the dominant one, are disregarded almost immediately (ibid.). This is also reflected in the representation at an international level; the US and the UK together distribute 41% of all scientific publications in the world, although their diffusion reaches between 74% and 82% in social sciences and the humanities, and 90% for natural sciences. Given the monumental exposition that mainstream journals have in the global community, and the benefits directly attached to being visible in them, it is no wonder that NNES researchers choose these journals, and the foreign language they are written in, over their local journals and native languages (Hamel 2005:40).

In fact, it is not only junior scholars who have difficulty in interpreting editors’ and reviewers’ comments. Canagarajah posted a story related to this issue on his blog. Under the heading ‘Reading Rejection Letters’, he recounted the case of a member of

the editorial board of *TESOL Quarterly* who complained about what he thought were rejections of articles he had submitted. Canagarajah explained that the decision letter the author referred him to was not exactly a rejection: 'What was surprising was that our decision letter didn't exactly say that he didn't have an opportunity to revise and resubmit. He had inferred that he has to abandon efforts to try to publish the article in *TESOL Quarterly*' (Flowerdew 2013:11).

The conclusion of the study was that "there may be difficulties in interpretation due to a lack of clarity in the schematic structuring of some of the letters and the use of face-saving strategies on the part of the editor when presenting criticisms and suggestions for revision" (abstract 463).

2.2.1. The Impact Factor

Give that one of the main interests of scientific editorials is to reach bigger audiences in order to be profitable, the scientific quality of the journal is extremely important (Salager-Meyer 2008:123). Likewise, researchers are looking to publish their research in highly-ranked journals for the benefits generated by reaching a wider audience. Thus, scientific journals are categorized according to the impact factor (IF) which marks the quality of the journal, a key element in the selection of a journal for the process of publication. The IF is a number calculated yearly for every journal, based on how many times it was referenced by other authors. In this way, there are journals with a high-IF (above 10), medium-IF (from 3 to 9) and low-IF (below 1). The IF of a scientific journal is not only an indicator of the country of origin and quality of the journal, but also of the type of research that it publishes.

A highly-ranked journal is frequently available to a wider audience. This means that such a journal is usually focused on a particular field, but this does not necessarily

mean that the readership consists of experts in the specific area (Aliotta 2014). These journals usually include articles that report on the application of materials or mechanisms already developed by the author, in different fields. For instance, an article published in *Nature Materials* from the field materials science (IF 21.395), and entitled “Designer vaccine nanodiscs for personalized cancer immunotherapy”, reported results of the application of an innovative cancer treatment to target specific areas. In order to be published in highly-ranked journals, the authors needed to mould the text, taking into consideration the varied audience, so that it had a brief, engaging and simplified manner, avoiding jargon and other terminological peculiarities from their specific area.

Mid- and low-ranked journals publish research that reports on the characterisation or analysis of a method or material and the synthesis or elaboration thereof, respectively. The readership of these journals is therefore specialised in a given area, and accordingly more limited. As such, articles from these journals receive a lower IF and citation index. The language used in such journals tends to be more descriptive, and can go into more detail on one specific topic, in comparison with the language included in highly-ranked publications. Examples of articles included in mid- and low-ranked journals are as follows. An article published in the mid-ranked journal *Nano Research*, based in China (IF 3.284), and entitled “Biotemplated synthesis of three-dimensional porous MnO/C-N nanocomposites from renewable rapeseed pollen: An anode material for lithium-ion batteries” (Feng Chen et al 2017), reported on the synthesis process used to improve the endurance of batteries with natural resources, and the beneficial potential of such material in future applications. Another article published in the low-ranked Mexican journal *Superficies y Vacio* (IF 0.109), and entitled “MWCNTs oxidation by thermal treatment with air conditions” (Contreras-Navarrete et

al 2015), reported on the elaboration of a new material, carbon nanotubes, through alternative methods. As can be seen from the title of the articles presented above, the type of language in these articles, as discussed above, includes highly technical vocabulary and information that can mostly be understood by experts in the area of materials sciences. Moreover, given that in most of the cases the already small audiences are mostly contained in the same geographical location, the texts are written with certain rhetorical and syntactical structures that result form the high influence of the native language of the authors. This is evidenced in the following section, which presents a statistical analysis of the scientific publication system from two main databases Scopus and Inspec direct.

2.3 Mexican Scientific Publications: Representation and Contribution at International Level

This section presents the statistical data of the scientific output at international level; in particular, the data concerns the publications submitted by Mexican researchers, in order to gauge the level of visibility received by NNES researchers from Mexico and Latin American countries. The following discussion details the production of scientific RAs over the past ten years. The information presented in this section is taken from the databases Thomson Reuters (TR), Scopus and Inspec Direct.

According to CONACYT (2017:73), at the national level during the period 2007–2015, the publication of RAs stood at approximately 5.41%, although this fell in 2015–16 from 6.94% to 1.30%. At international level, and compared to the members of the OECD, Mexico was positioned in 20th place among the 34 members. Although, according to CONACYT, the production of scientific RAs in Mexico has increased from

2007–2016, since 2012 this growth has been slowing down and is starting to decrease (see Bar chart 2.5).

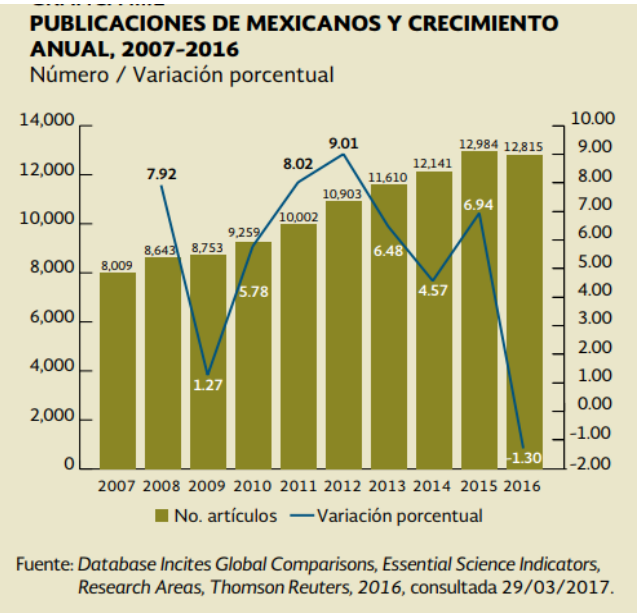


Chart 2.5 Annual growth of publications by Mexican researchers 2007–2016

The chart above shows the publications indexed in Thomson Reuters from 2007-2016 by Mexican researchers, and how the growth of their publications looks every year. The green columns represent the number of publications per year and the blue lines represent the fluctuations in percentage of the growth of the productions. According to the graph, the highest point in production was experienced in 2012, in comparison with the previous year, as a result of 9.01% growth. Although RAs are still being produced every year, the growth has been much slower, and indeed minimal. In 2016, there was no increment at all; in fact, the production decreased to 1.30%.

At the international level, of particular note are the publications by Mexican researchers in comparison to the publications produced by countries which are members of the OECD. As noted by CONACYT (2017:75), the representation of publications from Mexican researchers at international level is at a standstill; the average representation has stood at around 0.60%, with a fluctuation from 0.50 to

0.62% (CONACYT 2017:75). Indeed, 2015 and 2016 were the highest in terms of the representation (see bar chart 2.6).

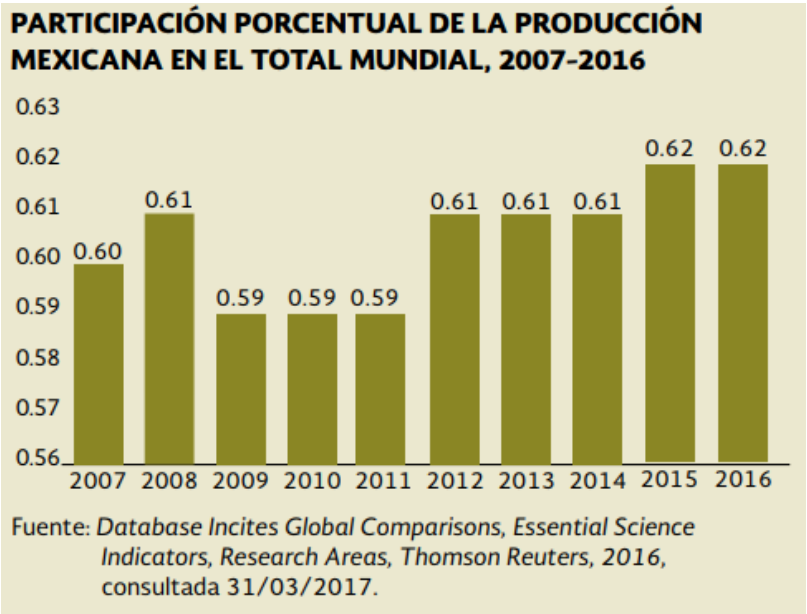


Chart 2.6 Participation of Mexican publications at international level 2007-2016

The data presented in charts 2.5 and 2.6 above represent publications in all academic and scientific areas. According to CONACYT, a breakdown of the areas considered is as follows: CONACYT shows a breakdown of the 22 areas of knowledge that were taken into consideration by Thomson Reuters; from this 0.60% of visibility shown in Chart 2.6, the first place is occupied by natural sciences with 12.55%, in second place is chemistry with 9.82%, third is physics with 9.43%, fourth is engineering with 8.86%, fifth is ecology and environment with 6.58%, sixth is agriculture with 5.70%, seventh is biology and chemistry with 4.79%, eighth is materials science with 4.51%, and ninth is social sciences with 4.41% (CONACYT 2017:75-76).

In comparison with other countries from the OECD, Mexico has made a minimal contribution in terms of the international scientific rankings. Although Mexico may be amongst the leading positions of scientific production in comparison with other Latin

American countries - it is second after Brazil, which contributes with 1.98%, and above countries such as Argentina, Chile and Colombia (CONACYT 2017:76) – it is positioned far below growing economies such as China, which represents 12% of the overall international production. When comparing Mexico to countries from the centre, the disparity is enormous. According to the results from the countries, we can see the contribution percentages for the scientific and technological powers such as the UK (5.10%), Germany (4.05%) and the US (18%), as well as China (12%), as a growing economy (ibid.).

2.3.1 Scientific Contribution of Mexican Researchers in the Hard Sciences

The following section presents data on the international scientific contributions from databases *Scopus (Scimago)* and *Inspec direct*, which specialise in the hard sciences. The database *Inspec direct* offers extensive coverage of journals in the fields of "physics, electrical & electronic engineering, communications, computer science, control engineering and information technology". It belongs to the Institutions of Engineering and Technology (IET) based in the UK. *Scopus* is a bibliographic database owned by Elsevier, which covers journals in the scientific, technical, medical and social sciences. *Scopus* offers four quality measures: h-index, Cite Score, SJR (SCImago Journal Rank), and SNIP (Source Normalized Impact paper). These quality measures offer "country rankings based on total published documents, citable documents, citations"[8].

Every year, *Scopus* and *Inspec direct* offer an updated report of the scientific and academic publications based on the number of citations that the journals and

[8] https://en.wikipedia.org/wiki/Scopus

articles received in the previous year. Both databases work in the following manner: there is an Advisory Board that evaluates the quality of the journals and the publications. The following shows the country rankings from both databases for the years spanning 2010–2016.

2.3.2. Country Rankings

According to Scopus, during the period 2010-2016, there were 12,137,855 publications in total from all subject areas.

Publications by Country: SCOPUS 2010-2016					
1.	US	2,735,099	**4.**	Germany	743,586
2.	China	2,121,723	**5.**	Japan	602,093
3.	UK	795,232	**6.**	India	564,137

Table 2.7 SCOPUS List of scientific journals listed by country years 2010-2016

According to the results shown in Table 2.7, the US is in first place with the largest number of publications, followed by China and the UK. As one might expect, the countries leading the ranking are scientific and technological powers. Latin American countries appear in the ranking with very low numbers of publications. Mexico comes 29th with only 258,077 publications.

Publications by Country: INSPEC DIRECT 2010-2016					
1.	US	2,418,594	**4.**	Germany	288,311

2.	UK	581,437	**5.**	Japan	57,310
3.	China	343,819	**6.**	India	17,832

Table 2.8 INSPEC DIRECT List of scientific production by country (2010–2016)

Inspec direct exhibits similar results. The rankings offered by *Inspec direct* show the same scientific and technological powers leading their listing. The only difference that can be identified is that, while China shows a comparable contribution to the US, with both powers delivering around 2 million publications, *Inspec direct* has a considerably lower contribution, with only 343,819 publications. Indeed, the majority of the data shown by *Scopus* is higher than *Inspec direct*. A possible explanation for the difference between both databases may be the quality and prestige of the journals from the research community's point of view.

The countries listed by *Scopus* and *Inspec direct* belong to the elite scientific community - i.e. those scientific communities that are established in developed countries. The top six countries in both listings constitute close to 80% of scientific production in total. Conversely, countries from the periphery of scientific production are responsible for the remaining 20% of scientific production. It has been suggested by authors such as Salager-Meyer (2008:121) and Canagarajah (2006) that these numbers evidence the strong correlation that exists between the production of scientific research and the wealth distribution across the world. Furthermore, they also highlight the imbalance between the centre and the periphery of science.

In 2015, the database of the Scimago Journal & Country Rank showed that, among 29,713 of journals indexed in the database, 40% are based in the US, followed by 40% in Western Europe. This means that 80% of scientific output is concentrated

in journals from countries in the centre. Table 2.9 below shows the distribution in percentage of the journals included in *Scopus*.

Scimago Journal Ranking 2015		
Region of origin	**No. of journals**	**Percentage**
Western Europe	12,035	40.5%
North America	11,896	40%
Asiatic Region	2,349	7.9%
Eastern Europe	1,601	5.3%
Latin America	749	2.5%
Middle East	479	1.6%
Pacific Region	460	1.5%
Africa	144	.04%

Table 2.9 Journal Ranking 2015, Scimago (supported by *Scopus*)

Table 2.9 above shows the enormous control exercised by (and therefore the marked disparity in) the representations of scientific journals internationally. Western Europe and the US lead the list with 40% each, together making up 80% of the publications. In contrast, Latin American countries are responsible for only 2.5% of contributions.

Given that this thesis focuses on a group of Mexican researchers in the area of materials science, the present section puts forth a statistical analysis of the publications in this area presented by *Inspec direct* and *Scopus* from 2010–2016.

Materials science is an interdisciplinary field that combines disciplines such as physics, chemistry and engineering in the study of the limitations of, and solutions to the limitations of, materials with applications in very specialised areas such as nanotechnology, biomedicine and pharmacology. The studies developed in this discipline are extremely specific, and the articles are usually extremely descriptive. Thus, journals from this area tend to have a mid- to low-IF, as the audience is reduced because of the level of detail and precision. Table 2.10 shows the results of the most influential journals in materials science during the period spanning 2010–2016.

Source of Publications of Materials Science: SCOPUS 2010-2016				
Journals		**Country of origin**	**SJR**	**No. of publications**
1	*Physical Review B Condensed Matter and Materials*	US	1.93	37,540
2	*Chemical Communications*	UK	2.77	22,333
3	*Journal of Physical Chemistry*	US	0*	22,063
4	*Journal of Alloys and Compounds*	The Netherlands	1.01	17,072
5	*Acta Crystallographica Section E Structure Reports online*	UK	0.18	16,238

Table 2.10 Journals Published in Materials Science Period 2010-2016

According to *Scopus*, the most influential journals in materials science, based on the number of publications received during the period 2010–2016, are located in the US, the UK and the Netherlands.

Publications by country: Materials Science			
	Country	**Publications**	**%**
1.	China	394,121	30.66%
2.	US	189,557	14.7%
3.	Germany	83,392	6.4%
4.	India	80,054	6.22%
5.	Japan	79,846	6.21%
12.	Spain	32,221	3.1%
33.	Mexico	8,281	

Table 2.11 Publication of materials science by country SCOPUS 2010-2016

On the other hand, the results shown in the table above illustrate that even though the majority of influential journals in materials science are based mostly in the UK and the US, most publications are submitted by scientists from other countries. The number of publications in these journals based on the country of origin, is considerably different from the country of origin. As shown in Table 2.11 above, the majority of the articles published in materials science are produced by Chinese researchers, who offer 30.66% of the overall contribution. China is followed by the US, with 14.7% of the publications. The following three positions are divided among Germany, India and

Japan, with a contribution of around 6% each. In contrast, native Spanish countries are responsible for only 3.1% of the entire production altogether.

Publications by country: Physics *Inspec Direct*			
	Country	**Publications**	**%**
1.	US	958,687	36.59%
2.	UK	590,817	22.55%
3.	China	341,336	13%
4.	Germany	273,434	10.43%
5.	Japan	64,044	2.44%
	Mexico	699	0.02%

Table 2.12 Publication of materials science by country INSPEC DIRECT 2010-2016

Inspec direct, on the other hand, shows that, of 2,619,761 publications in materials science, the US and the UK together are responsible for more than 50% of scientific contributions, with 36.69% and 22.55% respectively. However, the number of contributions by the US is considerably higher than the rest of the countries in the list. China, Germany and Japan, all of them technological and scientific powers, complete the top five shown by *Inspec direct*, with 13%, 10.43% and 2.44%, respectively. In contrast, Mexico is in last place with only 699 publications, making just 0.02% of the contributions overall.

Publications by Language: Materials Science			
	Language	**Articles**	**%**
1.	English	1,168,138	90%
2.	Chinese	88,375	6.8%
3.	German	9,826	0.7%
4.	Japanese	7,621	0.5%
5.	Russian	3,779	0.2%
8.	Spanish	1,995	0.1%

Table 2.13 Publication of Materials Science by Language SCOPUS 2010-2016

Table 2.13 shows a list of all the languages for publication in the area of materials science during the same period of time. As may have been expected, given the dominance of English among NNES researchers in the hard sciences, it is no surprise that 90% of the papers are published in English; this, as has been discussed in the sections above, shows how NNES researchers choose English as the main language of publications in order to be visible or even accepted in mainstream journals. Chinese occupies second place in the chart with 6.8%, leaving the remaining 3.2% to other languages such as German, Japanese, Russian and Spanish. It may be the case that these languages come from bilingual journals; for instance, the *Mexican Journal of Physics*, despite switching most of its publications to English (and even adopting the writing guidelines from the American association of sciences), still publishes some articles in Spanish.

2.4 The Effects of the Non-discursive Factors on the Mexican Scientific Community

Although the statistical data shown in the section above might seem overwhelming and the distribution of the visibility uneven, this is only a reflection of some deeper contextual problems that the peripheral scientific community from Mexico is experiencing. As noted already by de la Peña (1987), Aldana (2012), Sotelo-Cruz (2014) and Bennett (2016), the detrimental effect that the dominance of the Anglophone scientific perspective exerts over Mexican science goes beyond its simple (under)representation in international journals. In particular, as de la Peña observes (1987:39), the scientific, academic and even financial sectors of the country are becoming increasingly more dependent on the influence exerted by the US, given that it is shaped according to the needs, advantage and interests of the big international industries. According to de la Peña, a clear example of this is that academic institutions, and the entire country, have been designed for the consumption of the technology from developed countries rather than for the creation and development of new technology (ibid.). The dominant model of production is transmitted through the implementation of institutions that train technicians in the operation, installation and maintenance of foreign science and technology, in this way preserving and reinforcing its dominance (ibid.). Consequently, the growth of creative and independent scientists and technicians prepared to create new knowledge and new technology, and to help in the development of the country, is suppressed (ibid.).

This dependence is further reinforced in the scientific community by the continuous need to collaborate with researchers from the centre, as they are the ones who have the necessary resources, materials and the infrastructure (Aldana 2012:28). Furthermore, the lack of a well-defined scientific agenda on the part of Mexican researchers means that said researchers, with some exceptions, do not produce

scientific developments that answer the needs of the country; instead, they only focus on the replication of scientific agendas from the centre (ibid.).

Acording to de la Peña the fact that scientific production in Mexico is strongly influenced by the trends marked by countries in the centre shows that science in Mexico is working towards the ideals and objectives that benefit the centre over the ideals and objectives of the national academic and scientific development (ibid.). Nevertheless, as noted by de la Peña, such a trend does not come about in a conscious way given that this vicious circle is so deeply-rooted in the system of education and in the culture of Mexican researchers. There is even a mechanism that reinforces and maintains the dominance of internationalism: renowned Mexican researchers are trained in elite institutions from foreign countries (usually from the centre); they read and attempt to submit in elite journals based in countries from the centre (ibid.41). Furthermore, these researchers teach and train younger scientists based on the scientific ideals of the centre.

The mechanism of cultural domination is so strong that it has even been identified by intergovernmental organizations such as UNESCO: “scientific and technological dissemination is not a neutral phenomenon, it has cultural, ideological and political significance” (UNESCO 1976). Peripheral countries work for the preservation of dominant structures. The fact that developing countries such as Mexico work towards the assimilation and conservation of knowledge produced by the communities in the centre only contributes to their further dependency and underdevelopment (ibid.). Indeed, the importing of technology is now the vehicle with which to widen the distance between rich and poor countries and thus increase the dependence and domination of the richer countries. The draining of the already-scarce resources from underdeveloped countries, producers of raw materials for the owners

of the technology and modern knowledge, only widens the differences between the centre and the periphery (ibid.39).

