Scientific and Technical Translation in Brazilian Journals: A benchmark literature review

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ABSTRACT

This article aims to describe and discuss papers on scientific and technical translation published in Brazilian journals of translation and related areas such as linguistics, applied linguistics and literature from their creation up to 2013. Twenty-eight journals were investigated, and 34 papers were selected. In surveying the papers, the following aspects were identified as relevant to the study of scientific and technical translation: corpus compilation, terminology, science historiography, characteristics of scientific and technical texts and didactics. This literature review, which is designed for teachers, students and practitioners, provides one of the first examinations of scholarly articles on scientific and technical translation to be compiled in Brazil. It is intended to provide a benchmark for comparison with future developments in this field.

KEYWORDS: Brazilian journals of translation and related areas; Literature review on translation; Scientific and technical translation.

1. Introduction

Due to the internationalization of many products, services and information, increased attention has been given to theory, practice and research in translation, and this fact inevitably has implications for the training and work of translators.

According to the data published by the Ministry of Education,[1] 16 institutions in Brazil offer undergraduate translation programs, providing Brazilian students with different kinds of courses, aiming to prepare them for the international market and the language industry. In these institutions, translation is often taught in the area of Humanities, sharing courses with other programs, especially Linguistics, Literature and Language Teaching.

[1] Available on its website: < emec.mec.gov.br > accessed 22 September 2014.

In general, the translation curricula of these institutions include courses on theories of translation, languages, literature, culture, and technical and technological procedures for translators. Within these courses, students deal with different textual genres and types such as journalistic, literary, legal, audiovisual, and scientific and technical texts.

In relation to translator training, one of the most common worries, not only in Brazil but also abroad, has been dealing with scientific and technical translation, whose main characteristics include specialized language, and especially because 90% of what circulates in the language industry involves specialized communication.

For instance, in the scientific field, translators have to translate academic papers, theses, dissertations, and so forth. In Brazil, ABNT, the Brazilian Association of Technical Norms, requires that all research publications must have their abstracts translated into at least one foreign language, and most of the time these research abstracts are translated into English.

For Tebble (1999) and Cambridge (1999), inadequate use of scientific and technical language can compromise scientific practices themselves. In order to ensure that it is accurate and reliable, a translation may be the product of an adaptation process or terminological popularization, depending on the communication media for which the text is designed.

In a similar manner to Tebble (ibid.) and Cambridge (ibid.) in the 1990s, Montalt and Davies (2007) have recently claimed that, in addition to a knowledge of specific terminology, the translation of scientific and technical texts also requires knowledge of the communication and diffusion of different specialized disciplines, such as anthropology, psychology, sociology, law, among others.

These authors claim that factual comprehension is the key element in any translation, because it is relevant for both source and target language readers. However, this is a priority in the understanding of scientific and technical texts which must be taken into account. For the authors cited, the main focus of literary translators is style, rhythm, cultural references, puns, etc. On the other hand, the main focus of scientific and technical translators is factual and terminological accuracy (Montalt and Davies, 2007: 20).

Traditionally speaking, the teaching and learning processes for scientific and technical translation have been restricted to the study of terminological transfer, especially with the use of translation memory systems, whose segmentation may lead the translator to focus on segments (isolated sentences) and vocabulary, instead of the whole context of the communicative situation (Bowker, 2005).

Researchers are also concerned about the way translators are trained, revealing that most teachers use subjective or anecdotal experiences when teaching specialized translation. According to the authors, the scientific and technical translation classes or even the teaching of the translation of other genres and types of texts, typically involve decontextualized texts and materials which were probably translated by the teachers in their careers, serving as a master piece for the training of the translation student (Azenha, 1999; Darin, 2001; Colina, 2003; Gonçalves, 2006; Byrne, 2006).

The above arguments and worries give an indication of the need to explore the topic of scientific and technical translation, its practice, teaching, and the theoretical assumptions surrounding it.

The purpose of this paper is to present and discuss a literature review focusing on scientific and technical translation, integrating what authors have been researching on this topic. Our goal is to search for current trends in the study of scientific and technical translation, in an attempt to shed some light on what has been published on the topic in Brazilian journals of translation and/or in journals of other areas related to the translation field.

2. Addressing Methodological Procedures

This literature review uses as primary source all the Brazilian journals of translation and related areas such as linguistics, applied linguistics, or literature with the goal of identifying the underlying theories and concepts under discussion in the context of scientific and technical translation.

The published papers on the theme of scientific and technical translation are studied quantitatively and descriptively. The quantitative perspective specifies the number of papers

published on this topic, and the descriptive perspective identifies current trends in the study of scientific and technical translation.