As noted throughout the chapter, the non-discursive factors that affect Mexico such as economical, financial and political instability, a very young scientific culture, and the lack of initiative in the production of scientific knowledge, contribute to the perpetuation of the influence exerted by the NES scientific communities from the centre and its language. Furthermore, such factors and the constant contact with standards of scientific production of the centre have contributed to the normalisation of these standards and its consequent favouring over the creation of their own standards.

Having discussed the non-discursive factors that facilitate the influence of the NES scientific community, let us now pass on to discuss the discursive effects, derived from such influence on the scientific production of Mexican researchers.

Chapter 3: The Discursive Factors Affecting the Scientific Community from Mexico: Analysis of Writing and Translating for Publication

When weighing the effects that non-discursive factors have on the output and representation of Mexican researchers at international level, as discussed in the previous chapter, it might seem that the discursive factors of English specialised discourse do not affect this community. Nevertheless, although the distinctive discursive habits of NNES researchers may not be the decisive factors that prevent articles from being published in international mainstream journals, they are important in the process of publication and, as such, special attention should be paid to them given that, as previously observed by Coates et al. (2002:11) and Salager-Meyer (2008:10-11), what are viewed as “poor linguistic skills” are closely related to paper rejection.

As noted by Bennett (2015:10), the benefits offered by English scientific discourse to NNES researchers, such as access to the international community and more professional opportunities, are greater than those offered by their native language. However, she also notes that, at the same time, publishing in elite international journals is considerably harder for NNES located in the periphery and semiperiphery of science than it is for NES in the centre (Curry and Lillis 2010; Salager-Meyer 2008; Ferguson 2007; Uzuner 2008, in Bennett 2015:10). For NNES researchers, writing for publication is usually a long process, with extra time and money required before they have their works successfully published in a journal (ibid.). The standardisation of language in these areas, as Bennett further notes, has created an imbalance in the way that research communities from the centre and the periphery are

represented at international level, where NES researchers from the centre are more dominant in international publication.

The effects of discursive dominance in international scientific publication are particularly problematic in two areas: domain loss and the loss or alteration of the epistemological ideology ingrained in the native languages of NNES researchers (Bennett 2015). These effects are closely related to the notion of the dominance of ELF as a killer language, as mentioned earlier in this thesis. According to Bennett, domain loss refers to the deterioration of the specialised discourse used in science and academia, due to the lack of use in the native language. Domain loss can be viewed in two main ways, through a phenomenon called diglossia, whereby English is used as the dominant language in current research or high-level teaching, whereas the native language is used only for the dissemination of knowledge for the general public, and lower-level teaching (Gunnarsson 2001; Ferguson 2007, in Bennett 2015:10). Bennett (ibid.) notes that domain loss is seen through the partial or complete modification of the specialised discourse in the native languages of NNES researchers caused by the dominance of English discourse in these areas; in this case, the specialised discourse in the native language acquires syntactical characteristics typical of English discourse (Anderman and Rogers 2005; House 2008; Bennett 2012). As further noted by Bennett, in either type of domain loss, there is a "gradual erosion of cultural specificity, that brings psychological and sociological effects in the epistemological paradigm of the local community" (Collective and individual identity) (Ivanič 1998 in Bennett 2015:10).

The second area that is affected by the discursive dominance of ELF, as mentioned above, is the loss or alteration of the epistemological ideology of each of the linguistic communities in contact with ELF, which are affected as a result of the

domain loss in their native language. This phenomenon, according to Bennett, entails the loss or the complete or partial modification of the epistemological paradigm, i.e. the knowledge perspective of the native speakers of languages other than English. Therefore, as noted by Bennett, given that the languages encode a particular ideology which is transmitted in the way the language is structured, languages are never neutral, which leads to a challenge of the idea that EAD is “the transparent vehicle of objective truth” (ibid.).

As discussed in chapter 1 and 2, although it is possible that due to the dominance of ELF and the constant presence of the scientific community from the centre and its ideals, there might be interferences or modifications at deeper levels of the knowledge construal of NNES scientists in the periphery and semiperiphery of science. However, given that it is very difficult to differentiate between the knowledge perspectives of each group, particularly in the hard sciences, it is also difficult to identify the level of damage that factors such as the dominance of ELF or the dominance and influence of other knowledge perspective have on the knowledge of Mexican researchers. Moreover, as was discussed in chapter 2, the possibility of loss of domain due to the influence of ELF in science, does not fully describe what is happening with the discourse that Mexican researchers have developed. This is mainly due to two main factors. Firstly, as noted in chapter 2, science and research as we know it today was imposed in the Mexican society, rather than it being part of a natural process, this is scientific thinking. Secondly, as a consequence of the imposition of a new paradigm and the use of a scientific discourse, resulted in the lack of a proper discourse of this community. Thus, as far as the scientific community from Mexico concerns, the loss of a domain that did not exist in the first place is not a real concern.

Therefore, the discursive changes reflected in the current discourse developed by Mexican researchers, accordind to the multilingual paradigm, can be interpreted as a result of a creative process in which Mexican researchers, as multilingual users of ELF, negotiate between their L1 and ELF to facilitate communication. Nevertheless, although domain loss and the potential destruction of the epistemological paradigm of the Mexican scientific community are not areas that contribute to the disparity in their representation at international level, or changes in the discourse, there are other factors that affect the written production of this community and their subsequent representation at international level.

As discussed above, the discursive dominance of English is facilitated by different factors that affect the scientific community from each country. For instance, Salager-Meyer (2008:12) has noted that some of the most prominent disadvantages or factors that directly affect the discursive habits and characteristics of Spanish native-speaking researchers in international publishing are, firstly, the lack of academic and scientific writing policies in either the researchers' native language (Spanish L1) or in English (L2) at undergraduate level. Secondly, universities in these countries usually lack financial resources to cover the basic needs or materials needed for research; therefore, additional expenses such as specialised language courses or translation and proofreading services are not available for them, or are simply not considered a priority. A third factor that affects the scientific discourse is that the services offered by language professionals, such as specialised translators or proofreaders, are far too expensive. Such services add to the sometimes high fees required by predatory journals that the scientists already need to cover in order to have their manuscripts published, when the top mainstream journals reject their manuscripts. Furthermore, in many cases, these language professionals do not specialise in, or are not aware of,

the diverse types of styles in scientific discourse, and thus perpetuate or contribute to the interlinguistic interference of the specialised discourse of NNES researchers.

This chapter focuses on the study of the particular characteristics of the written production of Mexican researchers in the area of materials science. Furthermore, the study aims to identify the linguistic changes, at the lexico-semantic and syntactic levels, found in RAs written by Mexican researchers, both in Spanish and in English. For the linguistic analysis, thirty scientific articles written by Mexican researchers were chosen. Of these, fifteen were written in Spanish, the L1 of the authors, while fifteen were written in English, the L2 of the authors. It is worth mentioning here that although the English articles are published in this language, it is not possible to know whether the authors wrote them directly in this language, or if they were translated by a professional translator. The articles in the English L2 were collected randomly, by selecting one or two articles from three volumes published at the beginning, middle and end of each year between 2010 and 2016. The journals selected were as follows: *Revista Mexicana de Ingeniería Química*, the *Journal of Applied Research and Technology*, and the *Journal of Mexican Chemical Society*. The articles written in Spanish were collected randomly from the following journals: *Superficies y vacío*, *Revista Fitotecnia Mexicana*, and *Asociación Farmacéutica Mexicana*. The articles chosen were published during the period spanning 2010–2016. The choice of the years of publication was dictated by the fact that from 2010, the discourse presented in the articles seems to include a style that is similar to EAD when compared with publications from earlier years (1980s and 1990s). The journals mentioned above were selected for this study based on the subject area; namely, they all include studies dealing with materials science. The area materials science was chosen, due to the status, according to the ranking in scientific output in the country, as it involves studies from chemistry and physics, which are in

second and third place at national level in Mexico. Another important factor for the selection of these journals was the importance of these journals in the country due to their long-standing presence when compared to other journals in the country.

The purpose of this chapter is to explore the relationship between the linguistic changes included in RA by Mexican researchers and the compatibility between these changes and the standards for publication. Indeed, the aim is to identify agrammatical modifications and how they hinder their intelligibility and their publication. The potential relevance of this analysis for translation studies can be seen for technical translators, as being aware of the different factors that interfere in this context means that we can be more careful during our practice.

3.1 The Hybrid Discourse of Mexican Researchers

The scientific discourse of the Mexican researchers has evolved over time into a hybrid discourse that combines stylistic, rhetorical and grammatical constructions from both Spanish and English. Within this discourse, the textual features of academic Spanish escape the scholars' use of the standard scientific English and, the other way around, the standard scientific English features are combined with the use of the standard academic Spanish (Pérez-Llantada 2010:25). The following paragraphs discuss the factors that have contributed to the hybridisation of the specialised discourse of Mexican researchers in three main areas: 1) foreign language teaching; 2) areas of production/pressure exerted by institutions; and 3) editorial standards.

The first area is relevant in the following way: as a consequence of the non-discursive factors mentioned in Chapter 2, such as financial deficits and economic instability, spending on alternative tools, such as translation and proofreading services,

and foreign language courses in the specialized discourse, that can potentially boost publication in international journals is not a priority, as they represent unnecessary expenses (Salager-Meyer 2008). Although between 1970 and 1980 in Mexico, new language courses were developed that would cover specific skills, for the comprehension of scientific texts at universities, these programmes were never implemented on a massive scale (Aguado 1990:165). Despite the proximity of Mexico to the US, the level of proficiency in English achieved by many Mexican researchers and academics is far from good. As noted by Hamel (2005:49), foreign language teaching in Mexico, despite being mandatory in primary, secondary and higher education, in practice tends to be deficient. This is mainly because the courses offered in higher education programmes are not designed to respond to the professional and academic needs of the students. Simply put, the teaching is not designed to be functional in the technical contexts in which students will be able to develop and perform as researchers. Most of the curricula of language courses are based on standard skills and content mainly focused on developing oral, written and auditive skills in somewhat artificial, leisurely contexts. However, although these courses may offer researchers the basic grammatical structures of the foreign language, this is not what the researchers need.

The second area that contributes to the hybridisation entails the areas of development, application and socialisation in which Mexican researchers interact, and in which different languages interact. Hamel (2005:35-36) provides a chart illustrating all the discursive areas of interaction in which Mexican researchers interact:

Activities	**National or International**	**Hard Sciences**	**Applied Sciences**	**Social Sciences**	**Humanities**
Writing for publication (books and Journals	International	English	Span>>Eng	Spanish>English	Spanish>> English

Conferences	International	English	Eng>>>Span, other languages	English>Spanish, other languages	English>Spanish
Training, workshops	International	English	Eng>Span, other languages	Spanish>English, other languages	Spanish>English, other languages
Conferences	National	Eng = Spanish	Span>Eng	Spanish	Spanish
Training, workshops	National	Span>Eng	Span>Eng	Spanish>>English	Spanish
Writing: results, evaluations, collaborations	National	Span>Eng	Span>>Eng	Spanish	Spanish
Postgraduate: Teaching, reading, evaluation, collaboration	National	Eng>>Span (Reading) Span>>Eng (writing)	Eng>Span (Reading) Spanish (Writing)	Spanish (writing) Spanish= English (reading	Spanish (writing) Spanish>English (reading) Other languages (reading)
Dissemination: Publications, audiovisual material	National	Spanish	Spanish	Spanish	Spanish
Dissemination: Conferences, workshops	National	Spanish	Spanish	Spanish	Spanish

Table 3.1 Discursive fields of science and languages according to branch of science (Hamel 2005:35-36)

Table 3.1 above shows the different activities that Mexican researchers carry out both at national and international level, as well as the languages they need to use during these activities, depending on the field of science in which they specialise. The table differentiates between the hard sciences, natural sciences, social sciences and the humanities. According to the data shown above for researchers in the hard sciences, English is the language that completely dominates the activities taking place in international circles, i.e. writing for publication, presentations at conferences, and training courses or workshops. The fact that the foreign language is the dominant language in which NNES researchers have to interact may be problematic, as not all

of them show the same command of proficiency in all the skills of oral acquisition. For instance, the auditive and oral limitations of foreign languages may sometimes be more acute than reading, since an advanced command is required in order to attend specialised conferences and to participate in scientific discussions. Additionally, the multiple dialectal varieties in the written and spoken language in English, including English idiolects spoken by foreigners from diverse native languages, add to their problems (ibid.35).

On the other hand, for the humanities and the social sciences, although English is still a strong language used in international interactions such as publication in international journals, Spanish is the dominant language. The only exception is conferences, where English is more dominant than Spanish. This may be attributed to the fact that researchers in the humanities collaborate mostly with academics from the same linguistic background, as their research shares more similarities than it does with academics from other linguistic and cultural backgrounds. According to Hamel (2005), even though researchers in the social sciences and the humanities do not necessarily need to publish or interact in ELF, the lack of exposure to this language can have potential detrimental effects on their practices, as is also the case with researchers from the physical and pure sciences. Some of the detrimental effects, as further noted by Hamel, are seen, for instance, in the blockage of acquisition of international perspectives on behalf of NNES academics (ibid.37).

The principal difficulties arise when researchers are faced with the need to write articles or books in the foreign language. According to Hamel, researchers resort to two methods to meet this need: writing in the foreign language or translating the text into the foreign language. According to the table, depending on the scientific area, the level of difficulty in writing increases gradually as the focus moves from the pure

sciences to the humanities. As noted by Hamel, the difficulty in writing in the foreign language increases due to the rhetorical expectations from each field. For instance, the discursive style used in the humanities and the social sciences in Spanish includes a richer and more diversified vocabulary than that which is seen in the hard sciences. Furthermore, the specialised terminology is less uniform than in the hard sciences, and thus it differs tremendously from the discourse used in English. The discourse employed in the hard sciences, however, is less complex when compared to the humanities, due to the simplicity of the syntactic structures, as the specialised international discourse in English is based on formulae that do not require major syntactic or lexical sophistication**.**

The activities that take place at national level are those that may seem problematic for researchers, and particularly those from the hard sciences; the one exception is local conferences and publications, in which Spanish is the only language used in all four fields of science. With regard to activities such as teaching at postgraduate level and writing results for the pure and the applied sciences, the task becomes problematic, as the users have to be continuously shifting between languages. According to Hamel (2005:36), at postgraduate level, in many cases lectures, textbooks and the majority of the material are available mostly in English (Salager-Meyer 2001:36), while at the same time the everyday production is articulated in Spanish. The jargon derived from this process does not include terminology that can be easily translated or transferred into English; nevertheless, it is an informal register that satisfies, in general terms, the needs of the moment (ibid.). The main problem arises when the informal language has to be used in formal institutional or public domains, whereby the informal jargon has to be adapted through either the creation of

new terminology, or the maintaining of a scientific pidgin (ibid.); in either way, the versions may not always be reliable as they are not consistent among all users.

The third area that contributes to the hybridisation of the language comprises the standardised guidelines for publication applied and executed by the editorial boards from national and international journals. A big issue in regard to this point is that academic and scientific institutions in Mexico, such as scientific editorials, universities and research centres, do not regulate a standard scientific discourse in Spanish the same way that Anglophone institutions do with English discourse, nor do they offer guidelines that address a set of standard stylistic requirements for publication. Indeed, some journals promote the submission of research articles indicating a predilection towards texts written in English or following the English rhetorical structure I-M-R-D. For instance, one of the oldest journals in physics in Mexico, *Revista Mexicana de Física* (RMF), states on its webpage:

> The Revista Mexicana de Física (Rev. Mex. Fis.) publishes original papers of interest to our readers from the physical science community. Language may be English or Spanish, however, given the nature of our readers, English is recommended.
>
> (Revista Mexicana de Física[9])

Additionally, the authors intending to submit articles to RMF are referred to a manual from *The American Physical Society*.

> The Revista Mexicana de Física publishes articles preferably in English, but also in Spanish. The manuscript must have: title of the article; name, institution

[9] https://rmf.smf.mx/page/ [Retrieved 17/12/2018]

> and address of each author. It must also include: an abstract; one to five keywords; and one to three PACS code numbers of the American Institute of Physics (AIP)[10].Articles in Spanish must include abstracts in both languages. More details at http://forms.aps.org/author/styleguide.pdf (Page 7, Table I).

There are technical and academic style manuals (Contreras and Ochoa 2012) available to researchers in Mexico that serve as referential tools for publication in national and international journals in either English or Spanish. These manuals are a good tool for beginner researchers, as they elucidate the different types of scientific texts they will have to work with and the structure which each follows. Furthermore, they provide advice on the types of practices to follow or to avoid in order to secure publication. These manuals also offer guidance in terms of the selection of journals according to the topic of the articles and the type of research performed; additionally, they provide guidance on how to collaborate with other researchers. Nevertheless, these manuals fail to address the specific discursive style for research articles in the native language (Flowerdew 2008). Accordingly, with the growing pressure of publishing frequently exerted by the local institutions of Mexican researchers, and to be more visible to the international scientific community, researchers with a developed or higher level of proficiency in English prefer to write directly in English. Indeed, this significantly diminishes the possibility of creating a proper scientific style in the native language for the scientific community.

As a result of the factors mentioned above, Mexican researchers have developed a hybrid discourse in either Spanish or English. This hybrid discourse comprises the generalised use of English syntactic and rhetorical structures in the production of manuscripts in both their native language and in English, which they

[10] see: http://www.aip.org/pacs

combine with the rhetorical tools of their native language. Examples include the ways authors have adopted some rhetorical expressions from English, such as the use of hedging, and the way they relate to the audience of the text, making knowledge claims (an analysis and of these characteristics will be offered later in this chapter). Such characteristics may often be perceived as unpolished and in some cases even unintelligible by audiences outside the linguistic community of the authors, and thus deficient according to the standard requirements for international publication.

Finally, given the status of the scientific community from the centre, and particularly the Anglophone scientific community (i.e. the US and the UK), the texts in this analysis seem to show that the authors have deemed English discoursal characteristics to be exclusive to, or representative of, scientific discourse.

3.1.1 Characteristics of the Scientific Discourse used by Mexican Researchers

In general terms, and in non-specialised contexts, both languages, Spanish and English, are distinguished by different characteristics that make each language's discursive style unique. For instance, Spanish discourse can be characterised by a fairly picturesque and wordy style, in which linguistic elegance and precision are achieved by avoiding many practices that are acceptable and sometimes necessary in English discourse. As noted by Martin-Vivaldi (2000:14), Spanish discourse allows a freedom in the order of the words given in a sentence so as to achieve such ideals; as Spanish formal discourse is governed by the verb, verbal structures are far more common and acceptable in Spanish rather than nominal structures. English, on the other hand, is characterised by a more structured and linear way of presenting ideas, where verbosity and elaborate sentences are dealt with carefully, as they are perceived as obscuring the direction and sense of the text. As shown above, the writing styles

and characteristics of both languages are in two different extremes, and thus when authors mix characteristics from these languages in the same text, like Mexican researchers tend to do, they may be perceived as inexperienced writers, and therefore a considerable amount of the value or impact of the text may be lost or decrease.

Mexican researchers thus tend to combine styles and characteristics of both languages derived from: 1) the inevitable influence that Spanish, as their native language, has in the management of written language; and 2) the status of English discourse as the lingua franca in international scientific communication. The texts they produce tend to have a peculiar hybrid style. It is important to note here that even though, as noted above in this chapter, scientific English has a particular rhetorical structure (I-M-R-A-D), the style used in the corpus is still influenced by the style of traditional English discourse. Having said that, scientific discourse, in either Spanish or English, possesses characteristics that may not entirely reflect the syntactical characteristics or rhetorical rules of each language. For instance, the basic principles of scientific writing, namely *clarity* and *precision*, are achieved through certain techniques and rhetorical tools, e.g. repetition of words and ideas, which may be avoided or frowned upon by professional writers of either language. These principles are also achieved through the use of very technical vocabulary, which is abominable according to the standards of either language. This may allocate characteristics to the text that make it seem somewhat artificial and mechanic. Nevertheless, these are the characteristics that have aided Mexican researchers with the transmission of their scientific knowledge.

By way of illustration, the following paragraphs present a concise analysis of the stylistic characteristics, in Spanish and English, of the written discourse of Mexican researchers in the area of materials science. The excerpts used in this analysis were

randomly taken from a corpus made up of 30 articles, 15 written in Spanish and 15 written in English, by Mexican researchers, and published in the year 2016. The year of publication was selected purposefuly given that, as mentioned earlier in the thesis, the discurse used by Mexican researchers in more recent publications, as observed in an extensive discursive analysis of the publications from the same journals mentioned above, is very different from the dircurse used in earlier decades.This is, while the publications in earlier years show a stronger similarity to the Spanish discursive style, recent publications like those found in 2016 show a more hybridised style. The articles were selected randomly from the Mexico-based scientific journals, mentioned above, in the area of materials science: *Revista Mexicana de Física* (RMF), *Revista Mexicana de Ingeniería Química* (RMIQ), and *Superficies & Vacio* (S&V). The main purpose of this analysis is to identify the typical rhetorical and stylistic characteristics of the specialised discourse developed by Mexican researchers. The results of this analysis will, it is anticipated, help to single out those proper stylistic characteristics of Spanish written discourse and those from English written discourse. Consequently, this will offer an insight into the linguistic modifications made in the discourse by Mexican researchers in the area of materials science, in order to determine the effect that English scientific discourse has on the written production of this community.

The data from the linguistic analysis is presented as follows: Section 3.1.1.1. offers an analysis that looks at the discursive characteristics typical of academic Spanish discourse identified in the corpus, such as sentence length, verbosity and subordinate clauses. The analysis was carried out with the software program MAXQDA. Section 3.2 offers an analysis that intends to identify the characteristics typical of English scientific discourse at the lexico-semantic and the syntactic levels found in the same corpus. The analysis in this section focuses on articles written in

Spanish and English. Finally, Section 3.3 discusses the effects in the clarity and intelligibility of the RA caused by the interaction of Enlgish and Spanish discursive characteristics in the hybrid technical discourse identified in the analysis.

3.1.1.1. Grammatical Characteristics: Sentences

As argued throughout this chapter, Mexican researchers lack a scientific discourse of their own, and instead often tend to imitate the style of English scientific discourse. Nevertheless, there are still certain characteristics from the traditional academic Spanish discourse, as identified in the corpus, which may be a result of the negotiationg skills between English and Spanish as mentioned in the multilingual paradigm. Such characteristics include sentence length, verbosity, and the excessive use of subordinate clauses.

Sentence length is perhaps one of the most distinctive features of Spanish written discourse. At the same time, however, this feature may be problematic in its own right. On the one hand, in academic areas such as the humanities, social sciences and literary studies, writing in long sentences is a necessary technique, given that, according to the standards of written Spanish, the text is judged on the basis of its fluidity, consistency and literary beauty (Martinez-Vivaldi 2000:114). These characteristics are the typical or representative characteristics of Spanish language (ibid.). According to authors who defend the use of a rich language and long sentences, there is no set limit regarding the number of words that should be included in one long sentence; indeed, it can even be acceptable to have a single sentence as a whole paragraph. This practice is not recommended in English written standards which favour comparatively shorter sentences. According to the formal written standards in Spanish, short sentences are frowned upon and should be avoided; it is believed that they may

cause a sense of text fragmentation and sometimes even compromise the sense of the whole text (Martinez-Vivaldi 2000:184). On the other hand, however, in scientific and technical spheres, authors usually support the use of shorter and simpler sentences in order to follow the standards of scientific writing, often developed under the influence of English discourse. Indeed, this is recommended even if it means going against the ideals of proper writing, i.e. fluidity and aesthetics, in their native language (Martinez-Vivaldi 2000; Jimenez-Arias 2007). Thus, it is acknowledged by Mexican authors that the chief objective in scientific writing is the transmission of information in a clear and concise way rather than focusing on creating an aesthetically pleasing and lexically rich text. Characteristics such as clarity and conciseness, as mentioned above, are considered by Mexican researchers as being intrinsinc to English language. Still, the use of long sentences is one of the most prominent features identified in the corpus. Excerpt 3.1, below, is a clear example of this tendency. The excerpt was taken from an article published in the Mexican journal *Superficies y Vacio* in 2011. The article describes the study of the characteristics of electrolytes found in samples of soils taken from coal-mining areas in Mexico.

Excerpt 3.11

A partir de estos resultados se puede decir que la muestra de suelo utilizada posee una gran capacidad amortiguadora ya que a pesar de las grandes variaciones de pH que se presentan en los suelos durante el desarrollo de las microelectrolisis, al retirar la imposición del campo eléctrico y darle tiempo al suelo de secarse a temperatura ambiente, este logra estabilizar el pH y solo presenta variaciones, de 0.3 a 0.6 unidades de pH con

respecto al inicial, donde se considera que no se alteran las propiedades fisicoquímicas del suelo después de un tratamiento de electrorremediación, y que las variaciones de oH sufridas se podría compensar con la adición de un fertilizante (S&V 2011, 24 (1). 24-39).

Literal translation:

From these results, it is possible to say that the soil samples used in the experiment possess a high shock-absorbing capacity because, despite the significant pH variations in the soil samples during micro-electrolysis, when the electric field imposition is moved away and the soil is dry at ambient temperature; this stabilises the pH and only shows variations, of 0.3 and 0.6 pH units, with respect to the initial numbers, where the physiochemical properties of the soil are not altered after an electroremediation treatment, and the pH variations can be compensated for by the addition of fertiliser.

Composed of 114 words, this is the longest sentence in the corpus. At first glance, and from a translator's perspective, this sentence can be overwhelming, given its length and the type of information in it. In fact, due to the type of information in this sentence, even experts in the area would perhaps need to read it more than once in order to comprehend it fully. This sentence is composed of several subordinate clauses. In the following section, the sentence is broken down into smaller and simpler sentences in order to identify the main clause.

(1) The results show that the sample used [in the study] has high shock-absorbing properties.

(2) The presence of the high shock-absorbing properties materialises despite the variations of pH in the soils during the process of microelectrolysis.

(3) Despite the above-mentioned variations of pH values in the soils, the pH values are stabilised after micro-electrolysis.

(4) The pH is stabilised after the imposition of the electrical field is withdrawn from the sample, and the soils are dried at room temperature.

(5) The pH values of the soils present variations from only 0.3 to 0.6 in relation to the initial pH.

(6) The physicochemical properties of the soils are not thought to change after electroremediation.

(7) The pH variations in the soils can be compensated for by adding fertiliser.

Because of the high level of subordination in this sentence and the use of pronouns and synonyms – a practice that is employed to avoid repetition, as is normally expected in Spanish discourse – it was difficult to discern its main structure. As shown above, seven shorter sentences were derived from the original sentence. In some cases, the sentences build up information presented in the first sentence, while others only add extra information about the topic. Two main clauses were found in this sentence (numbers 1 and 3), whereas the remaining five sentences only add information derived

from the main clauses, but do not actually contribute to the main purpose of the main clauses.

Given that the elaboration into long sentences is so deeply ingrained in the rhetorical style of Spanish native speaking authors, they also tend to replicate this structure in English. This feature was also identified in the articles written directly in English by Mexican researchers.

Excerpt 3.2

> For example, the sensitivity to variations in operating conditions (pH, overloads, temperature, substrate composition, etc.) can inhibit and even stop the process; the non-linear dynamics and the non-stationary nature of anaerobic digestion can be difficult to analyse and to control. Moreover, the hydrodynamic behaviour of the reactor can induce transport phenomena which are hard to manipulate; following this, to guarantee operational stability (Hill et al. 1987) and to avoid the eventual breakdown of the anaerobic processes, the organic matter in the phase liquid must remain inside a predetermined set of values depending on the reactor configuration and the characteristics of the wastewater to be treated (Ahring et al. 1997) (RMIQ 2010, 9 (2). 219-229).

Excerpt 3.2 above comes from an article published directly in English in *Revista Mexicana de Ingeniería Química* in 2010. Setting aside the evident grammatical errors and other peculiarities (which will be discussed in depth in 3.2 below), this sentence is composed of 100 words – a length that is not common nor recommended in English scientific discourse. It is also possible to see that the techniques used in the elaboration

of this sentence are very similar to those used in Spanish. This sentence presents a high degree of subordination. That is not to say that manuscripts written by Mexican researchers are entirely made up of paragraph-like sentences. They vary in terms of the length of the sentences, depending on the purpose of the sentence or the type of the information introduced.

Another common feature identified in the corpus was the high number of subordinate clauses used to connect several ideas in one single sentence. In Spanish there are three types of subordinate clauses, namely adverbial, substantival and adjectival clauses. The most common type of clauses identified in the corpus were adverbial clauses. The following excerpt shows a sentence with a high degree of subordination, using mostly adverbial clauses:

Excerpt 3.3

Las puzolanas naturales están compuestas mayoritariamente por silice y otros compuestos de aluminosilicatos **y además** contienen una proporción de silice vitreal, **la cual** puede reaccionar con el hidróxido de calcio (C-H) **formando** silicato de calcio hidratado (C-S-H) **y** este contribuye a la resistencia del concreto.

Literal translation:

Natural “puzolanas” are mostly composed of silica and other aluminosilicate compounds; **furthermore** they contain a vitreous silica proportion, **which** may react with calcium hydroxide (C-H), thus creating calcium silicate hydrate (C-S-H) **and [which]** this contributes to the resistance of the concrete.

Verbosity and over-elaboration language are other characteristics identified in the corpus. Simply put, these refer to constructions or descriptions that would rarely be found in English scientific discourse. Excerpt 3.4 below is an example of this type of language. The sentence was found in an article written originally in Spanish.

Excerpt 3.4

En los microsistemas una corriente de fluido, en lugar de la mano humana, es la encargada del transporte de la muestra hacia los distintos pasos de un proceso, donde se manejan volúmenes en el rango de microlitros y tiempos de proceso en rangos de segundos... (2010 superficies y vacio).

Literal Translation:

In microsystems, one fluid flow, instead of the human hand, is in charge of taking the sample through the different steps of the process, where volumes in the range of microliters and processing times in the range of seconds are used.

As shown in the excerpt above, elaborate and imagistic expressions such as *elaborado por la mano humana (made by the human hand)* are odd expressions to be seen typically in scientific texts in English. In Spanish, however, such expressions are considerably more common, and are used as a way of giving the text fluidity and formality. This type of flexibility in Romance languages, such as Spanish, as noted by Bennett and Muresan (2016:101-102) is facilitated by grammatical characteristics such as inflections and grammatical agreement, allowing the users of the language to be

more creative in the writing by loading and decorating the text. English on the other hand, is more analytical, and unlike Romance languages, it relies more on the order of the words in order to convey grammatical relationships in a text (ibid). For this reason, the simpler structure Subject-Verb-Object is favoured in academic and scientific writing with very limited subordination (ibid.) Notwithstanding the incompatibility of such discursive and rhetorical characteristics from Spanish academic discourse, such characteristics: verbosity, long sentences and high degree of subordination were were also found in articles written directly in English. See excerpts below.

Excerpt 3.5

> The laccase enzyme has received special attention from investigators over the past decades due to its catalytic properties and capacity to oxidise phenolic substrates in the natural manner, and non-phenolic substrates, in the presence of mediators (2013 RMIQ).

The characteristics presented above are not compatible with English scientific discourse in two main ways: firstly, as noted above by Bennett and Mauranen, the grammatical structure of English, that is the lack of inflections and broader flexibility, does not support the densely packed style of Spanish. Secondly, at the same time these characteristics in addition to the perceived authoritarian style of Spanish are conflicting with the core standards of academic and scientific writing “clarity, economy and precision”.

3.1.1.2 Argumentation and Ways of Making Claims: Hedging

The ways in which claims are presented in written texts by Mexican authors are very different compared to Anglophone argumentative conventions. Claims and arguments in English discourse are expected to be presented cautiously through the use of hedging. Hedging is a rhetorical strategy typical of academic and scientific discourse, used to present information with a specific strategy, e.g. caution, detachment, modesty, humility, indeterminacy, and accuracy level, among others. The main purpose of hedging devices in the text is to allow writers of scientific and academic discourse to be careful in the way they present their claims and point of view so as not to appear too aggressive, or not to overgeneralise claims than can later be refuted; these devices also facilitate intellectual debate by inviting reactions (Myers 1989; Hyland 1994, 1998, in Marti-Martin 2006:134; Oliver 2015:144).

The common hedging devices in English discourse include mostly the modal verbs *may*, *might*, and *could*, as well as modal adverbs such as *possibly*, *perhaps*, and *probably*, and lexical verbs and derived nouns such as to *attempt*, *aim*, *intend*, *propose*, and *suggest*, among others (Poveda-Cabanas 2007:147). Spanish discourse, on the other hand, typically does not include the same modal verbs; however, the discourse includes other linguistic devices to express modality in the text (ibid.145). Examples include adverbial expressions and the verbal modes, such as the subjunctive (ibid.). Other items used to signal hedging in both languages include lexical verbs and the nouns derived from them, such as *propose–proponer*, *suggest–sugerir*, *attempt–intentar*, *contribute–contribuir*; adverbs that introduce a degree of indefitness or lack of precision, for instance *partly–apenas*, *relatively–relativo/relativamente*; and prepositional groups such as *over the years*, *in an attempt*.

According to the analysis the hedging strategies that were identified in the corpus were the combination of lexico-grammatical items from both languages: 1) (Non-hedges) expressions, fairly common in Spanish. Excerpt 3.6 and 3.7 below show some of the most common uses.

Excerpt 3.6

Es bien conocido que *los fármacos disponibles para tratar estos padecimientos producen diversos efectos secundarios y existe un incremento alarmante de casos ocasionados por parásitos que son resistentes a los fármacos actuales (RMFC 44 (2) 2013:33)*.

Literal Translation:

It is widely known that drugs used to treat illnesses cause secondary effects and that there is an alarming increase in those cases caused by parasites that are resistant to drugs used currently.

Excerpt 3.7

Así mismo, los tres espectros, ***como era de esperarse,*** *tienen una similitud notable con el espectro Raman de etanol, que ha sido utilizado como referencia (RFM 38 (2) 2015: 149)*.

Literal Translation:

Likewise, the three spectra, **as expected,** are notably similar to the Raman spectrum in ethanol, which was used as a reference.

The expressions used in the excerpts above, namely *es bien conocido que…* and *como era de esperarse*, are typically used in Spanish discourse to introduce claims;

when translated literally into English, however, they may be perceived by NES as making generalisations or making bold claims. Given that such expressions do not seem to soften or be cautious about the information presented in the text. Indeed, expressions such as *it is widely known* and *as expected* make the information introduced seem to be referring to an absolute truth. This creates a conflict with the purpose of scientific research and more importantly scientific writing, since the main purpose of science is not about giving absolute truths but about analysing, improving and sometimes refuting already existing theories with evidence for the pursuit of knowledge advanacement. The excerpts 3.8 to 3.10 below show the lexico-grammatical items identified in the corpus of articles written directly in English by Mexican scientists.

Excerpt 3.8

> *Buddleja cordata is a species of dioecious shrub or tree that is distributed across a variety of habitats in the Mexican territory. This species* ***is highly important*** *due to its diversity of uses that include ornamentation, for aging, exological restoration as a pesticide and medicinal purposes.*

The underlined sentence with the use of the expression “highly important’” by not having hedging devices such as modal verbs or adverbs the sentence gives the impression to be making a bold claim where the object of the grammatical subject of the sentences is positioned in the highest level of importance above other plant species. Authors such as Salager Meyer (2011), Flowerdew (2000, 2011) and Oliver (2015) have studied the use of hedging devices and strategies in cross-linguistic

groups in scientific and academic texts; the results of these studies showed that hedging devices are more common in English (by a 10% of appearance, that is around 10% of the structures used in the texts include hedging devices) than in Spanish academic texts (only about a 5%) (Oliver 2016:151). As noted by Salager-Meyer (2011-36) due to the lack of hedging devices in the discursive style developed by native Romance speakers, and not only Spanish, is perceived by Anglophone readers as arrogant and over self-confident, characteristics that are also attributed to an authoritative style. Moreover, she notes that certain rhetorical variations made by native Spanish speakers, such as those presented above, are considerably different to those made by NES (ibid.,35). There are certain aspects of hedging that are determined by the culture, while others are determined by the genre of the discipline, as is the case in scientific texts. Some of the culture-dependent aspects of hedging identified in the corpus are the authoritarian and prescriptive language elements typical of Romance languages. Native speakers of Romance languages tend to use a more authoritarian and prescriptive language (Salager-Meyer 2011:36).

As noted earlier in this section, NES researchers tend to soften their claims using modal expressions such as *may*, *might*, *could*, *possibly*, and *likely*. Although hedging devices are not part of the traditional discursive standards of the Spanish language, they are being adopted by Mexican researchers. The following are examples of anglicised expressions found in the same articles. The expressions in question are presented in bold.

Excerpt 3.9

La variación de la remoción del arsénico en los experimentos ***puede ser debido a*** *las diferentes formas en las que se*

encuentra presente el arsénico como contaminante, el contenido de hierro y manganeso presente en el suelo **puede ser adsorbido** *en los óxidos de estos metales, y puede desorberse en condiciones reductoras, asimismo la alcalinización del suelo contribuye a aumentar la movilidad del arsénico (S&V 24 (1) 2011:28)*.

Literal Translation:

The variation in arsenic removal in the experiments **may be due to** the various ways in which arsenic is present as a pollutant; moreover, the content of iron and manganese in the ground may be adsorbed by the oxides of these metals, and **may be desorbed** in reducing conditions. Likewise, the alkalinisation of the ground contributes to the increment of arsenic mobility.

Excerpt 3.10

Cabe mencionar que el uso tradicional que se le atribuye a la especie para tratar padecimientos gastrointestinales, ***puede estar relacionado con*** *infecciones provocadas por bacterias y virus y no por parásitos, por lo que se necesita evaluar el efecto antibacteriano y antiviral de estos extractos para confirmar el uso tradicional que se le atribuye a esta especie (RFMC 44 (2) 2013:34)*.

Literal Translation:

It is worth mentioning that the traditional use (of the plant) is attributed to the species used in gastrointestinal procedures; **it**

> **may be related to** infections caused by bacteria and viruses but not by parasites, and thus it is necessary to evaluate the antibacterial and antiviral effect of these extracts to confirm the traditional use allocated to this species.

As shown in the excerpts above, the hedging strategies used by Mexican researchers in these excerpts are similar in both the Spanish and English languages. The modal verbs are being used in the text in the same way they are used in English. As can be seen in the examples, this helps soften the tone with which the authors are presenting their information. However, the adoption of such strategies with the passive voice construction is not always aligned to the grammatical requirements of the language, for instance the use of the periphrastic passive voice *puede ser debido* in excerpt 3.9 – although the structure is grammatical – takes away much of the fluidity of the text. A much better version could have been achieved using the reflexive passive voice with *se* as in *se debió*.

As suggested by Oliver (2015:143), each discourse community has different expectations regarding the writing styles used in the texts. For this reason, one could expect to find rhetorical devices typical of Spanish and English discourses, respectively, in texts written in each of those languages. However, according to the results found in the corpus (as illustrated by the excerpts above), it seems that Mexican researchers tend to mix rhetorical constructions from Spanish (L1 texts) and English (L2 texts) in their manuscripts. Spanish textual and rhetorical strategies however seem to be more predominant in both languages in the texts shown in the excerpts above. In many cases, this may be attributed to the fact that many of the researchers are beginner or intermediate learners of English as L2. When this happens, according to

Connor (1996), if L2 writers have not totally absorbed the target language audience's expectations, that is, the NES audience, writers will transfer the textual and rhetorical strategies in their writing (Connor 1996, in Oliver 2015:143). Thus, Mexican researchers, as they are unable to produce the written discursive expectations of English L2 (the language of science as they perceive it), transfer the style of their native language. Day (1998:25) claimed that, in order to master the discourse conventions of the foreign language, an L2 writer has to adopt the standard conventions of the predominant (Anglophone) academic style and the genre strategies used by the members of the discourse community (Oliver 2015:143).

In summary, the hybrid scientific discourse developed by Mexican researchers combines rhetorical expressions and syntactical constructions from both Spanish and English discourses. The hybridisation is derived from the attempts to comply with the discoursal requirements of scientific international publication. However, given the characteristics transmitted in the English L2 text which are submitted for publication in international journals, the majority of the articles are rejected by the editorial boards of these journals on the grounds of "incorrect grammar and/or intelligibility"[11]. Editors normally do not offer further clarification or any type of assistance in reference to the specific textual problems or, indeed, on the sections of the text that are perceived as problematic, Regardless of how the authors chose to correct the manuscripts - whether they choose to have their manuscripts domesticated in order to comply with the stylistic requirements of the journals, or to focus on the modifications only with the aim of improving the content of the research, the articles tend to end up with inconsistencies in either the content or the style of the text. As a consequence, in some cases, authors choose to publish their articles in other, less demanding journals.

[11] Information gathered form the survey for Mexican researchers, which will be presented in Chapter 4.

3.2 Cross-linguistic Analysis of Textual and Grammatical Modifications in the Scientific Discourse of Mexican Researchers

In addition to the fusion of rhetorical and stylistic expressions and devices in the texts produced by Mexican researchers in Spanish L1 and English L2, there are also textual and grammatical modifications at deeper levels that affect the reception of these texts by NES and international audiences. According to Uriel Weinreich (1977), the frequent contact between two languages in the practice of an individual generates "distantiations from the norms of both languages, both in written and spoken language" (in Aguado 1990:163). A large number of Mexican researchers, as mentioned earlier in this chapter, are in constant contact with English scientific discourse from their earlier years of training through the material available to them. As they have been in contact with the language and the norms of English in this context, and due to the fact that there is no official Spanish scientific discourse, in addition to allocating English as the official and more "logical" language for the transmission of scientific knowledge, they assimilate the written norms of English discourse. According to Yebra (1982), linguistic interference tends to have a unilateral impact, given that the most predominant language, in this case English, inevitably invades the weaker language, in this case Spanish (352, in Aguado 1990:163).

As discussed in the section above, the scientific discourse that Mexican researchers have developed comprises formal lexico-grammatical and rhetorical features from Spanish and English into interaction with each other. There are some instances where the features adopted in the texts seem to work, even though the constructions may seem odd to native speakers of either English or Spanish. Such constructions can be seen in the adoption of hedging devices, such as those presented

in excerpts 3.11 and 3.12. For instance, as the foregoing discussion is concerned to show, although the use of modal verbs in this sense may not be a common practice among native Spanish speakers, the constructions are grammatical and help transfer the main idea. Other examples of odd constructions for Native speaker of English and Spanish that were identified in the corpus are:

1) word order,

> Such a situation arises, for example, in the coherent imagery when it is necessary to eliminate the undesirable speckles in the image (see, for example, [1]) or in the problem of generating the propagation-invariant fields, when it is necessary to create a secondary source with a special structure of spatial coherence [2–4].
>
> (RMF 2005 vol. 51)

2) The use of words (verbs, adverbs, adjectives), mainly in Enlgish L2 texts, that seem odd in the context of scientific writing but are fairly common or acceptable in Spanish, e.g.