In reviewing the literature, three specific objectives were formulated: 1) to include all the journals dedicated to translation studies or related disciplines in Brazil, such as linguistics, applied linguistics and literature, selecting the ones which present a special issue on translation; 2) to identify papers on the topic of scientific and technical translation*;* 3) to explore current trends in the study of scientific and technical translation by surveying the papers. Further explanation on how exactly the journals were included in this paper can be found in the next section.

According to Chesterman and Williams (2002: 59), one reason why a literature review is important is that concepts drive action, that is, what we think about scientific and technical translation, how we define it, how our concepts concerning this type of translation influence what we do, how we continue studying the topic, and how we teach our students to translate texts with specialized language.

2.1. The journals and the papers

As our discussion will show, journals are a particularly important type of literature provided they are up to date with the latest research. The journals selected for this literature review were found using the data available at Qualis/CAPES website[2] (Coordination for the Improvement of Higher Education Personnel of the Brazilian Ministry of Education). Trying to refine our study, we collected from Qualis/CAPES on-line database all of the journals in the areas of Translation, Linguistics, Applied Linguistics, or Literature.

Searching through the Qualis/CAPES database, we noticed that one Brazilian journal in the translation field was missing, probably because it had not been indexed or cataloged yet. Considering its relevance to translation in Brazil, we included it, accessing its website in Google Scholar. This is the case of "PROFT em Revista", for example, a journal organized by professional translators in Brazil.

[2] Available on its website: <http://qualis.capes.gov.br/webqualis/publico/pesquisaPublicaClassificacao.seam> accessed 22 September 2014.

Twenty-eight Brazilian journals were found, including 14 specifically on Translation Studies, as listed in Table 1, and 14 others on Linguistics, Applied Linguistics, and Literature in general, presenting a special or thematic issue on translation.

Table 1: Fourteen Journals of Translation Studies, their titles, institution, and year of creation

Journal	Institution / Year of creation
Belas Infieis	UnB (2012) (University of Brasilia)
Cadernos de Literatura emTradução	USP (1997) (University of São Paulo)
Cadernos de Tradução	UFSC (1996) (Federal University of Santa Catarina)
Cadernos de Tradução	UFRGS (1998) (Federal University of Rio Grande do Sul)
In-Traduções	UFSC (2009) (Federal University of Santa Catarina)
Revista Brasileira de Tradução Visual	UFPE (2009) (Federal University of Pernambuco)
N.T. (Nota do Tradutor) - Revista Literária em Tradução	Organized by professional translators (2010)
Rónai: Revista de estudos clássicos e tradutórios	UFJF (2013) (Federal University of Juiz de Fora)
ScientiaTraductionis	UFSC (2005) (Federal University of Santa Catarina)
TradTerm	USP (1994) (University of São Paulo)
Tradução e Comunicação	Centro Universitário Anhanguera de São Paulo (Anhanguera Educational Center) (old name Centro Universitário Ibero-Americano /Unibero) (1981-1986; 2000)
Tradução em Revista	PUC-Rio (2004) (Pontifical Catholic University of Rio de Janeiro)
Traduzires	UnB (2012) (University of Brasilia)
Translatio	UFRGS (2011) (Federal University of Rio Grande do Sul)

Table 2 names the journals of Linguistics, Applied Linguistics and Literature, the institution to which they belong and year of creation. As mentioned, they were selected because they present a thematic or special issue on translation. In parenthesis, it is possible to identify the title given to the thematic issue on translation or other relevant information.

Table 2 Fourteen journals of Linguistics, Applied Linguistics and Literature with a special issue on translation

Journal	Institution / Year of creation
Aletria	PosLit/UFMG, v. 22, n. 1, jan-abr. 2012 (O cânone da literatura traduzida no Brasil) (Best-translated literature in Brazil – Federal University of Minas Gerais)
Cerrados	UNB, 1992 (Thematic issues on translation – University of Brasília)
EstudosAvançados	USP, ano 26, vol. 76, USP, 2012 (Dossiê Tradução Literária) (Literary Translation Dossier – University of São Paulo)
Graphos	UFPB, v. 11, 2010 (Dossiê Cultura e Tradução: abordagens e perspectivas teórico-críticas) (Culture and Translation Dossier: theoretical-critical approaches and perspectives – Federal University of Paraíba)
Ipotesi	UFJF, v. 13, 2009 (O Brasil e seus tradutores) (Brazil and its translators – Federal University of Juiz de Fora)
Letras	UFSM, v. 8, 1994 (Tradução) (Translation – Federal University of Santa Maria)
Letras	UFPR, 2011 (It presents papers on translation from 1966 to 2010 – Federal University of Paraná)
PROFT em Revista	Organized by professional translators, 2011
Rascunho	Translato (2010)
Remate de Males	Unicamp, v. 4, 1984 (Território da tradução) (Translation Territory – State University of Campinas)
Revista Brasileira de Literatura Comparada	ABRALIC, v. 19, 2011 (Poesia e tradução: relações em questão) (Poetry and translation: relations into questions – Brazilian Association of Compared Literature)
Revista de Letras	UNESP, v. 49, 2009 (Tradução) (Translation – State University of São Paulo)
Revista Horizontes de Linguística Aplicada	UnB, v. 8, 2009 (Tradução no ensino de línguas) (Translation and Language Teaching – University of Brasília)
Trabalhos em Linguística Aplicada	Unicamp, v. 50, 2011 (Tradução) (Translation – State University of Campinas)