> Such a screen may be created in practice by means of the electrically controlled spatial-time light modulator on the basis of a twisted nematic liquid crystal placed between two polarizers
>
> The configuration and control of the modulator was carried out with the aid of the attached software.
>
> (RMF vol. 51)

Nevertheless, there are many other instances where the constructions developed challenge the linguistic norms of both languages. Such constructions adversely affect the clarity and objectivity of texts. Accordingly, these constructions are the ones that

cause problems for editors and translators, as trying to interpret and translate these texts can be challenging. Said interferences work mainly at the lexico-semantic and the syntactic level (Gutiérrez Rodilla 1998).

As the written guidelines from English discourse are usually considered the standard for scientific writing by Mexican researchers, there are certain characteristics that they have adopted without realising the effect that such foreign constructions have on the written discourse from their native language. In most instances, the effects caused may only challenge the grammatical constructions of the text; in other instances, however, the incorporation of the foreign structures may be affecting the text at deeper levels.

Sections 3.2.1 to 3.2.3 of this chapter, accordingly, present an analysis of the modifications of English discourse found in the RAs written by Mexican researchers in the multidisciplinary area of materials science. The analysis looks at the two levels affected by the interplay of discursive habits described by Gutiérrez Rodilla (1998): the lexico-semantic level, and the syntactic level. The excerpts of the analysis were taken from the corpus mentioned in section 3.1 above.

3.2.1 The Lexico-Semantic Level

The lexico-semantic level comprises the usage of foreign terminology in the discourse of the native language. According to Bermúdez-Fernández (1997:17), the lexico-semantic level is the most vulnerable in scientific language, as it is the most variable and least formally structured level in a linguistic system. Terminology may be considered a crucial component of scientific discourse, as the specialised terminology allocates the degree of technicality to scientific language. Furthermore, as noted by Cabré (2000a:37), terminology also helps to unify the concepts and terms used in

subject fields, which facilitate the communication among researchers (in Farbe 2012:14). According to Farbe (2015:15), terminology belongs to a linguistic and cognitive domain; in this sense, terms are linguistic units which convey conceptual meaning within the framework of specialised knowledge texts.

A problem that can derive from the usage of technical terminology is that its incorrect usage may carry negative repercussions for a specific area of specialisation. As noted by Gutiérrez Rodilla, “a bad [wrong] terminology from an erroneous scientific language may change their concepts, making them wrong, consequently damaging scientific rigour” (1998:24). The problem is aggravated when a third party, for example an inexperienced or non-spacialised translator or proofreader, is involved in the process, as the lexical errors are perpetuated, and the clarity and accuracy of the texts are compromised by faulty translations. The following paragraphs show examples of technical terminology in Spanish.

The insertion of anglicisms in scientific discourse can be categorised in two main groups of transference: lexical and semantic. Lexical transference refers to the incorporation of a new word into the lexicon of the area; semantic transference refers to the allocation of a new meaning to existing terminology of the L1 (Bermudez-Fernandez 1997:18–20).

3.2.1.1 The Lexical Level

The lexical level comprises: loanwords, calques and hybrid words. Many of the insertions or modifications of this type do not alter the meaning of the terms, only the lexicographic preferences or the final “version terms” (Gutiérrez Rodilla 1998) that the authors choose to use. The following sections diccuss the lexical transferences as loanwords, calques and hybrid words from English identified in the corpus.

The following table shows the lexical transferences from English discourse found in the corpus.

Lexical insertions from English	**Examples identified in the articles**
Loan words	38
Calques	22
Hybrid words	13

Table 3.2 Lexical insertions identified in the corpus.

3.2.1.1.1 Loanwords

A loanword is a new word from a foreign language that is incorporated into the host language, adapting the phonetic structure of the host language (Bermudez Fernandez 1997:18). Very frequently loanwords have no equivalent in the target language (Spanish), and thus native users of the guest language incorporate these new terms but modify them with certain lexical and phonetic characteristics of the native language. The table below shows some of the loanwords identified in the corpus. The table shows the Spanish adaptation (which was found in the corpus), the version in English, the frequency of appearance in the corpus, and the number of documents in the corpus these terms appeared.

Spanish adaptation	**English term**	**Frequency**	**No. of documents**
Adsortiva [noun], adsorcion [noun]	*Adsorption [noun]*	90	7
Compuesto [noun.]	*Compound [Noun.]*	55	10
Cromatografía [SPAN, noun];	*Chromatography [ENG, noun]*	16	3
Reservorio [noun]	Reservoir [noun]	17	1
Soluto [noun]	Solute [noun]	16	3
Efluente [SPAN noun]	*Efluent [noun]*	10	3

Suirfactante [noun]	*Surfactant [noun]*	8	2
Sulfuracion, Sulfidizacion [SPAN, noun	*Sulfidation [ENG, noun]*	6	2
Se embeben [verb present simple], embebidas	Embedded [noun] [verb participle]	3	1
Eluente, eluyente [noun]	Eluent [noun]	2 (eluyente) 1 (eluente)	1
Dielectroforesis [SPAN, noun	*Dielectrophoresis [ENG, noun]*	1	1
Sesquiterpenos or *Sesquiterpenoides [SPAN, noun];*	*Sesquiterpene [ENG, noun]*	1	1
Ablación láser [SPAN, noun]	*Laser ablation [ENG, noun]*	1	1

Table 3.3 Loanwords of new terms identified in the corpus.

The terms listed above refer to concepts that do not exist in Spanish, or at least are not commonly used outside the technical context in that language. Thus, in most cases, the only problem that may derive from the usage of said concepts in Spanish is that the spelling of these words may not be uniform, and hence some researchers might favour one version over another. For instance, *Eluent*, a technical term in English that refers to a type of solution, is adapted in Spanish as *eluyente* or *eluente [SPAN]*.

Nevertheless, there are some cases where loanwords are incorporated into the host language when there is already an equivalent term available in the native language. The predilection for an English term over the term in Spanish may be attributed to the influence exerted by the dominance of the scientific community of the centre; indeed, as the latter is considered the elite group, and thus the point of reference in scientific production, the language they use is considered “correct” in the field. The following table shows Enlgish derived terms, which have an equivalent in Spanish, that were identified in the corpus:

Terms identified in the corpus	Spanish equivalent	No. of documents	frequency
Antibacterial (from antibacterial)	Antibacteriano	1	1
similaridad	similitud	1	1

Table 3.4 loanwords of terms that already exist in Spanish.

Such is the case with the Spanish term *antibacteriano* and its English counterpart *antibacterial*. Although the incidence of the Spanish term is still strong in scientific manuscripts, the English counterpart is becoming increasingly more common, now exhibiting the same frequency as the Spanish equivalent.

3.2.1.1.2 Calques

The second type of modification at the lexical level is calque. Calque comprises the incorporation of neologisms derived from the translation or the substitution of lexical structures from the influencing language (Bermudez-Fernandez 1997:18-20).

The following table shows the calques identified in the corpus.

Term identified in the corpus	Term in Spanish	Frequency of repetition	Number of documents
Foto- as a prefix	Fotoeléctricas or foto-electrica, fotovoltaico or foto-voltaico, fotoconductividad or fotoconductividad, fotocorriente or foto-corriente,	74	7
No-lineal	-	31	3
Ambientalmente amigable, amigables con el medio ambiente (from environmentally friendly)	Ecologico	4	1
Rata (from rate)	Índice, tasa	3	1
No-unido	separado	2	1
No-simetrico	Asimetrico	1	1
	Antisimetrico	1	1
No-elastico	inelastico	1	1

Table 3.5 Calques identified in the corpus

Even though the majority of the technical terms are imported from English, in most cases these terms are adapted into structures that already exist in the target language. In *dispersión no elástica* and *espectro de emisión no simétrica*, the prefix *non-* or no + adj does not exist originally in Spanish - nevertheless, the structure has been translated into Spanish following the English structure in a literal way. The following excerpts show other versions of the adjectives used above that do exist in Spanish: *inelastic [ENG] – inelástico [SPAN], asymmetric [ENG] – asimétrico [SPAN].*

Excerpt 3.11

> **Inelastic X-ray scattering** with meV energy resolution (IXS) is an ideal tool to measure collective excitations in solids and liquids. In the non-resonant scattering condition, the cross-section is strongly dominated by lattice vibrations (phonons) (*Nature Communications* 7:13547, 2016:1).

Another Anglophone term that has been recently used more than its Spanish equivalent is *environmentally friendly*, literally translated as *ambientalmente amigable* by Mexican researchers – a term that already has an equivalent in Spanish: *ecológico [adj.]*.

Excerpt 3.12

La utilización de jal de cobre para sintetizar zeolita representa una opción ***ambientalmente amigable*** *para prevenir la generación de drenaje ácido de minería (DAM)*.

Literal translation:

Using copper jal to synthesise zeolite is an **environmentally-friendly** option to prevent acid mine drainage (AMD).

Similarly, the term rata de evaporacion as shown in excerpt 3.13 below is used as the equivalent of the English term *evaporation rate*.

Excerpt 3.13

Para medir el flujo de los metales evaporados en la primera etapa se usó un monitor de espesor Maxtec ™-400 con cristal de cuarzo como sensor, la ***rata de evaporación*** *de Sn se mantuvo en 3.0 A/s y la* ***rata*** *de Bi en 2.0A/s (RMF 2016 vol 62)*.

Literal translation:

In order to measure the flow of evaporated metals in the first stage, a thickness monitor Maxtec ™-400 with quartz sensor, the **evaporation rate** of Sn stayed in 3.0 A/s and the **rate** of Bi in 2.0A/s

The main problem with the version in Spanish lies in the translation of *rate* as *rata*. While *rate* in English refers to the ratio between two measurements, *rata* in Spanish refers to a rodent (rat). *Rate* already has two equivalents in Spanish that perfectly transmit the same idea, namely *indice* and *tasa*. This may be attributed to the similarity

between the words *rata* with *rate*, as a false cognate, in addition to attempts of the scientitsts to make new specialised terms similar to those in English discourse.

When terminological inconsistencies of this nature appear in the specialised discourse, it may seem that the users are overgeneralising English syntactic structures, such as the negative prefix *non*-, into their native language; this may be derived from the allocation of English discourses as the official and only vehicle for the international dissemination of scientific knowledge.

3.2.1.1.3 Hybrid Words

The last type of modifications at the lexical level is hybrid words. These words are characterised by the fusion of local (Spanish) and foreign (English) lexical elements (Bermudez- Fernández 1997:19). The following table shows the hybrid words identified in the corpus.

English term	**Hybrid adaptation of the term**	**Frequency of repetition**	**No. of documents**
Shifting	Corrimiento, corridas, corren	13	2
Passivate	Pasivar	1	1
Sampling	Muestrear	1	1
Maping	Mapeo	1	1

Table 3.6 Hybrid words identified in the corpus.

3.2.1.2 The Semantic Level

Semantic transference comprises the allocation of a foreign meaning to a word in the host language. The data identified in the corpus is shown in the section below according to the semantic transference identified by Bermúdez-Fernández (1997:20): homologue-semantic transference.

3.2.1.2.1 Homologue-Semantic Modifications

Homologue modifications include those that derive from the contact between two different signifiers that share similar characteristics with their semantic field (Bermudez-Fernandez 1997:18) in a way that the influencing unit, in this case English, transmits a new ***seme*** to the influenced unit, the Spanish term, which was not part of it (ibid.). Table 3.9 below shows homologue transferenses found in the corpus.

English term	**Hybrid adaptation of the term**	**Frequency of repetition**	**No. of documents**
Rank [noun]	Rango [noun]	19	7
Reagent [noun]	Reactivo [noun]	19	5

3.7 Homologue modifications

The words *rank* and *range*, both of which translate to *rango* in Spanish, which we have already looked at in a different context, are clear examples of homologue semantic transferences. Although *rango* is a fairly common term in scientific manuscripts, its meaning in Spanish has been modified, perhaps due to the influence of *range*, or the similarity in sound between both terms, *rank* and *rango*. As noted by Gutiérrez Rodilla (1998), the correct translation is *rank* as *rango* and *range* as *recorrido/amplitud*.

A similar case is seen with the Anglophone term *reagent* (“a substance that is added to a system causing a chemical reaction”). *Reagent* is translated into Spanish as

reactivo and *reactante*. Both terms are treated as synonyms, and it is common to see definitions referencing both words at the same time. For instance, Wikipedia gives the following definition: “Reactivo or reactante, in chemistry, is the substance that interacts with another in a chemical reaction, producing other substances with different properties, characteristics and configuration, named products”[12].

Likewise, it is common to see terms treated as synonyms by students on specialised blogs. Nevertheless, *reactivo* and *reactante* are not fully synonymous. According to Álvarez-Blanco (2004), these two terms differ slightly in terms of the type of substance handled in the reaction. *Reactivo* [both as a noun and an adjective] “refers to products used in laboratories, where its purity is the determinant factor”; and *reactante* [noun] “refers to bulk chemical products used in big quantities in reactors for industrial synthesis, they are completely different to *reactivos* in terms of purity and quantity” (Álvarez-Blanco 2004:108).

3.2.2 The Syntactic Level

At this level the interplay between English and Spanish scientific discourses is manifested, for example, by the odd use of verbs and prepositions, as well as the lack of, or the excessive use of, determiners. Given that scientific material is available in English for the most part, NNES researchers have unconsciously identified Anglophone syntax as typical of scientific discourse. This conception is further reinforced by faulty translations of articles, including suggestions and corrections made by the editors from local specialised journals that favour anglicised texts for publication (Gutiérrez Rodilla 1998:272).

[12] Retrieved from: https://es.wikipedia.org/wiki/Reactivo

3.2.2.1 Verb Phrases

3.2.2.1.1 The Passive Voice

One of the most interesting aspects of scientific discourse is the predominance of passive voice constructions. Indeed, this is because they are considered a linguistic and stylistic tool signalling impartiality, objectivity and clarity.

There are two types of passive voice constructions in Spanish: the periphrastic passive voice (e.g. *fueron analizados*), which is very similar to the English passive voice, and the pronominal or reflexive passive voice (e.g. *se analizaron*, *se prepararon*, etc.). The Spanish periphrastic passive voice is created by combining the auxiliary verb *ser* [to be] and the past participle of the main verb. A clear example of this structure is the first sentence in excerpt 3.22:

> *Los tallos* ***fueron colocados*** *en un contenedor de acero inoxidable*.

This is very similar to the corresponding English structure:

> *The stems (from candelilla)* ***were placed*** *in a stainless-steel container*.

The pronominal passive voice, on the other hand, is created by combining the particle *se* and the main verb conjugated in the 3rd person singular or plural. The first sentence from excerpt 3.23 is a clear example of this construction:

Terminados los experimentos, ***se recuperó y se fraccionó el suelo*** *en 5 secciones*.

[After the experiments, the soil was recovered and divided into five sections.]

The following table shows the frequency in which these passive voice constructions were identified in the corpus.

Passive voice construction	Frequency of appearence	No. of documents
Periphrastic passive voice	23	15
Pronominal/reflexive passive voice	1,243	15

Table 3.8 Passive voice

Pronominal passive voice is by far the most common structure in the corpus, with an incidence of 1,243 overall, against and incidence of 23 repetitions of the periphrastic passive voice. The pronominal passive voice is mostly favoured by Spanish native speakers, as it flows more naturally in comparison with the periphrastic passive voice. However, when used excessively, there are some features from the pronominal passive voice that may interfere in the clarity of the text. Firstly, unlike English passive voice constructions, the Spanish pronominal passive does not take an agent complement, since this structure is used to focus on the object detached from the agent. However, native Spanish-speaking authors have shown a tendency wherein they use this passive construction and attach the agent complement to the preposition *por* [by].

Excerpt 3.14

Terminados los experimentos, se recuperó y se fraccionó el suelo en 5 secciones como se muestra en la figura 2, se secó a

temperatura ambiente en un rango de 20 a 25 oC durante 48 horas, ***las muestras se prepararon*** *por triplicado mediante digestión ácida* ***por el método USEPA 3050B*** *y* ***se analizaron por absorción atómica*** *la concentración de plomo, cadmio y arsénico, se determinó el pH y la conductividad en una dilución de 1:2.5 (suelo / agua) de cada sección*.

Literal translation:

After the experiments, the soil was recovered and divided into five sections, as shown in Figure 2; it [the soil] was dried at room temperature at a range of 20-25 ℃ over a period of 48 hrs. **The samples were prepared in threefold by acid digestion using the USEPA 3050B method**; following this, **the concentrations of lead, cadmium and arsenic were analysed by atomic absorption**. The pH and conductivity of the solution of 1:2.5 (soil/water) of each section were determined.

In excerpt 3.14 there are two main verbs in the pronominal passive voice *las muestras se prepararon*… and [*las muestras] se analizaron* … both adding the complement with the preposition [por]. Passive voice constructions, such as those used above, are grammatically incorrect. The sentences highlighted in excerpt 3.14, namely *Las muestras se prepararon….por el método USEPA*, and *se analizaron por absorción atómica*, use the reflexive passive voice with the complement introduced with the preposition *por* [by]. As noted above, the reflexive passive does not take that particle. Secondly, given that the particle *se* is also used in reflexive verbs, the construction may cause ambiguities when the grammatical subject of the phrase is a person. For

instance, the phrase *Los pacientes se operaron* can be understood as referring to patients performing a surgery on themselves, in addition to the patients who were operated on.

To a great extent, the excessive use of the passive voice is derived from the influence of English, given that in the last two decades researchers have started to favour passive voice constructions in order to make scientific discourse more "objective, in the sense that the writing should ideally represent the world in terms of objects, things and materials, not humans" (Leong Ping 2014:1). Thus, as noted by Navarro et al. (1994: 462), considering that Spanish scientific discourse is largely derived from translations and adaptations of syntactical components of English scientific discourse, it is not surprising that the prevalence of the passive constructions was also transmitted. Nevertheless, this construction is undesirable when "barbarian" calques of English passive voice, as Gutiérrez Rodilla (1998) calls them, replace standard Spanish constructions in RAs.

The consistent use of the passive voice in technical texts has met with conflicting opinions. On the one hand, some feel that the passive voice is not excessive, since this construction is what makes scientific discourse technical. For instance, a survey by Ping (2014) reported that the majority of NNES international students in Singapore consider the passive voice to be the norm in academic writing (2014:2). On the other hand, others are opposed to its exaggerated use in technical texts. For instance, Gutiérrez Rodilla (1998:271), expressed the view that the passive voice is not typical of the scientific language, given that before English became the lingua franca in science, other languages were in the same position, and used other types of constructions to achieve similar rhetorical outcomes. Moreover, she indicates that the passive voice does not necessarily make the text more objective or make it

appear more scientific; on the contrary, she argues that by detaching the semantic agent of a construction in the passive voice the message becomes ambiguous, thus going against the precision of scientific discourse. Furthermore, Gutiérrez Rodilla notes that the excessive use of these constructions in many cases is “more confusing than it is precise, since this construction discards the semantical agent in a sentence” (ibid. 271–272).

3.2.2.1.2 Verb Usage

Another syntactic transference that has been identified in scientific language concerns abnormalities in verb usage. In these cases, authors use Spanish verbs with the sense of English verbs. The following table shows odd verb usage identified in the corpus.

Verbs identified in the corpus	**English influence**	**Correct use in Spanish**	**Frequency of repetition**
Se hicieron crecer	Were grown	Crecieron	2
resulto	result		11

Table 3.9 Odd verb usage.

Excerpt 3.15

En este trabajo se presenta un método nuevo para crecer películas delgadas de SnS u SnS…..

Literal translation:

This study presents a new method to grow thin films of SnS and SnS:Bi…

Excerpt 3.16

El catalizados Pt/TiO2 resulto ser suficientemente activo para oxidar formaldehido en CO2 and H2O.

Literal translation:

The catalyst resulted to be active enough for the oxidaition of formaldehyde in CO2 and H2O.

Although the verbs used in both excerpts, *crecerse* and *resultar*, do exist in Spanish, they are not typically used in the sense that the authors have given to them in these texts. For instance, *crecerse*, which means to mature or stand up in English, usually refers to an inner growth in the person experiencing it. For instance, “El valiente caballero **se crece** en situaciones peligrosas” [the brave knight **thrives** in dangerous situations]. The verb refers to a spontaneous reaction taking place in a person, similar to *grow*; it does not denote an action that is directly being manipulated by an external agent, as it is being used in excerpt 3.27.

Similarly, *resultar* is usually translated in English as *to turn out* or *to work out*. It is not a direct equivalent of the English verb *to result*. Both verbs are frequently used in scientific texts written by Mexican researchers, thus indicating perhaps that they have become technical terms in their scientific discourse.

3.2.2.1.3 Gerunds

In everyday language, Spanish gerunds tend to be used in a limited number of constructions (Gutiérrez Rodilla 1997:309). Gerunds work as adverbs that describe the predicate of an action as long as the action expressed by the gerund happens before or at the same time as the main action. For instance:

> .*Me di cuenta que olvide las llaves* ***bajando*** *por las escaleras*. [I realised I forgot the keys as **I was walking down** the stairs.]
>
> ***Abriendo*** *la puerta de la casa entre al cuarto*. [*I entered the room as I* ***opened*** *the door*.]

Gerunds are also used in circumstantial dependent clauses expressing condition, manner, duration or cause (Mendiluce-Cabrera 2002:74). For instance:

Habiéndote *leído las lecturas obligatorias, el examen es fácil* (condition). [If you read the compulsory texts, the exam is easy.]

Habiéndose leído las lecturas obligatorias, el examen es fácil (cause). [Having read the compulsory texts, the exam is easy.]

Interestingly, in scientific discourse it is common to see gerunds in certain constructions that are considered agrammatical in the traditional Spanish or popular discourse. Such constructions are posterity gerunds and copulative gerunds (Mendiluce-Cabrera 2002:76). Posterity gerunds express an action that happens after the main action of the sentence. The following sentence is a clear example of a gerund in this sense:

Excerpt 3.17

Se puede observar que en todos los casos, en el anolito existe una disminución del pH alrededor de 1.5 unidades con respecto al valor inicial, **presentando** un carácter ácido en todos los experimentos (S&V 24 (1) 2011:28).

Literal translation:

It can be observed that, in all cases, the pH in the anolite decreases by around 1.5 units in relation to the initial value, **showing** an acid behaviour in all the experiments.

The use of this construction is not widely accepted by Spanish language specialists. While some feel that posterity gerunds degenerate the Spanish language, arguing that there cannot be a temporal relation between the gerund and the main action of the sentence (Bello 1946; Spanish Royal Academy 2009), others (Badia 1964) defend their use as this construction is registered in old documents, and that due to the growing use these days, the gerund can now be used to express a relation before and after the main action (Padilla 2013:7).

On the other hand, as shown in excerpt 3.18, copulative gerunds connect one or more independent ideas that either complement or contradict the main action (Padilla 2013:8).

Excerpt 3.18

Se hizo un análisis de los perfiles de deshidratación **encontrando** una variación en la pérdida de peso de manera significativa y posteriormente fue **reduciendo** conforme se incrementó el tiempo de deshidratación **aproximándose** asintóticamente a la humedad de equilibrio como se definió en la ref. [9] (S&V 26 (4) 2013:140).

Literal translation:

The dehydration profiles were analysed, **finding** a significative variation in the loss of weight, which subsequently **reduced** as the dehydration time increased, asymptotically **approaching** the balance humidity as defined in reference [9].

This sentence is a clear example of copulative clauses with a gerund. The first acts as a posterity gerund, where the action, *encontrar*, happens immediately after the first action, *se hizo un análisis*. The second gerund *reduciendo* is also a posterity gerund; the sequence is introduced by the adverb *posteriormente*, giving the text more fluency. The third gerund introduces an action that happens at the same time as the previous gerund clause. The following table shows odd or problematic usage of gerunds identified in the corpus.

Identified in the corpus	**No. of articles**	**Frequency**
Before or same time as main action	15	269
Circumstantial gerund	0	0
Posterity gerund	15	110

Table 3.10 Gerunds identified in the corpus.

There are some constructions, as shown in excerpt 3.19 below where the gerund clauses are linked without apparent connection; this refers to conjunction gerunds.

Excerpt 3.19

En estudios preliminares reportados por nuestro grupo de investigación, hemos demostrado que **usando** diferentes disolventes apróticos bajo condiciones de reflujo, se presenta la descarboxilación de compuestos organometálicos **formando** compuestos de tamaño nanométrico (JMCS 2004 vol 48, II).

Literal translation:

In preliminary studies reported by our research group, we have demonstrated that **by using** different aprotic solvents under reflux conditions, decarboxylation of organometallic

compounds is presented **making** compounds of nanometric sizes.

The relations of the gerund clauses used in excerpt 3.31 above interact only due to the position they have; in such cases, Moliner (1971) indicated that Spanish native-speaking readers establish a logic relation between the clauses. In these cases gerunds give an “expressive strength” to the text – an effect that conjunctions would not achieve otherwise (in Padilla 2013:8). Moliner further recommended that this type of copulative gerund should not be used excessively in written texts, as there is a high risk that the connections between the gerund and the main subject may get lost. Such is the case with the gerund *formando* in Excerpt 3.31, due to the order of the clause in *formando compuestos*, it is not clear whether it refers to the main clause or the main clause of the sentence.

As noted by Gutiérrez Rodilla (1998:273), the main problem with the use of gerunds is that, when used incorrectly or excessively, they cause an “expressive deficiency” in the text, as they neutralise the different temporal uses that can be added to the language with other syntactic constructions.

3.2.2.2 Prepositional Phrases

Prepositional usage may be considered one of the most difficult aspects of a language system, as every language conceptualises the relationships between prepositions and the words they connect in a different way. Prepositions designate categories such as space, direction, force and causation; however, they are limited to particular aspects and combinations of aspects, that is, they cannot interact freely within these category domains (Talmy 1983:227, in Brala 2002:35). An example of this is the way the spatial

preposition *en* in Spanish interacts in the language compared to the prepositions *in* and *on* in English.

*The ball is **on** the table*.

*The ball is **in** the bag*.

The English prepositions *in* and *on* locate an object with respect to a point of reference. *The ball* is the figure of the sentence; this is the movable active component of the sentence, and *the table* and *the bag* are the ground, or the point of reference based on which the figure is located. Even though both are spatial prepositions, each describes a different type of relation between the figure and the ground. The preposition *on* establishes a relationship of location with a one-dimensional object, while *in* establishes a relation of containment within a three-dimensional object. For this reason, these prepositions cannot be interchangeable.

On the other hand, the Spanish equivalent *en* is more flexible in terms of the dimension of the ground. Thus, it is possible to use the same preposition in both situations.

*La pelota está **en** la mesa*.

*La pelota está **en** la bolsa*.

Prepositional usage is based on these basic spatial relations, and can then be expanded to more abstract concepts. However, the spatial relations are completely governed by the epistemological paradigm of the native language, which in turn influences how we conceptualise different objects. Consequently, when learning and producing a foreign language, our native language interferes in the construction of several aspects of language, including prepositional phrases. As stated by Brala (2002:42), “[t]he crosslinguistic variation of prepositional usage is due to the fact that languages associate words with prelinguistic concepts at different levels of generality,

the component Figure and Ground do not operate at the same level in all languages". Thus, as Brala further notes, it is highly unlikely that native speakers will use prepositions in prepositional phrases incorrectly in their native language. Nevertheless, in the scientific discourse of Mexican researchers, an odd usage of Spanish prepositional phrases was identified in the corpus. The odd prepositional usage adopted by Mexican researchers in scientific manuscripts includes direction prepositions *por*: to, for; *para*: for, to; and *a*: to. The following sections offer an analysis of the odd usage of Spanish prepositions by Mexican researchers. The following table shows the odd usage of prepositions identified in the corpus.

Prepositions	**Incidence**	**No. of articles**
A	2183	15
Por	546	15
Para	635	15

Table 3.11 Odd usage of prepositions

3.2.2.2.1 Preposition [a]

This preposition has the highest incidence of agrammatical use in the articles in the corpus. *a* indicates the direction of the movement expressed by the main verb, going from the figure, or point A to the ground, or point B. For instance:

*Voy **al** parque [I'm going **to** the park]*

*Le di las flores **a** Laura [I gave the flowers **to** Laura]*

Nevertheless, said preposition is not used in this sense in some articles from the corpus, as the following examples demonstrate.

Excerpt 3.20

A la salida del láser de excitación y **a** la del dispositivo contador de fotones, se colocó un filtro dieléctrico para la línea de láser (RFM 38 (2) 2015:147).

Literal translation:

A dielectric filter was placed **at** the exit/end of the excitation laser and at the exit/end of the photon counter device, for la línea de láser.

The preposition in this excerpt is expressive of the static location of the object (the filter) in the sentence. As indicated earlier, given that *a* does not indicate a static relation, the selection in this sentence is agrammatical. The preposition *en* is more suitable in this context.

Excerpt 3.21

Se analizó y ajustó el modelo asintótico **a** los datos experimentales del proceso de deshidratación de granos de maíz (S&V 26 (4) 2013:139).

Literal translation:

The asymptotic model was analysed and adjusted to/on the experimental data of the dehydration process of maize grains.

Another strong tendency identified in the corpus was the incorrect use of dependent prepositions in verb phrases, in which *a* is the most common selection of the authors.

Excerpt 3.22

No obstante, la mayoría de los contaminantes puede **transformarse a** algunas de sus especies solubles (S&V 24 (1) 2011:24).

Literal translation:

Nevertheless, most of the pollutants can be **transformed in** some of their soluble species.

The sentence in excerpt 3.22 above shows the preposition *a* when the dependent preposition of *transformarse* is always *en*.

Excerpt 3.23

.....sin embargo el ambiente **generado al** cátodo puede impedir la solubilización de los contaminantes que contengan iones metálicos (S&V 24 (1) 2011:24).

Literal translation:

However, the environment generated **in** the cathode can obstruct the solubilisation of the pollutant with metallic ions.

Similar to excerpt 3.23, the dependent preposition for the verb *generar* is /en/.

Excerpt 3.24

Las mezclas poliméricas fueron preparadas previamente **de acuerdo a** las siguientes relaciones de PEG:PLA (S&V 23 (3) 2010:15).

Literal translation:

The polymer mixtures were prepared previously **according to** the following relations: PEG:PLA.

Excerpt 3.36 is a clear example of the influence of English prepositions on the production of Mexican researchers. As indicated in the *Diccionario Panhispánico de Dudas* (2005) *de acuerdo* can only be followed by the preposition *con*; although *de acuerdo a* is very common, especially in Latin American Spanish, it seems that this construction is a calque from the English *according to*. This prepositional phrase was found in the corpuse with an incidence of 23 times, in 7 out of 15 documents.

Another interesting prepositional usage identified in the corpus was the excessive use of prepositions *por* and *para*. In most instances, these prepositions appear in the articles due to the passive voice constructions, where *por* is usually used to introduce the agent compliment.

Preposition	**Frequency**	**No. of documents (out of 15)**
Por	546	15
Para	635	15

Table 3.12 Common prepositions in passive voice constructions

3.3 The Effects of the influence of English in the Discursive and Publishing Practices in the Scientific Community from Mexico

As identified throughout this chapter, the somewhat hybrid discursive style developed by Mexican researchers is a result of factors such as a lack of a porper scientific discourse of their own and the status the ELF has over Spanish, their L1. The hybrid discourse can be seen as modifications made at the syntactic and lexical leves of the discourse developed by NNES scientists.

These syntactic and lexical modifications can be either conscious or unconscious. That is, the scientisits can be actively choosing Enlgish-like syntactical constructions such as the passive voice or anglicised terminology or by adding new terminology in order to make a text more publishable. For instance, examples of conscious choices regarding the combination of lexical characteristics from English are the borrowings of new terms in the area of specialisation such as *Chromatography* ⇾ *Cromatografía; Dielectrophoresis* ⇾ *Dielectroforesis*. Moreover, such conscious modifications can also be as noted by Aguado (1990:165) derived from perceived deficiencied and gaps in either the native or the target language, which are fulfilled by chossing a specific discursive construction from either the L1 or L2.

On the other hand, the linguistic modifications can also be unconscious, that is, derived from the constant interaction of scientists with Enlgish discourse certain syntactical and semantic constructions become more natural and therefore automatical in the context of scientific writing. Such unconscious modifications or interferences comprise, as discussed in the analysis above, the odd usage of verbs such as *crecer – to grow* in the participle form *ser crecido*; the allocation of anglicised functions to gerunds, this is when they are used as nouns instead of being used as verbs, and the odd usage of prepositions, which is strongly derived from the influence of English prepositions. As is the case with the dependant preposition *de acuerdo a* instead of *de acuerdo con, due to the influence exerted by according to.*

The characteristics of the hybdrid discourse, this is the modifications made at the lexico-semantic and syntactic levels as shown above in the analysis can be either interpreted in two ways: one that sees such interferences as damaging,

and the other that sees them as an asset. On the one hand, a view that sees such interferences of English scientific discourse in the written production of Mexican scientists as having negative effect, that supports the view of ELF in international publications, as noted earlier in this thesis, as a killer language (Skuttnal-Kangas 2003:33) or a tyrannosaurus rex (Swales 1997:374), which completely disregards any other type of discourse, where the users are mere victims without any agency in the process of using ELF in publication.

On the other hand, there is a view that sees this hybrid discourse as a result of the interplay of both discurses, Spanish as the L1 and English as the L2, as an asset of multilingual scientists, given that they are able to negotiate meaning by chossing discursive and grammatical structures of both languages in order to better communicate and express their thought process and viewpoint for the international audience.

The following paragraphs discuss similar practices that are performed during the process of translation of scientific texts by external parties to the scientific community. As noted by Montgomery (2009:13), given that scientific production involves the interplay of textual and spoken information between different languages, translation is a crucial part in the production of science and its dissemination. Therefore, in the process of wiritng for publication not only the aurthors of the original L1 text anf the translators/proofreader as the mediator between the source text in L1 and the target text in L2 are involved, but also the author of the original as the self translator of the target text. 1. Authors write their own manuscripts directly in English, working here as self-translators of their own work. 2. Authors sometimes resort to the use of technical translators for the

translation into Engish of their texts and sometimes for proofreading servies of their self translations.

As noted by Rainier Grutman and Trish Van Bolden (2014:323), in self translation the authors in these two versions of the document are not always identical, “the self-translating persona often appears later on in a writer’s career, and some bilingual writers even choose to differentiate between their respective personae in each language” (ibid., 324). As noted above, oftentimes Mexican scientists chose to translate their own manuscripts to later have them proofread by a a colleague in order to avoid high expenses.

As noted by Grutman and Bolden (ibid., 327) the process of self translation can involve a type of language transfer, in which certain discursive characteristics from the L1 of the authors is passed onto the translation in the L2. This is not to say that the language transfer from the L2 to the L1 does no happen also. As noted in the analysis above, the discourse identified in the corpus both in English and Spanish, involves a combination of discursive and rhetorical characteristics from both languages. Nevertheless, as noted by Grutman and Bolden, in comparison with technical translators, self translators have more liberty and flexibility in terms of the modofications applied in the translation given that the self-translator owns, intellectually, legally and morally the original version of the text.

According to the prescriptive view that sees the hybridization of scientific discourse as a result of the damaging interference of Enlgish discourse in NNES users, the process of translation of scientific discourse, in this way, can also be affected by the influence of ELF. Nevertheless, there are two main viewpoints regarding the role of ELF and the role of translators in the process of translation

of technical and scientific language as is described in the following paragraphs. (House 2013; Gordin 2015). On the one hand according to the view of English discourse having a damaging influence on the production of NNES researchers, Gordin (2015:11) has contended that the linguistic capacities of the translators or authors do represent an obstacle in the translation (or writing) process, as these texts, or translations, need to be completely reformulated in terms of the linguistic expectations of the target culture. Translators thus manipulate the communication according to the authors' perspective or epistemological paradigm. This happens particularly in the translation of the terminology, either by professional translators or the researchers themselves. The process of translation, either from Spanish to English or the other way around, is affected in that when a manuscript is written in either of these two languages, the translator has to reformulate the source text in order to make it intelligible according to the requirements of scientific discourse, which respond to NES standards.

Accordingly, the translation strategies mostly used by unskilled or amateur translators, such as literal or domesticating translations, continue to reinforce practices that may damage NNES knowledge, by favouring English-like constructions either into English or out of English. Such unconscious interferences, Bennet notes, are further "backed up by the non-discoursive mechanisms that reinforce the hegemony of EAD and, by extension, the empiricist paradigm, through 'quality-control' and crucially, resource allocation procedures" (ibid.). Similarly Curry and Lillis (2006, 2010) suggest that editors, translators, proofreaders, etc., or "literacy brokers" contribute to the damaging practices in the diveristty of knowledfe in science as they bring the NNES texts into line with the standard norms from the dominant groups (ibid.).

On the other hand, House (2013:293) contends that the dominance of English scientific discourse in other languages is not possible given that multilingual speakers as well as translators move flexibly between the languages they have. Moreover, she argues that, in spite of languages being two distinct systems, they are essentially transferable, and as such there is no proof that only one language defines the thinking and conceptualising of each person. House (2010, 2013) argues that ELF is not a defective but a fully functional means of communication, and that the arguments put forward against ELF, as being a "tyrannosaurus rex", come close to an appeal for an outdated prescriptive English native norm (House 2013:286). This, as Bennett argued, effectively invalidates different ways of construing knowledge.

House further notes that as translators are multilingual and multicultural experts when they switch between languages, it is unlikely that they will be affected by English scientific discourse (ibid.294). However, this notion fails to consider that, although translators are trained to differentiate between the linguistic and cultural characteristics between a source language (SL) and a target language (TL), they can also be affected by unconscious factors such as linguistic bias, such as the perception of English being the most suitable language for scientific publication. As noted by Benett (2013:171), given the strong status of English in this domain translators tend to strongly domesticate translation into English according to the linguistic and rhetorical standards of the language. Similiarly, when texts written originally in English are translated into other languages translators do not feel they need to adjust the discourse according to the standards of the target language (ibid.)

Along these lines, the hybrid discourse is brought about by the authors, and by the editors, translators and proofreaders, because of the need to comply with the social or socio-rhetorical requirements to belong in the international scientific community. Thus, as noted by Bennett (2015), these modifications are not only caused by the assimilation of foreign discursive standards as their own, but also arise because there is a conscious selection of rhetorical expressions and grammatical constructions to fulfil a specific objective.

As noted earlier in this thesis, although textual/linguistic interferences offer evidence of the influence of English in the scientific production of Mexican researchers, they are not complete evidence that the influence of English discourse in scientific writing is indeed damaging or destroying the knowledge perspective of Mexican researchers. In other words, even though the syntactic and lexical modifications may alter the information expressed in the texts, they are not enough information to determine whether the epistemogological paradigm of Mexican scientisits is also altered. Such syntactic and lexical interferences only show certain habits, derived from conscious and unconscious choices, which affect only the way the research of NNES or Mexican research is perceived outside, but do not fully show the process of knowledge construal or perception from the Mexican scientific community.

As Aguado argues (1990:165), the inevitable influence exerted by English discourse in the production of NNES researchers is not the problem; in fact, according to Aguado, it is an enriching practice, since it fills deficiencies and gaps in their native languages in terms of new concepts, objects and processes that are being created every passing day. The main problem, according to Aguado, is when the transferences are carried out incorrectly. Therefore, the modifications

in the discourse produced by NNES researchers, such as the combination of rhetorical expressions, the missuse of prepositions, generalization of grammatical rules, ambiguity caused by inaccurate terminology, etc. in scientific international communication is not entirely a cause of the perceived monopoly of a single language. But on the lack of awareness, on the part of the users of ELF (scientisits, translators, editors and proofreaders) of the effects caused by conscious or unconscious choices regarding the rhetorical and syntactic characteristics of the languages in interaction in international communication - such as the ambiguity caused by inaccurate terminology.

Thus, identifying the non-discursive and discursive factors surrounding a particular scientific community, and the effects that such factors have on the production of this particular group is a good start in terms of understanding how such discursive choices affect the text, and eventually help us to find better approaches to scientific translation that will eventually facilitate the production of scientific manuscripts that can be understood by audiences from other linguistic backgrounds. More important, however, is raising awareness of the effects that certain translational practices used in scientific contexts, and awareness of the need of translators specialised in specific sectors of academia and science, it may be possible to facilitate the dissemination of NNES research as well as to recognise a greater diversity of knowledge perspectives.

Although the information presented up until this point in this thesis has shed light on many of the discursive and non-discursive factors that affect the way that Mexican scientists communicate their findings in ELF and as a consequence how the discursive peculaiarites affect how they are viewed at international level, the analysis has been made from an external point of view –

in other words, the apparent intention of the researchers through the texts is being analysed from assumptions derived from textual and therefore decontextualized choices that are perceived in this way through the lens of translation studies and linguistics. For this reason, the following chapter moves on to discuss the process of scientific writing, and the dominance of ELF in the process of scientific research from the perspective of Mexican scientists.

Chapter 4: Translating and Writing in the Lingua Franca of Scientific Publication: A Different Perspective on Scientific Writing

"However global a language may be,
it will not erase the vernacular realities
of being a scientist or mathematician
or doctor or engineer in everyday life"
—S.L. Montgomery (2009:8)

Up to this point, our discussion has focused on the identification and study of the discursive and non-discursive factors that affect the writing and publication process of Mexican researchers. However, the perspective has been external to these researchers – that of linguists and translators – and has therefore offered a generally linguistic analysis that has highlighted the perceived inequalities that derive from the various levels of competence in the English language that these researchers display. In other words, until now, this thesis has not included any insights from the actual scientific community from Mexico. For that reason, this chapter examines the viewpoints of Mexican scientists regarding the presence of ELF and the impact that its dominance has had on their works contrasting the views of these scientists with those of linguists. Additionally, this chapter also contains the studies and analyses yielded by linguists in terms of how NNES are affected in the process of scientific publication.

In terms of the contrast between linguists and scientists, Tardy (2004:262) notes that although both these groups have focused on the issues arising from the position of English as a lingua franca in science and academia, they have done so from different perspectives. For instance, linguists have based their studies on the circumstances that led to English discourse assuming the place of the lingua franca in international communication today, and on the inequalities that the predominance of such discourse (especially in terms of its standard requirements imposed by editors and reviewers) have inflicted on NNES researchers; as a consequence of this, linguists have also

focused on the effects that such dominance has on the global production of scientific knowledge (ibid.). Moreover, within this perspective, as we noted in Chapter 3, linguists are broadly divided into two groups: one that considers the pervasive presence of English discourse in science as a “predator language”, and a “killer language” (Skutnabb-Kangas 1988; Tardy 2004; Bennett 2007), given the many discursive and non-discursive effects identified in the NNES scientific community - such as domain loss, the stigmatisation of scientists in the periphery, degradation of the language - where NNES are victims of the dominance of ELF. The second perspective sees ELF as a functional language in international communication (House 2013), as it facilitates international communication and the fast dissemination of knowledge. Nevertheless, this second perspective, considers NNES users of the language as no less responsible for the consequences that they are currently experiencing (Aguado 1990; Curry and Lillis 2006; Ferguson 2007), given that they are the active contributors in the selection of English discourse over their own native languages.

On one hand, Skuttnab-Kangas (2003:33) describes English discourse as a “killer language” (in Ferguson 2007:14) due to the historical background of its dominance and the correspondingly detrimental discursive and non-discursive effects that this dominance has exerted in the scientific communities from the periphery in terms of the way NNES researchers communicate their research (whether in their native language or in English as L2). For instance, according to this view, ELF/English discourse is the main actor responsible for the lack of visibility of NNES researchers, particularly from the periphery, in international journals within the inner-circle of scientific production (Salager-Meyer 1994, 2003, 2008, 2011, 2014; Gutiérrez-Rodilla 1999). Skutnabb-Kangas (1988) further notes that the dominance of English in science

has become an example of linguicism[13] in that the financial disparities between the centre and the periphery, coupled with the process of scientific production, only "validate big languages at the expense of small ones "(Philipson & Skutnabb-Kangas 2000:22; in Tardy 2004:251). Some authors, such as Swales (1997, 1998), extend this argument to warn that domain loss of specialised discourses is the initial step towards the death of the languages affected (Tardy 2004:251).

On the other hand, it must be noted, other linguists do not see English in such a negative way. For instance, Ferguson (ibid.) notes that referring to English discourse as a "killer language" or a "predator language" is not appropriate or even relevant. In his view, those who participate in the process of publication, i.e. the authors and researchers, proofreaders, translators, editors, etc., are themselves the main contributors to the practices that hinder scientific publication, since all of them are active participants in choosing one language over the other. The English language itself, on the other hand, cannot be an active contributor to that choice: "Languages do not kill languages; their speakers do, in giving them up, although they themselves are victims of changes in the socio-economic ecologies in which they evolve" (Mufwene 2001:12, in Ferguson 2007:14).

One might thing that this is merely a semantic nuance. According to this position, even though the users may be the main actors in the hindrances of scientific publication through their predilection for ELF over other native languages, this predilection is affected by the context in which the users find themselves. That is, as Mufwene notes above, the choice of favouring English over the researcher's native language is influenced by the socio-economic context in which the scientific and

[13] "Ideologies and structures that are used to legitimate, effectuate and reproduce an unequal division of power and resources between groups which are defined on the basis of language". Retrieved from http://wps.ablongman.com/ab_nieto_diversity_5/75/19241/4925793.cw/index.html

academic communities develop; simply put, it is a consequence of the numerous non-discursive factors (such as those mentioned in Chapter 3), as well as of the lack of a tradition in both research and writing for publication (as mentioned in Chapter 2). According to Pennycook (2000), the metaphor of “killer language” refers more to the fact that languages other than English have assumed lesser roles in the hierarchy of languages, and are used in less prestigious domains, while English is used in domains such as business, higher education and scientific communication (Ferguson 2007:15).

Thus, according to such linguists, the strong dominance of English discourse is largely attributable to the academic gatekeepers from the international mainstream journals, who are in turn the active participants contributing to the damaging effects of the peripheral NNES scientific community - such as the lack of representation in international databases. Furthermore, according to this perspective, scientists seem to be only passive participants or victims of the publishing process without much control over the way their research is disseminated. Montgomery (2009:11) points out that the requirements demanded by the reviewers from international journals, such as the requirement to provide abstracts in English, and the practice of citation indexes to include or favour English-language references over others, are all factors that define a linguistic policy. The consequence of this linguistic policy is that these practices obscure the visibility and impact from relevant and valuable research simply because it is written in other languages (ibid.). According to Montgomery, such practices bulwark the dominance of English because the message transmitted to the users is stark: “if you do not publish in English, you risk invisibility, both for your work and yourself” (ibid.).

Nevertheless, as noted by Tardy (2007) and Montgomery (2009), scientists do not see the prevalence of English in scientific communication in such a negative way,

nor do they consider their role as that of passive actors in the process of international publication. According to Tardy (2004:262), scientists tend to focus more on the practical implications of ELF, where they see the language as a necessary tool, regardless of the negative impact it might have on the publication and citation practices related to English-language research and researchers based outside the UK or the US. Moreover, they also focus on the difficulties experienced in international publishing by researchers from the periphery of science, as well as the potential negative effects that language bias may cause in publication beyond the discursive level (ibid. 263).

In that way, according to Montgomery (2009:8), NNES scientists "see themselves as linguistic actors not as victims, the linguistically enslaved". As Montgomery further notes, rather than perceiving ELF as a threat, many scientists see it as an unavoidable consequence in the current "globalised scientific enterprise", where English works as a tool that enables them to expand their research and open doors for their careers at international level (ibid.). Moreover, Montgomery goes on to observe that NNES researchers are aware of the fact that linguistic commonality – through the medium of English - is necessary, as the central objective of scientific research is to be available to as much of the disciplinary community as possible (ibid.11). Although scientists acknowledge the need for ELF, clearly cognizant of the benefits it potentially has for their careers, they also acknowledge the importance of continuing to conduct research in their native languages (ibid.). From a survey aimed at NNES postgraduate students at a university in the US, Montgomery lists the following points that reflect the attitude of NNES scientists towards the use of English as the lingua franca in science:

1. It is essential that science in the mother tongue be maintained, to enrich the language and to keep knowledge available to as much of the population as possible.

2. Despite this, learning English is wholly required, as it grants someone direct access to their field of study, nothing less. Without it, they would be reliant on any translations that might be made.

3. Acquiring English is a skill with many gleaming edges, many opportunities that cut in several dimensions, for example the ability to study abroad, engage in international research projects, represent one's work to foreign media and the public.

4. Being competent in English does not force these scientists to abandon their mother tongue, but makes them feel they are participating members in the international community of their discipline, and also high-level professionals among their own national peers too (two types of identities that do not seem to conflict, but wholly overlap).

(Montgomery 2009:12)

In terms of these issues that concern scientists, Tardy (2004:251) notes that the scientific community also expresses concerns regarding linguistic diversity and the language-based bias on the part of the reviewers for top-tier international journals. Such bias, as noted by Tardy, has negative consequences on the work of NNES scientists. According to this argument, the language bias means that the research itself and its applications are only seen in developed countries, while the work of researchers from the periphery falls into the lost science domain, in this way “giving a distorted view of research in these fields” (van Dalen & Henkens 2001; Wishart & Davies 1998).

This is necessarily a brief outline of a deeply contentious issue; however, although the information presented here begins to shed light on the perspective of scientists regarding ELF, it does not pretend to give the whole picture of all NNES

scientific communities; indeed, as reiterated throughout this thesis, the socio-cultural context in which the different scientific communities are immersed determines the way in which these different communities are affected. The following section, accordingly, focuses exclusively on the views provided by Mexican researchers regarding the dominance of ELF in the sphere of international publishing.

4.1. Mexican Researchers on Scientific Publication: A Survey of the Views of Local Researchers

Given that the section above offers mainly the views of NNES researchers drawn from across different linguistic communities, particularly of those located in a NES community different from their native language (e.g. NNES students in the US.) (Montgomery 2009), this section will focus specifically on the viewpoint of a group of Mexican Spanish native-speaking researchers from two scientific institutions, CINVESTAV QUERETARO and the Physics Department form UNISON Mexico, located in two different cities in Mexico in order to determine what specific issues they face, and hence to ascertain the needs of this particular group in terms of mitigating any possible effects of their encounter with the dominance of ELF. The reason for the selection of this group of scientists particularly from these two institutions, as mentioned earlier in this thesis, is the close relationship I have with them, as they have been my clients for the past 10 years. Thus, it was easier, and more significant for my research, to study how the dominance of ELF in the production of scientific articles affects them. Consequently, with this information I can find a better approach to continuing working with this group of researchers.

The results from this survey may offer a more complete picture of the effects caused by the dominance of ELF in scientific publication and the resulting

epistemological paradigm that develops from and is imposed by the scientific community from the centre.

The analysis offered in this section constitutes the second part of the study carried out for this thesis. This part consists of a survey designed for a small group of Mexican researchers in order to collect information regarding the discursive and non-discursive factors caused by the dominance of English discourse in scientific publication (discussed in Chapters 2 and 3). The survey also seeks to determine how the dominance of the scientific community from the centre affects the researchers' production and consequent representation overseas. The broad objective has been to use the data collected through the survey to shed light on the viewpoints of these Mexican researchers regarding the presence of ELF as the dominant language in scientific communication at international level.

The survey itself consists of nine closed and open-ended questions designed to obtain information about the common habits and practices of researchers while submitting their articles to international journals. The survey also aims to acquire information about the type of comments made by the editorial boards of the journals, as well as the researchers' attitude towards the whole process of publication. The main purpose of this case study, in other words, is to complement the linguistic analysis of scientific articles conducted in Chapter 3 by taking into consideration the perspective of the central participants in the process of scientific publication: Mexican scientists. In this way, through identifying the actual needs of the researchers themselves, it might be possible to identify the role that we, as specialised translators of science, should adopt.

The questionnaire was designed to elicit information in four different areas: a) experiences in the publishing process in international journals; b) the perception of the

role of ELF in science; c) comments received from the editors of international journals; and lastly, d) strategies and tools adopted by the researchers in order to ensure publication in the journals. The list below shows the questionnaire that was sent to the participants.

Original questionnaire

1. ¿Cuánto tiempo lleva publicando artículos científicos?
2. ¿Qué tipo de experiencias ha tenido al publicar artículos en revistas internacionales? (por ejemplo obstáculos, duración del proceso de publicación a partir de la primera revisión)
3. ¿Considera que sus habilidades de redacción en español son similares a sus habilidades en inglés?
4. ¿Qué es lo que más se le dificulta en la redacción de un artículo científico en inglés?
5. ¿Que tipo de cambios percibe al usar el inglés? (Por ejemplo en la claridad y precisión del artículo original)
6. Una vez que ha enviado un artículo a larevista internacional, ¿qué tipo de comentarios recibe usualmente?
7. ¿Qué tipo de estrategias usapara solucionar esos comentarios?
8. ¿Alguna vez ha recurrido a la ayuda de alguien externo a su área para la edición o traducción de sus artículos?
9. ¿Considera que recurrir a personas externas a su área es de ayuda?

The survey was conducted in Spanish, the native language of the participants. The language was intentionally chosen in order to ensure a higher level of accuracy as the participants reported their experiences in the process of writing in English for publication. The answers provided by the participants were then translated for the

purposes of the analysis in section 4.1 .1 to 4.1.2. The following is a translation into English of the original questionnaire.

Questionnaire

1. For how long have you been publishing your work in international journals?
2. What types of experience have you had in the publishing process?
3. Do you consider your English and Spanish writing skills to be similar?
4. What do you find most difficult in writing English for publication?
5. What types of changes do you perceive in your work when you use English?
6. What types of comments do you usually receive from editors of international journals?
7. What are the strategies you follow after receiving negative comments from editors?
8. Have you sought help from persons outside your field to proofread or translate your articles?
9. Do you think that reaching people outside your field is beneficial?

Although question #1 does not fall within any of the categories described above, it is nevertheless important as it collects information regarding each participant's years of experience conducting research. Question #2 aims to obtain general information about how the researchers see the whole process of publication in international journals, asking the participants to share their experiences, either positive or negative, that they have had in their interactions with the editors and reviewers from international journals. Questions #3 and #4 are designed to elicit information about the English written skills

of the researchers, as well as the aspects of the language with which they struggle the most. Question #5 intends to encourage the researchers to identify any differences they perceive in their work depending on the language they are using, while question #6 seeks to identify the types of comments they have received from the editors of the journals, as well as their perception of these comments. Finally questions #7, #8 and #9 intend to gather as much information as possible about the strategies adopted by the researchers following any negative comments on, and indeed rejections of, their manuscripts. A secondary purpose of these questions is to gauge these scientists' perception of translators and proofreaders, as well as to examine how they feel about translations of their work, and the extent to which they consider such translations to be useful in their field.

The questionnaire was sent electronically through a link generated on the SurveyMonkey website. The survey was initially sent to a small group of scientists (7) from both research centres. They were asked to invite other peers within the same scientific community to answer the survey. In the end a total of 32 researchers answered the questionnaire. Table 4.1 below shows the data collected by question #1.

	Years of experience	**Number of researchers**
Early-career Researchers	2–6	10
Mid-career Researchers	10–16	11
Senior Researchers	20–35	11

Table 4.1 Question #1: Participants in the survey.

The survey reached scientists who were at different stages of their career. As presented in the table above, the participants were divided into three main groups based on the number of years they had been writing and publishing their research in national and international journals; in point of fact, the three groups were as follows: early-career researchers (2–6 years), mid-career researchers (10–16 years) and senior researchers (10–35 years). As we can see in the table above, the groupings in each category were quite balanced. Of the 32 participants, 10 were categorised as early-career researchers. Four of them identified themselves as postgraduate students. Eleven participants, categorised as mid-career researchers, mentioned having from 8 to 16 years of experience as active researchers. Finally, senior researchers were those well-established researchers with more than 20 years of experience conducting research and writing for publications in international journals.

It is interesting to note from the outset that, regardless of their years of experience in research and publishing, the majority of the participants expressed similar attitudes towards the whole process of writing for publication in English L2. Nevertheless, researchers with more extensive experience were able to give more detailed answers regarding specific aspects of the process of publication, as well as about the interaction between editors and researchers. In that way, the analysis of the data gathered in the survey, as will be shown in the sections below, was not significantly homogenised by this categorisation. The analysis of the data collected in the survey is presented in the sections below. The analysis of specific questions is set out in the groupings discussed above: experiences in the publishing process (4.1.1.); the perception of the role of ELF in science (4.1.2.); interactions with editors and reviewers (4.1.3.); and strategies and tools to secure publication (4.1.4.).

4.1.1. Experiences in the Publishing Process of International Journals

This section presents the information collected by question #2: What types of experiences have you had during the publishing process?

Problems mentioned	**# of times mentioned**	**Problems mentioned**	**# of times mentioned**
Long process	18	English language	3
Unqualified editors, reviewers	6	Lack of understanding	3
No bad experiences	5	Conflict of interests	1

Table 4.2. Question #2: Experiences during the publishing process.

The results shown in the table above indicate the number of times each problem is mentioned in the survey, given that each participant refers to more than one issue. The most significant difficulty raised by the participants concerns the time that it takes from initial submission of the article to successful publication in the journals. Problems with the length of the process is mentioned 18 times; indeed, the participants state that the time invested in the process of publication is too long. Although the majority of the participants refer to the length of the process of publication in general terms, only two participants give an estimate of the time it usually takes to get articles published. Participant #30 notes that although his/her experiences were not bad, it had taken him/her a whole year to have some articles published one at a time. Moreover, according to participant #26 (a senior researcher): “the time varies depending on the journal you choose, generally it is between two months and a year”. The length of time, as noted by the participants, is dependent on the type of modifications that editors require to perform, this is either on the clarity of the methods or process in the manuscript or use of English, in many cases the modifications required by the editors

relate to the quality of the writing in English. Thus, extra steps are added to the process of publication, such as rewriting, waiting for any translation or proofreading services. In terms of this point, it would be helpful to know whether the researchers experienced similar waiting times to have their manuscripts published in high-, mid- or low- IF journals. As discussed in Chapter 2, depending on the IF of the journal, the content of the articles/or the way the articles are written change. It may be the case therefore that the variations in time spent before publication are dependant on the IF, that is the higher the IF the higher the requirements and longer waiting time for publication; whereas the lower IF, the easier and more accessible it becomes for NNES scientists.

The second biggest problem, appearing in six responses, relates to the interaction with the editors and reviewers. According to this set of results, the participants felt that, in some cases, the rejection of their manuscripts was mainly due to unqualified reviewers or editors who were not familiar with the topics and the field in which they, as experts, specialised - for instance, participant #29 (a senior researcher) felt that his/her articles were “rejected because editors are not experts in the field”. Moreover, participant #19 (a mid-career researcher) mentions that “often editors do not understand the techniques we use”. This response in particular sheds light on the extra steps needed for the process of publication, which in turn slow down the process as continuous clarifications of the research need to be shown to the editors.

Three participants state that the English language itself is an obstacle for them, and one even notes a degree of bias due to his/her degree of competence in English L2. For instance, participant #25 (a senior researcher) observes that he/she had felt discriminated against due to his/her command of English. This particular point was not further elaborated on by the participants - that is, they only mention in general terms the linguistic barriers experienced by the use of English as L2 in publishing. The

results, however, support findings of this (and indeed the idea of further) research into the development of a sense of stigma on the part of NNES scientists, due to a deficient command of English discourse, according to the NES standards. As noted earlier by Flowerdew (2008) and Crystal (2012), NNES scientists develop a sense of stigma due to their inhability to comply with the NES standards required by the journals, which is derived from a shared fear among NNES scientists that their work will be ignored by the scientific community.

Three participants mention a certain lack of understanding, on their part, of the whole process of publication. For instance, participant #9 (a mid-career researcher) states “[I am often] confused throughout the whole process from the first time I submit my manuscript until it gets published”. A similar answer is given by participant #3: “I feel uncertain about the way in which my article is evaluated”. Other problems they mention concerned the formats required by each journal, with participant #26 (a senior researcher) stating: “I have experienced obstacles with the different formats required by each journal to which we have to adapt our articles. Things would be easier if all the journals had the same and a simpler format”. This points to the differences and consequent incompatibility of the rhetorical habits between Spanish and English. Although, as noted in Chapters 2 and 3, the Mexican scientific community does not have a scientific style of their own, their rhetorical style is strongly influenced by the rhetoric and rhetorical system of their native language, which is not a linear one, thereby, causing difficulties when adapting their writing into the already standard rheotircal structure required by the journals.

Only five participants report that they had not had any negative experiences while submitting articles to international journals. Among these were two early-career researchers, both students with two years’ experience as researchers and writing for

publication, who reported positive outcomes from their experiences. Participant #2 states: “I have improved my writing skills in English”, while participant #3 remarks: “I have acquired a richer technical vocabulary”. It is important to bear in mind that there may be some degree of bias in these reponses - although it may be possible that the participants in this section did experience an improvement in their written skills in English L2, it is highly likely that many of the grammatical choices made in their texts may not be responding to the sense intended in the original text, but instead are derived from the socio-cultural norms of international publication imposed/required by international journals as an attempt to belong to the international scientific community. Thus, without acknowledging it as such, they may still be contributing to the modification of their knowledge. This would be an interesting aspect of this research to analyse further, outside the constraints of time and space of a doctoral thesis.

4.1.2. English as the Language of Publication

This section includes the information collected by questions #3 *Do you consider your English and Spanish writing skills to be similar?*, #4 *What do you find most difficult in writing English for scientific publication?*, and #5 *What types of changes do you perceive in your work when you write in English?* The intention behind these questions is to shed light on the way Mexican researchers perceive the use of English L2 as the dominant language in scientific publication.

Question #3 in this section seeks to obtain information about what language, either Spanish or English, the participants feel more comfortable using for their publications. The results are shown in the table below.

	Participants
Spanish	23
English	0
Both	8

Table 4.3. Question #3: Predilection of language for publication.

The majority of the participants, around 74%, indicate that their written skills in Spanish L1 are far better than their skills in English L2. However, the rest of them, 8 participants, indicate that they feel comfortable with their skills in both languages. For instance, participant #28 (a senior researcher) notes: “My writing skills in both languages are similar, I even make the same grammar mistakes”. This statement in particular is interesting, in that it may indicate that the participants do not necessarily acknowledge the rhetorical differences between both languages nor the implications that choosing one style over the other might have for the final text. Indeed, these comments support the idea, mooted in the section above, of the damaging effects to the clarity and intelligibility in RA applied by the users of the language due to a lack of awareness of the syntactical rhetorical differences between the SL and the TL and the effect such differences have in the content of the texts.

Question #4, on the other hand, seeks to obtain information about the elements of English written discourse with which Mexican researchers struggle the most. The results are shown in Table 4.4 below.

Problems	# of times mentioned	Problems	# of times mentioned
Writing in the appropriate style	10	Being concise and accurate	4
Transmitting the main idea in the second language	6	Translation	1
Grammar	6	No problems	1
Vocabulary	4		

Table 4.4. Question #4: Issues with English written discourse.

The participants report experiencing many problems during the process of writing their manuscripts. The biggest problem, according to the data, is the adoption of what the participants refer to as “the proper style of scientific language”. For instance, participant #27 (a senior researcher) notes that he/she struggles with adopting the “scientific style”. This response, as noted earlier in Chapter 1, seems to confirm the widespread notion, shared by NNES, of English discourse being the official or most suitable discourse for the transmission of science, since as noted in the survey, the participants refer to English discourse as “the proper style of scientific language”. Moreover, participants draw a comparison between their writing style and the style produced by NES; indeed, as the participants note, the style they produce is seen as somehow faulty or deficient, whereas those texts written by NES are perceived as far more elegant and more suitable for scientific publication. For instance, participant #22 (a senior researcher) comments as follows: “I write my articles directly in English, because it is harder for me to write them in Spanish and then translate them into English. [However] it is difficult to write a text in English that flows naturally. Instead I end up with a robotic text”. A similar comment is made by participant #19 (a mid-career

researcher): “the texts written by native English speakers are far more elegant compared with the texts I write, which are usually very basic and simple”. According to participant #15, “It is hard [for me] to be consistent throughout the text and adopt only one writing style”. These reponses indicate that while the participants notice differences in the writing styles between Spanish native speakers and NES, they perceive the quality and style of NES to be qualitatively superior, thereby attributing the differences in writing style to their perceived lack of proficiency in English L2. This particular point is emphasised in terms of the challenges posed by specific discoursal features, such as the conciseness and accuracy of scientific discourse, reported by four participants who note that achieving conciseness and accuracy in English is their main issue - although they do not give any further details. However, it is interesting to note that they do not seem to acknowledge that such differences are derived from the rhetorical and cultural differences of Spanish rather than their own lack of language competence.

Notwithstanding the high status that the participants alocate to English discourse, they also identify particular incompabilities between their writing style and certain characteristics of English discourse. For instance, as reported in the survey, two common issues are raised, both related to the use of English as L2: the transmission of the main idea into English, and English grammar - both issues are raised six times each in the survey. The participants mention different factors that contributed to this obstacle; for instance, some participants note that English lacks certain tools and a more varied vocabulary in comparison with the perceived precision of Spanish, which hinders them in constructing the text so that it expresses exactly what they think. Participant #5 (an early-career researcher) indicates in particular that “maintaining the main idea is difficult, because technical English is not as extensive as

Spanish". Participant #31 (a senior researcher) noted that "the main idea is not as clear in English as it is in Spanish". Furthermore, according to participant #8 (an early-career researcher), "English lacks certain words, synonyms and adjectives". These responses appear to contradict the notion of English discourse being the most suitable language for the transmission of sience, given that they identify deficiencies in the discourse that prevents them from writing fluent texts. These responses may indicate that while the widespread notion about the suitability of English discourse in science is a restricting factor throughout the writing process, at a perhaps unconscious level the stylistic and rheotircal characteristics of the scientists' own native language is something that they value in their writing process, regardless of whether they are producing texts in either English or Spanish.

Six participants indicate that English grammar, in general, is the most difficult aspect when it comes to writing for publication. Here, although no further details are offered in the responses given by these participants, this section points to the deficiency of the foreign language instruction offered to students and researchers, particularly in the formal discourse used in their area of speciality - as noted in Chapter 3. Finally, only one participant reports not having any issue with writing in English.

Question #5 seeks to establish whether or not the participants perceive any changes in the content of their research depending on the language they were using, as well as exploring how they feel that these changes have affected their texts. Table 4.5 below shows the results obtained for this question.

Differences	**# of times mentioned**	**Differences**	**# of times mentioned**
English is more suitable	10	No changes	3

Loss of ideas	9	The text is condensed	1
Clarity is compromised	8		

Table 4.5. Question #5: The effect of English in articles written by NNES researchers.

Ten participants note that one of the differences they identify when their work is written in English is that they perceive an improvement, due to - as their responses claim - the perceived suitability of English discourse for the type of information in the RA. For instance, participant #27 (a senior researcher) notes that “English is a more logical language”. Similarly, participants #24 and #26 (senior researchers) state that “English is more accurate than Spanish”. Moreover, participant #17 (a mid-career researcher) observes: “I do not see a big difference. [However] I prefer to write in English as I feel it is more efficient in communicating new ideas”. While the reponses given in question #4 mostly communicated deficiencies in English discourse, here they seem to say that regardless of those perceived deficiencies English discourse is still more suitable for the dissemination of science.

Although a third of the participants perceive articles written in English to be of higher quality, the majority of participants are aware of negative changes in their own writing when using English. For instance, nine participants note that they perceive a loss of ideas and some concepts in the English version of their articles; indeed, participants #6 and #8 (early-career researchers) state that “ideas and concepts get lost”. This make sense when considering that they identify the lack of “the extensive technical vocabulary” with which they work in their native languages (mentioned in question #4); as such, it is difficult for them to express their ideas wholly in the foreign language. Furthermore, eight participants report that the clarity and the accuracy of their text is compromised when using English. For instance, participant #15 (a mid-

career researcher) states that “ideas are not transmitted in the same way”. Similar to this observation is a remark made by participant #16: “the precision of the original text is lost”. These responses may cast some light on the modification of the underlying espistemological paradigm of the knowledge of NNES; however, in order to determine this it might be necessary to carry out further contrastive analysis of the original texts and the translations into English. Two participants share more neutral observations about the topic; according to participant #15, “in some aspects one language is more precise than the other” (although it was not clear which language this participant was referring to).

Moreover, participant #30 (a senior researcher) comments as follows: “I write directly in English. Some versions are clearer than others; not due to the language, but because of the order in which the results are exposed”. One participant observes that, when his/her texts are written/translated into English they are usually more condensed than the original version in the native language. Finally, three participants mention that they did not perceive any change in either language.

In general, therefore, it seems that the information gathered in this section points to a shared notion among the participants in the survey that English is the indisputable language for international scientific publication, as they perceive, based on the answers given, that the instrinsinc characteristics of English - such as terminology and syntactical structure - give the texts the fluidity and stylistic characteristics necessary for the dissemination of scientific knowledge. On the other hand, it is interesting to see that, at the same time, they identify negative effects in their texts when writing in or translating in English, such as the loss of ideas, lack of accuracy and condensation of the text, as well as recognizing a certain degree of incompatibility with their way of argumentation and the foregin linguistic structures. The viewpoints shared in these,

point to the modification of the epistemological content when adapting a text in a completely different language. As noted in the responses where scientists identify changes in terms of 'loss of accuracy, clarity and ideas, there is also evidence that points to the epistemological modification derived from the complete reformulation of a text into English as the target language (as was noted in Chapter 3). Nevertheless, the characteristics identified by scientists in the survey are still not enough to determine the depth of the potential epistemicidal effect in the knowledge perspective produced by Mexican, or NNES, researchers. Further analysis needs to be carried out to be able to identify this.

4.1.3. Comments Received from Editors

This section presents the data collected by question #7 *What types of comments do you usually receive from the editors of the journals?* Table 4.6 below presents the most common observations made by editors, as reported by participants.

Comments received by editors	**# of times received**
Issues with English grammar	16
Content of research/sections of the article	10
Style (format)	3

Table 4.6 Question #6: Common comments received from editors.

As noted in the table above, the majority of the participants report receiving comments about the quality of the writing, where a perceived poor command of English is the main issue; participant #12 (an early-career researcher) remarks that "editors usually suggest that I have my articles checked by a native English speaker". According to participant #23 (a mid-career researcher), "editors have commented that I need to

improve the language in the majority of my articles", while participant #22 complains that "after I send my articles to a language professional, I only get comments about the content of the article, not the language". This type of comments point out to the pressure exerted by international journal editorials, as noted by Flowerdew (1999a, 1999b), Curry & Lilies (2004), Bennett (2007), Canagarajah (2014), to oblige contributors to comply with the standard NES requirements in order to secure publication, corroborating the statement that international journals only accept what looks familiar to them. As editors and reviewers require the manuscripts to be revised by NES, they are effectively requiring the domestication of the texts. And, allthough this does not confirm that the intention is to disregard and intentionally silence the knowledge perspective from NNES research, it does contribute to damaging effects in the diversity of knowledges and to the stigmatisation of NNES scientific communities.

That said, the second type of comment reported by the participants is related to technical aspects regarding the content of the article. For instance, participant #15 (an early-career researcher) states that "one time I received a comment stating that no scientific contribution was found in my article". In addition, participant #28 (a senior researcher) tells of how "lately all the comments I receive concern the content of the article, such as clarifications about the aim of the study, graphs, and the discussion section". Finally, three participants report that they received feedback related to the style and format required by the journals. For instance, participant #18 (a mid-career researcher) stated: "I usually receive comments regarding the adoption of the editorial norms of the journal". As noted earlier in Chapter 1, international scientific journals require research articles (RA) to be embedded in a particular rhetorical structure (I-M-R-D) which dictates the order in which the information is presented in the document. When Mexican researchers incorporate different rhetorical tools into the RA they are

submitting for publication, coupled with other rhetorical expressions and tools derived from their native language and its discursive style, it might be the case that international journal editors struggle to identify information such as scientific contribution and aim of study in the particular RA that these Mexican researchers submit. This lack of understanding on the part of editors, as noted in the responses above, is remedied – from the perspective of the editors - by the further push to impose the rhetorical structure required by the editorial norms of the journals. This, as noted before, carries further detrimental effects in the epistemological infrastructure of the scientific knowledge of Mexican researches, given that through the imposition of the foreign rhetorical norms, valuable information transmitted through the native discoursive style of the scientists is lost.

4.1.4. Strategies and Tools Used to Secure Publication

The final section of the survey comprises the data collected by questions #7 *What strategies do you follow after receiving negative comments from the editors?*, #8 *Have you sought help from persons outside your field of expertise?*, and #9 *Do you think this practice (using translators) is advantageous for your articles?*

Question #7 seeks to gather as much information as possible about what researchers do after the first rejections of their manuscripts in order to secure the publication of the manuscript. Table 4.7 below shows the responses to this question.

	# of times mentioned		**# of times mentioned**
Send work to translators or proofreaders	14	Seek help from colleagues	5

Work on the suggestions received	10	Imitate structures used in other articles	3

Table 4.7. Question 7#: Actions Taken Before Re-submitting the Articles.

Let us consider the most common strategies adopted by the participants in order to re-submit their articles for publication. Fourteen participants report that when their article is rejected following the first attempt, they send it to a professional translator or proofreader. By contrast, ten participants report that they prefer to work by themselves in rewriting and following the comments received from the editors. For instance, participant #25 (a senior researcher) states: “I rewrite the article carefully, regardless of how long it takes me”. Another strategy followed by the participants is to seek help from more experienced colleagues, particularly those who have better skills in either English L2, regardless of their status as NES or NNES, or in their field of specialisation. For instance, participant #23 (a mid-career researcher) notes: “I seek help from colleagues who are better skilled in English than me”. Further techniques reported in the survey include imitating structures used in other publications of the field. Three participants report doing this; however, they do not specify whether they choose articles written by NES authors. For the most part it seems that they trust these texts because they have already been accepted for publication.

As noted by the result above, the techniques adopted by the majority of the participants, which are based on the conscious replication of syntactical and rhetorical constructions completely decontextualized from the original texts, can be considered as detrimental to the diversity of languages. As noted earlier by Canagarajah (2014:14), such practices are damaging given that while this type of constructions are replicated in order to have their manuscript published, the manuscript or the knowledge poduced in them is developed “in relation to discourses from the centre and in terms

of the journals and institutions from the West". As a consequence, the applications in the periphery in their local communities are underdeveloped.

Although, it appears that such techniques may well produce the desired effect, in that the manuscripts are eventually published in the targeted journals, there seems to be a lack of understanding on the part of the contributing authors, as mentioned above, of the contextual and epistemological consequences that certain linguistic choices carry for the original text. These responses seem to show that the participants are not aware of the crucial differences between the rhetorical and discursive structures and the effects that each carries in the transmission of knowledge.

Question #8 was designed to gauge whether the participants had sought help from language professionals outside their field of expertise.

Getting help from non-experts in the area	
Yes	23
No	8

Table 4.8. Question #8: Getting help from persons outside their field.

The majority of the participants report that they usually send their articles to professional translators. However, eight participants expressed their scepticism about translators; they even cast doubt on the quality of the translation and proofreading services offered by some of the journals they were submitting to, given that, according to their experiences, such translators did not fully understand the terminology, technical discourse and conceptual universe of their field of study. One participant expresses his/her discomfort in relation to this practice: "I recognise it is a popular practice, mainly derived from the current pressure to publish our work faster and more

often. However, I do not agree with sending my work to a translator or proofreader, and do not think that any external person should interact with our work" (a researcher with 30 years of experience). Nevertheless, the majority of the researchers are keen to receive help from people outside their field: many of them indicate that this kind of feedback may help improve their discursive style and give a natural flow to their texts, even though eventually they always have to review and improve the translations themselves. One participant indicates that it would be ideal to have specialized translators or proofreaders working closely with them in their everyday routine.

Question #9, following on from this, is designed to collect information regarding the participants' views of the role of professional translators and proofreaders in their field.

Do you trust people outside of your area of expertise to edit your work?	
Yes	25
No	6
Sometimes	1

Table 4.9. Question #9: The role of the specialised translator.

Even though the majority of the respondents, i.e. 25 participants, indicate that they are keen to send their work to translators, only 40% of these report having used the services of professional translators and proofreaders. Many of them declare that they have more trust in the services offered by the journals and some agencies, with www.ajar.com being the most popular agency; indeed, these participants feel secure knowing that their work will be handled by experts in science as well as in English. However, not everyone relies on those services, mainly due to the elevated costs, which represent a big investment for the participants. For instance, participant #30 (a

senior researcher) notes that sometimes he/she cannot afford to send articles to a translator given that “it is hard to find someone reliable who offers competitive prices”.

Overall, as indicated by the results collected from the survey and as noted by Montgomery (2009) and Tardy (2004), Mexican scientists generally do not see themselves as the victims of the “predator discourse”. For instance, as noted in the results from question #2 even though they recognise that English L2 may function sometimes as a problem, they view the largest issue they have to negotiate as the standardised requirements imposed by the editorial boards of the journals, and the performance of particular editors, rather than their proficiency in Egnlish L2 and the perceived incompatibility between the stylistic characteristic of Spanish L1 and English L2. Of particular significance for this study are the points raised in regard to specialised translation: 1) the detrimental effects, in terms of content and time, caused by inexperienced translators, and 2) the need for technical translators specialised in one specific area of study and who can work closely with the scientists (see the responses to questions #7 to #9). These responses further support the call by Bennett (2013) with regards to the importance of training translators in specific areas, for them to be able to meadiate between the linguistic and cultural characteristics of the SL and TL discourses without completely modifying or destructing the epistemological infrastructure of the SL.

4.2. Managing the Effects of the Dominance of English Discourse

As a way of managing the difficulties that result from the constant contact between different languages in international publishing in science and academia, linguists, translators and speacialists in foreign language education have been engaged in a

constant search for ways to implement language policies that can counteract or help mitigate the obstacles thrown in the way of scientific languages in different scientific communities, such as those presented in the survey. Nevertheless, as Hamel (2006:96) notes, the language policies that have been implemented so far are affected by a number of factors - firstly, given that different linguistic communities are organised in nation states, they develop different perspectives in terms of: 1) the role of their scientific communities, 2) international scientific communication, and 3) the languages involved in the process. Thus, the perspectives on language usage and the interests of their communities are different. Secondly, since scientists and scientific communities are in control of, and at the same time are controlled by, their local language policies, they all work towards the interests that would potentially bring benefits to their own scientific community; however, at the same time, they struggle with the same interests and "needs of access to the international scientific network which are in part related to language(s)" (ibid.). Furthermore, as stated by Gouldner (1979), given that specialised languages play a role in the promotion of social relations, i.e. they modulate their discourse according to the type of relation they have with other scientists - in other words, scientists adopt different registers of the technical language depending on the target audience they are addressing, and their status within the scientific community (e.g. experts in the same area, scientists from different areas, or the general public), which leads to the creation of a hierarchy; indeed, within this hierarchy the NES may clearly be at a huge advantage in comparison with their NNES counterparts (ibid.).

Thirdly, as opposed to the widely-held view that the international sphere of science is an independent unit that "regulates its own field of action, it in fact represents the interest and expresses the power of the English-speaking scientific community and its publishing industry" (Hamel 2006:96), thus further supressing the language,

research interests and status of NNES scientific communities on the periphery and semiperiphery of scientific production. Lastly, large corporations exert considerable influence on the development of science and technology, particularly in the industries - e.g. pharmaceuticals, which are inclined to support the English monopoly as they too benefit from the centralisation of such corporations (ibid.). Thus, relying only on the implementation of, sometimes biased, regulations cannot be the only solution to the many problems experienced by NNES researchers, as said regulations mostly contribute to the perpetuation of the dominance of native-English standards in scientific publication.

In Mexico particularly, as noted by Reyes et al. (2012:167), there is no free-standing common language policy. Instead, whatever language norms are adopted are based on partially following international tendencies in regard to foreign language teaching (ibid.). Therefore, many of the syntactic and rhetorical characteristics of the specialised discourse of Mexican researchers, as shown in Chapter 3, are strongly influenced by the trends identified in NES publications.

Of note here is the discussion on the possible ways in which the users of ELF can manage the dominance of English discourse in science in order to transmit the knowledge produced by NNES researchers without necessarily “killing” or modifying their own knowledge perspective. Given this discussion, both scientists and linguists, as Tardy (2004) notes, have explored different ways in which to achieve a change in the language policies, or, in some cases, to create certain policies to counteract the inequalities experienced by NNES researchers in international publication. Although both groups have based their observations on slightly different contexts, it is clear that, for both groups, English is a necessary tool in international communication, while, at the same time, it can also act as a double-edged sword (ibid.252). For instance, in

broad terms, linguists base their suggestions on aspects such as the historical origins of the dominance of ELF (see Chapter 1), the difficulties in publishing experienced by NNES (see Chapter 2), and the dominance of discursive NES standards enforced by the gatekeepers (see Chapters 2 and 3). In that way, linguists have focused more on raising awareness among the scientific community, as well as among specialised translators and students, of the many issues that derive from the dominance of English (Clyne 1991; Swales 1997, 1998; Bennett 2013); these linguists have also focused on the implementation of activities such as mentoring between advisors from the inner circle and students (Flowerdew 2000), as well as calls for action from the gatekeepers and policy makers of international journals and editorials to ensure that the process of publication may be more flexible in terms of the English standards of the texts (Canagarajah 1996; Phillipson & Skutnabb-Kangas 1999; Salager-Meyer 1997, in Tardy 2004:252).

On the other hand, scientists focus more on the current situation of scientific publication, and are looking for additional practical and strategic solutions that can help them counteract the language bias during the process of publication in order to facilitate the interaction between NNES researchers, particularly those from the periphery (ibid.). Thus, as Tardy (ibid.) notes, these scientists have been making changes in relation to recommendations made by local journals to publish and write directly in English (Glaze 2000:369); indeed, some have even recommended increased collaboration between scientists from the centre and the periphery, focusing on research relevant to developing countries. However, as discussed throughout this thesis, such changes, although well intentioned, do not really help to counteract the effects of English language and Anglophone-centred policies, and may even help perpetuate the lack of visibility of different knowledges. This is because, as noted in

Chapter 2, in most instances international collaboration implies doing research that is not directly relevant to the advancement of the local scientific community nor for the application for the benefit of the local community. On the contrary, international research collaborations are mainly focused on the improvement and enhancement of projects that are relevant mostly in the centre. As noted by Santos (2014) according to the ecology of knowledges theory, the different knowledges produced in centre and peripheral scientific groups are meant to be complimentary, thus having these institutions and colaborations impose only their interests would go against the diversity of knowledges and would support the abyssal thinking, noted by Santos (ibid., 119) based on the appropriation/violence dichotomy.

As a way to be able to strike a balance between the issues that affect the publication and visibility of NNES publications, the following section discusses the different areas explored by both scientists and linguists in order to counteract the damaging effects of the dominance of English discourse and policies in international scientific publication, and which together help to paint a more complete picture of the different stages involved in international publication. These sections offer the following discussions: 4.2.1 English L2 teaching, 4.2.2 a plurilinguistic model in scientific production, and 4.2.3 editorial and translation services.

4.2.1. English L2 Teaching

The implementation of changes in the teaching of English as L2 is one of the suggestions made by several linguists in order to facilitate the learning of a language in specialised areas, as well as to explore the bias and agendas that certain groups and even certain journals may choose in order to favour the interests of the scientific community from the centre. Both scientists and linguists have suggested that the

implementation of English as L2 teaching practices would eventually facilitate the diversification of specialised languages in international publication. For instance, Hamel (2006:115) notes that in order for NNES researchers to achieve high levels of proficiency in English L2, several changes need to be implemented at university language centres. Specifically, these centres should reinforce requirements in the planning of the curricula, academic mobility in foreign countries for staff and students, and should orient the curricula "toward advanced proficiency in all four macro-skills including the writing of papers" (ibid.).

However, as suggested by Tardy (2004:263), although the implementation of an "improved" or more specialised way of teaching English as L2 among the NNES scientific groups may seem like a way of perpetuating the status quo of ELF, as Benesch (2001) notes this can be diminished by balancing the linguistic content of the instruction with relevant aspects of the process of publication in the classroom. Benesch (2001:137) recommends a pedagogical approach that could diminish the imbalance between NES and NNES; this is critical in the case of English for Academic Purposes (EAP) because EAP learners are also active agents of their learning in that "they are encouraged to question the unreasonable requirements" of the industry, and they are made aware of ideological biases (in Fenton-Smith 2016:A24). Similarly, Swales and Feak (2000) suggest showing the students data that reflect publication bias in a particular area of study. Furthermore, they recommend that EAP instructors could teach the sociopolitics of their disciplinary community "in terms of production, reception and distribution of scholarship and a mechanism for change, as well as showing the factors that influence the way texts are produced and received in an international community" (in Tardy 2004:264).

According to Tardy (2004:264), language classrooms could also bring attention to the gatekeeping practices, that is, the social-political practices that surround the different academic and professional genres, by comparing the processes between elite circles with those in the periphery. Additionally, English L2 teachers can address the mechanisms of change within these domains (ibid.). In this way, English L2 or foreign language students can consider the impact that ELF has on science and academia, while at the same time allowing multilingual students to shift their mindset from considering their language skills as a liability and viewing them instead as an asset (ibid.).

Similarly, Salager-Meyer (2013:4) remarks that it would be beneficial for universities, societies, as well as journal editors to collaborate in workshops and seminars to train researchers, journal staff and editors to learn about the culture of academic and scientific publications, and the written skills in the native language of the scientists and academics as well as in the L2. This, as she further notes, can also be implemented in translator training, as the students will be more acquainted with the discursive characteristics of the specialised languages in both languages (ibid.). Equally important, according to Salager-Meyer (ibid.), is including in these workshops the promotion of good research conduct and the raising of knowledge on publication ethics.

4.2.2. Plurilinguistic Model in Scientific Production

In addition to the implementation of specialised/technical English courses with a pragmatic perspective on international publication, other authors (Hamel 2006; Fung 2008) suggest maintaining a more diversified offer of scientific/academic publications in terms of the languages that authors choose for their manuscripts. This is suggested

in order to counteract the numerous negative consequences that derive from the monolinguistic model that dominates modern science and higher education. According to Hamel (2006:99), given that the prevalence of English discourse up until now has contributed to the reinforcement of the already-existing asymmetries in scientific production and dissemination between the centre and the periphery, international science and higher education are affected by the dominance of a monolinguistic model in the following way. The consequences of the asymmetries brought about by monolingualism are, as Hamel further notes and as was raised in Chapter 2, seen in the impoverishment of scientific creativity, the deletion of scientific production in countries in the periphery, and the consequent lack of economic development (ibid.100). Furthermore, monolingualism can also affect fields such as culture, international relations, intercultural relations and the preservation of peace. Therefore, Hamel (ibid.) suggests that NNES scientific communities could contribute to plurilingualism in international publication by creating policies that could make their language more attractive for the international scientific community.

Fung (2008:3) states that in order to facilitate the dissemination of scientific language and to include NNES researchers and audiences, scientists could choose to publish in multilingual Open Access journals. In these journals, as Fung further proposes, in order to reduce any barriers scientists could choose from four options: writing abstracts in alternative languages, 2) including wiki-style open translation, 3) implementing an international board of translators-editors, and 4) offering an alternative language version of the journals (ibid.1).

According to Hamel (2006:111), the international scientific community needs a flexible model for the production and dissemination of science that promotes plurilingualism and opposes monolingualism wherever possible. In order to achieve

such an approach, various changes, such as conceptual movements and practical measures need to be applied, involving a general collective ideology that relates cultural discursive and linguistic choices to the ideology of the communities. Hamel proposes a plurilingual strategy that implies the transition from a monocultural to a pluricultural orientation. In his view, pluricultural orientation (PO) includes the following:

> - PO admits the legitimate existence of other scientific cultures when defining basic concepts of its own scientific culture and approach;
> - PO seeks complementary integration of different types of knowledge instead of a substitution of one by another;
> - PO means to strengthen the development of science in each country in close relation to its own culture, acknowledging multiple relations between history, society and science;
> - PO takes as a starting point the recognition of a structural asymmetry in the development of science in different countries. For that reason, it fosters measures to protect and strengthen the development of science in the weaker countries as a basis to participate in international communication and exchange;
> - Finally, PO encourages reciprocity in international communication.
>
> (Hamel 2006:111)

As further noted by Hamel (ibid.), while a monocultural orientation sees the interaction between different languages as problematic in terms of language barriers that obstruct the dissemination of scientific information, the plurilingual orientation sees language diversity as an asset to enrich the development of research. Furthermore, it strengthens the national languages, providing a "better basis to learn and use foreign languages in science". According to Hamel, foreign language teaching, translation and L2 writing are measures which help reduce the barriers of access to the international

spheres of science. Such measures, as Hamel further remarks, complement each other as “components of an integral plurilingual language policy” (ibid.115). Nevertheless, obstacles, such as budgetary costs, are factors to be taken into account in the implementation of such initiatives (as noted in Chapter 3), due to the financial limitations of scientific communities, such as that of Mexico.

4.2.3. Editorial and Translation Services

Perhaps one of the most relevant suggestions for this thesis, coming from linguists and scientists alike, in terms of the translation of scientific discourse is the implementation of technical editorial and translation services in science and higher education. As long as English continues to be the dominant language in international publication, there will always be issues among the NNES scientific community. Likewise, Flowerdew (1994:142) notes that, as NNES scientists continue to use their native languages in their day-to-day professional lives, and translations of new research become more rapidly available to them in their native languages, it is highly likely that using English in these particular areas will pose a problem, given that the scientists may have less exposure to the English language. This, as suggested by Flowerdew, may affect the translation process as well. On the other hand, according to Montgomery (2009:7), given that approximately over 80% of the international scientific community are not NES but use English as their main language for communication, “most of the world’s scientists are themselves actively engaged in some type of translation activity — moving textual or spoken material between languages. Translation is thus an integral part of scientific production”. Furthermore, as scientists continue to use ELF, translation will become an even more central aspect of communication (Montgomery 2009:13).

While the scientific groups in the centre may benefit from accessible editorial services for publication, i.e. proofreading, translation, these services might not be as accessible for scientific groups from the periphery. According to Hamel (2006:116), the institutions that offer programmes in translation and interpretation in Mexico lack translation centres that could provide the necessary tools to facilitate translation, such as automated translation programmes. Furthermore, Hamel identifies the lack of support received by researchers in terms of the difficulties experienced when writing for publication in English (ibid.). Similar issues with regard to editorial services are also mentioned in Chapter 2 of the present thesis.

In this respect, Flowerdew (1994:142) notes that offering editorial support in training for writing for publication and increasing opportunities for international academic exchange could help diminish the many obstacles in the process of publication caused by the conscious and unconscious choices derived from the dominance of ELF. Furthermore, Flowerdew (1999:33) postulates that, in order to increase the participation of NNES in international journals, journal editors and reviewers should be made aware of the many problems experienced by NNES contributors, as this may encourage them to take such problems into consideration when reviewing the articles. In addition, he suggests that editorial services, such as mentoring programmes and writing workshops, should be offered to NNES scientists (ibid.). Similarly, Salager-Meyer (2013:4) notes that it would be useful for international journals to allocate language specialists who are experts in different disciplinary fields to help, on a one-on-one basis, NNES applicants write their manuscripts.

Although the proposals offered by Flowerdew and Salager-Meyer above are positive ideas in that they would considerably reduce many of the difficulties in the publication process for NNES, in addition to the boost they would offer to the already

weak and underrepresented local journals, these proposals also have a number of limitations, because in order to implement these changes factors such as finance and the creation of new roles in scientific institutions need to be considered. Of particular concern is the application of such proposals in the social, cultural, political and economic context of semiperipheral countries such as Mexico. As mentioned in Chapters 1 and 2, given the political and economic environment of Mexico, and the limited financial support offered to science and technological development, expenses in editorial services are not a priority for the political agenda of the country (Chapter 1). Moreover, given the constant pressure exerted on individual scientists in the periphery and semiperiphery of science, which involves the push towards the frequent production of novel research and numerous publications in local and international journals, it is unlikely that researchers with the required experience and skills (Chapter 2), such as senior researchers, would take on a new and demanding role. Furthermore, although as noted in the survey in Chapter 4, there is an awareness for the need of language professionals - i.e. translators, editors, proofreaders, specialized in specific areas of science and academia - there are not many researchers who could easily consider a change of professional path.

In this respect, as noted by Hamel (2005:50-51), Mexican universities could benefit from the creation of centres and programmes specialised in writing and translating for publication which would accommodate the needs of each “discipline, area, topic and type of texts that need to be translated” in order to facilitate the production of scientific papers with potential impact at national and international level (ibid.). He adds that it is important that editors and translators are trained in the specialised language of a particular field in both L1 and L2, given that the skills required for writing for publications are independent from the skills that a person possesses as

a native speaker of any language (ibid.51). This proposal indeed answers to te current needs of Mexican scientists, and perhaps other NNES scientific communities, as noted in the survey presented earlier in this chapter.

Along these lines, as set out by Hamel (ibid.48), scientific publishing and communication in Mexico can be strengthened by the implementation of a language policy that includes a stronger and more inclusive approach to teaching English as L2, training programmes for specialised translators and proofreaders, as well as training researchers and students and providing them with skills for writing for science and academia. Moreover, Hamel (ibid.) notes that foreign language teaching policies should be complemented by a translation policy from English to foreign languages, and foreign languages to English, consequently resulting in a greater availability of resources in the native language of NNES scientists. Given that, in the past, this translation task was the responsibility of the big editorials, although they only translated texts for those areas for which they were sure they had a market (ibid.50). Furthermore, it was only already-established authors who were translated, and trending topics, as well as the documents themselves being translated, were at times not the most up-to-date. Offering constantly updated material is, of course, crucial for the improvement of scientific research in the country (ibid.).

4.3. The Role of the Translator as a Cultural Mediator in Scientific Translation

As noted earlier in this thesis, the process of translation of scientific texts has usually been approached in two main ways: one that involves, in Bennet's terms, the total deconstruction of the epistemological infrastructure of the ST in order to comply with the requirements of the international NES standards; and the second that involves the

literal translation of the ST into the TL. However, both approaches either contribute to the complete destruction and decontextualization of the knowledge of the NNES scientists, or to their invisibility in international journals and further stigmatization of the local scientific community. Rather than choosing a foreignising or a domesticating approach to the translation of scientific texts, and rather than resisting the dominance of English as the lingua franca in scientific discourse, translation should, as argued by Montgomery (2009:9), be recognised as a necessary tool for the dissemination of scientific language. In this way, the translator should take advantage of the flexibility of both Spanish and ELF in order to find a balance between both languages, at the same time he/she looks for ways to improve approaches of the translation process, that will ultimately help with a more appropriate transmission of scientific texts, more appropriate in terms of the clarity of the translations without disregarding the epistemological content of NNES researchers. The dominance of English, and the attention it gets from scholars today, can disguise the vernacular element that remains integral to science - that is, the linguistic peculiarities added to the discourse that are very much part of the cultural aspect behind the knowledge construal and processing of knowledge. Scientific translation, similarly, tends to be overlooked in that the cultural content included in specific linguistic constructions of the different scientific discourses are generalised, which is also transmitted in the translation techniques, which tend to be domesticating. As Montgomery (ibid.) further notes, “if we admit, as we must and as scientists already do, that communication is essential to the technical enterprise, then we should admit that translation is very much part of this”.

Indeed, the translation of scientific texts tends to be seen as a completely different process than literary translation – in the case of the former, textual accuracy is the ideal that the translator is expected to fulfil (Lu and Hou 2001:175). As reported

by Min-Hsiu Liao (2010:45), the widely-held view about scientific translation is that it should be focused on the information instead of on how the information is communicated, so that the accuracy of the content becomes the priority. One major drawback of this conception is that the components of scientific discourse, such as idiomatic expressions, rhetoric and terminology, as stated by Kastberg (2007), vary formally from culture to culture, just as the conceptualisation of knowledge formation also varies. According to Bennett (2013:170), in most cases the process of translation involves the reformulation of the source text in order to make it intelligible in the target language; this results in “the destruction of the epistemological infrastructure and its replacement with another” that is more suitable for the target audience. For instance, as the results of the survey show, there are slight but continuous modifications performed during the translation process into English, which result in a target-language text that invariably lacks part of the information in some degree. For instance, as highlighted by the respondents, the translation into English varies in terms of technical concepts, ideas and terminological precision from the original text, all of which are components that are transmitted through the process of argumentation, not only through the results.

Therefore, in adopting domesticating approaches in the translation of scientific texts – effectively changing the structure and many of the syntactical and lexical choices made by the NNES authors - we run the risk of completely destroying or obscuring details transmitted that shed light on the way that these scientists conduct their research. This can occur when particular verbs are disregarded and replaced with a more anglicised version. Such modifications might be overlooking slight aspects of the thinking process of NNES scientists which are ingrained in the original text, for instance their perspectives on seemingly universal scientific methods and conclusions

drawn from their particular thinking process. Therefore, components as simple as a verb may comprise the building blocks of the epistemological paradigm of Mexican researchers.

The translation of scientific texts, or any texts, also involves consideration of the relation of the translators with the text, the audience, and the socio-cultural norms of the target audience. According to Denghua (2010:30), the relationship between the translator and the source text is manipulating and being manipulated, in other words, at the same time that the text is being transformed by the translator to fit target audience expectations, the text can also have an effect on the translator in the way the information is being interpreted, as in many cases the structure and style of the text may obstruct the main message of the text, as the translators pursuits a balance between both the message and the appearence of the text. As for the relationship between the translator and the reader, according to Denghua (ibid.), the translator must presume the reader's expectation in order to produce an acceptable translation, and which can also demonstrate the translator's subjectivity. Denghua, however, fails to consider the perspective, the cultural aspects and the intention of the original, given that, according to the approach described above, only the needs of the target audience are considered, thus requiring a domesticating approach to translation, an approach that, while responding to the needs of the target audience, might be contributing with the damaging practices already described in Chapters 2, 3 and 4. Moreover, we can see the mutual relationship between the translator and the socio-cultural norms. On the one hand, these socio-cultural norms tend to regulate and constrain the translator's behaviour, while on the other hand, the translator can exert his/her subjectivity in the translation process (Denghua 2010:30).

Furthermore, according to Bennett (2013:172), given that one of the main features of academic and scientific discourse, as discussed throughout Chapter 3, is that it contains cultural information - that is, the discourse is not neutral, it is culturally biased. Thus translators require not just linguistic and interpersonal skills that will help them “challenge the dominant discourse, without losing sight of the real-world constraints under which they will be expected to operate” (ibid.), but also the cultural awareness that enables them to engineer the sort of cultural shifts that the new texts demand. Beyond that, translators also require critical skills that will enable them to negotiate the “ideological and ethical issues involved in the transfer of knowledge in the current context of globalization” (ibid.).

This is a necessarily very brief summary of what is required from such translators. Bennett (2013:185) proposes training programmes for translators in which they will develop skills in three main categories that together are concerned with the imparting of these skills: 1) critical analysis; 2) writing skills; 3) mediation and negotiation. Critical discourse analysis will help translators critically analyse texts, both in their L1 and L2, so that they can become familiarised with the vocabulary and thus be able to understand, in depth, the style of the text they will be working with. Bennett also suggests that it is important for translators to develop their writing skills of the discourse, first in the L1 and then in the L2, before they can make any changes to it. Once the students have mastered the norms of the specialised discourse in both languages, they can translate into those languages (ibid. 186). Lastly, equipping translators with the mediating skills is essential in mitigating damaging practices, as translators are able to negotiate the possible solutions in relation to the real-world goals.

According to many authors, the technical translator should assume different roles in order to successfully transmit the information in the text, in a way that respects the epistemological boundaries of the authors while at the same time allowing target audiences to be able to understand what is being brought to them. These roles embrace and apply the skills needed both to be a technical translator (Kastberg 2007) and a mediator (Hoorickx-Raucq 2005). Echoing Bennett (2013), Kastberg states that because of the deep-rooted cultural framing in technical translation, cultural competence should be added to the general competences of a skilled technical translator (2007:104):

1. General language competence L1 + L2
2. LSP competence L1 + L2
3. Knowledge of the relevant domain
4. LSP translation competence L1 <–> L2
5. Cultural competence L1 + L2

Hoorickx-Raucq (2005:105) describes the role of the scientific translator as that of a mediator, arguing that in this role translators adopt a more active way of contributing to the transmission of scientific texts by finding new ways of communicating science in the target language. Given that the terminology and the structural organisation of scientific discourse are dependent on the cultural markers and cognitive processes, the discourse requires mediation rather than translation (ibid.97). For instance, Rey (2000) identifies that the use of concrete images in English scientific papers differs from culture to culture, as NES and NNES do not produce scientific manuscripts in the same way; this, as stated by Hoorickx-Raucq, requires the intervention of the translator

as a mediator interpreting the information between the author and target audience, playing a more important role in scientific exchanges (2005:100).

5. Conclusions

In conclusion, throughout this thesis, our discussion has drawn attention to the dominance of English as the modern lingua franca in scientific communication, which has led to the interplay of discursive and stylistic habits in the production of scientific RA in international journals. This in turn, affects the way in which science in countries from the periphery and semiperiphery is transmitted and received by the international scientific community – a condition of reception that could potentially damage the diversity of knowledge in international science.

Chapter 2 was helpful in identifying the non-discursive factors that affect the scientific community from Mexico, such as economical, financial and political instability, a very young scientific culture, and the lack of initiative in the production of scientific knowledge. As noted in this chapter, these factors explain much of the hindrances that researchers, as well as local journals experience in Mexico, which as a consequence hinder their production and their visibility at international level.

Through the linguistic analysis offered in Chapter 3, it was possible to identify the discursive charcateristics arising from the linguistic modifications caused by the interplay of ELF and the scientists L1 derived from the dominance of ELF, and the lack of a specialised discourse from these researchers' own language. Such modifications, as noted in the same chapter, inflict damage on the Mexican scientific community because they lead to their work being assessed via superficial assumptions based on the linguistic characteristics of their articles. Moreover, it was possible to see that contrary to the notion of this linguistic interaction L1-English L2 to be a spontaneous result of the dominace of ELF linguistic modifications derive from conscious selections made by the authors in order to either fill gaps that cannot be achieved by their native

language, or as a way to belong to the international scientific community by complying to the standard linguistic requirements. The data from the linguistic analysis show a phenomenon of hybridisation in which Mexican researchers combine rhetorical expressions from both languages; the first purpose of this is to better communicate certain ideas in a particular way, which could not be admitted in the linguistic structure of one language, while the second is to fulfil the discursive expectations harboured by the editors and reviewers in order to secure publication.

Through the results from the survey in Chapter 4 it was possible to confirm that indeed, ELF is not seen as a predator discourse, but as a tool that facilitates communication among the international scientific community and the transmission of scientific knowledge. Nevertheless, although, as noted in the survey, Mexican researchers do not see themselves as victims of ELF nor do they see this discourse as an obstacle, it was evident that when negotiating between the rhetorical and stylistic strategies in their articles, they are not aware of certain incompatibilities between Spanish and English and the effects that these have on the clarity and intelligibility of their RA. Such results shed light on two important points that concern translation:1) the detrimental effects, in terms of content and time, caused by inexperienced translators, and 2) the need for technical translators specialised in one specific area of study and who can work closely with the scientists.

Although the principal objective of this thesis was to find traces of epistemicide in the way scientists construct their knowledge – i.e. their epistemological paradigm – it was not possible to find concrete evidence of negative changes at levels that go beyond text level. Nor was it possible to find the underlying paradigm that clearly and unambiguously differentiates one type of knowledge from the other. Nevertheless, although no concrete evidence of epistemicide was detected in the linguistic

modifications performed at the level of the text, this does not mean that the discursive and non-discursive factors that affect the scientific community from Mexico are not influenced by the interest of the scientific groups from the centre. That is to say, the discursive choices performed at the writing stages of scientific articles are heavily influenced by a foreign ideology. Indeed, as noted in Chapter 2, given that science, in the modern sense, was introduced in Mexico through the application of the knowledge produced by elite scientific groups from developed countries, rather than being the result of a natural process of development originated locally, it makes sense that the prioritisation of the discursive characteristics of the foreign language over the native discourse, or development of their own specialised discourse, and the inclination towards publishing and doing research in topics more relevant to the centre, are still among the most common choices among Mexican scientists. However, at the same time this does not mean that the scientific community from Mexico has not yet developed a type of knowledge of their own that responds to the technological and infrastructural needs of their country.

Therefore, in view of the data collected in this thesis, rather than focusing on the influence of ELF in science, which is seen as responsible for a phenomenon in which the knowledge of scientific communities outside the centre are completely disregarded and destructed, I have shifted my focus on prioritizing the linguistic mediation through translations that would ideally favour the dissemination of scientific knowledge produced in peripheral or semiperipheral communities like Mexico, for the benefit of the diversity of knwoledges, or ecology of knowledges.

It can be said thus, that the obstacles experienced by Mexican researchers in international publications are derived from discursive and nondiscursive factos such as the hybrid discourse developed from the interplay between Spanish and ELF, as

well as the imposition of academic and linguistic standards by international academic gatekeepers - and which is applied through linguistic bias by NES and NNES users equally, based on the status and the perceived strength of the lingua franca over other native languages. The lack of representation of NNES research from the periphery and semiperiphery in international journals in this guise, involves the interplay of discursive, nondiscursive factors that vary according to the geopolitical location of the affected epistemological community. Moreover, this invisibility points directly to the prevalence of the Anglophone viewpoint on scientific production, and consequently the dependence of scientific (knowledge) communities from the periphery on the knowledge produced by the centre (the scientific, technological and economic powers); it also points to the lack of awareness of the different ways of construing and understanding knoweldges on behalf of scientific gatekeepers, which results in the further neglect of the work and topics relevant to the periphery and semiperiphery, which is crucial for the development of these countries.

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