Thirty-four papers on the topic of scientific and technical translation were identified in the journals. In order to develop this research, a corpus with summaries of the three journals was compiled, containing all the titles of the papers from their tables of contents. A manual counting of each issue and the organization of these numbers on an Excel table led to the total of 34 papers. The papers were selected with reference to whether their titles and abstract included the

words "technology", "technical", "science", "scientific", "medicine", "medical", "specialized", and their variations in English and in Portuguese (plural and masculine/feminine, as required for Portuguese). Searching for key words in the titles and abstracts is justified because this is how authors flag the significant content of their articles and how readers decide on which papers to read.

Table 3 summarizes the information about the selected papers chronologically: the title of the journal in which the paper was published, year of publication, author and the title of the paper. Key words in the title of the papers appear in bold in the fourth column below in order to highlight our selection method.

Table 3 – Thirty-four papers on scientific and technical translation

Journal	Year/vol./nº	Author	Title
1. TradTerm	1995, v.2	P.M.R. Gomes	A vulgarização de um vocabulário **científico** (The vulgarization of a **scientific** vocabulary)
2. TradTerm	1996, v. 3	J.C. Boulanger	Les dictionnaires généraux monolingues, une voie royale pour les **technolectes** (Monolingual general dictionaries, an authentic way for **technolects**)
3. Cadernos de Tradução	1996, v.1, n.1	J.Azenha Jr	Tradução **técnica**, condicionantes culturais e os limites da responsabilidade do tradutor (**Technical** Translation, cultural conditions and the limits of the translator's responsibilities)
4. Cadernos de Tradução	1997, v. 1, n. 2	R. J. Vieira	The translation of **scientific** and **technical** texts - a brief analysis
5. Cadernos de Tradução	1999, v.1, n.4	M. S. Muñoz, J. S.Munõz	La percepción de las características del texto **científico-técnico** por los alumnos de traducción: un estudio de casos (The perception of the characteristics of **scientific-technical** texts by translation students: a case study)

6. TradTerm	2000, v. 6	R. S. Valente	Pode-se considerar o verbo uma unidade lexical **especializada**? Descrição de verbos especializados do português (Is it possible to consider verbs as a specialized lexicon? Describing **specialized** verbs in Portuguese)
7. TradTerm	2001, v.7	F. H. Aubert	Tradução **técnico-científica** e terminologia: um ensaio exploratório de uma via de mão dupla (**Scientific and technical** translation and terminology: an exploratory study of a two-way road)
8. Tradução & Comunicação	2001, n 10	D. C. Camargo	Estudos tradutológicos baseados em corpus de textos **técnicos**, corporativos e jornalísticos (Corpus-based translation research of **technical**, corporate and journalistic translations)
9. Tradução & Comunicação	2002, n. 11	V.Soler (not available online)	Aportes de la perspectiva sistémico-funcional en la formación del traductor **científico** (Contributions of functional-systemic perspective in the training of the **scientific** translator)
10. TradTerm	2002, v. 8	R. C. G. Braga	Valor da cooperação **técnica** para a produção de documentos terminológicos (**Technical** cooperation value for the production of terminology documents)
11. TradTerm	2002, v.8	S. Tarp	Propuestas para la traducción **especializada** mediante un sitio web (Proposals for the **specialized** translation by a web site)
12. TradTerm	2002, v. 8	C. R. Bevilacqua	Terminologia mono/bi/multilingue: algumas propostas e reflexões referentes às unidades fraseológicas **especializadas** (Mono/Bi/Multilingual Terminology: proposals and reflexions on the **specialized** phraseologisms)
13. Cadernos de Tradução	2002	B. Maia	Do-it-yourself, disposable, **specialised** mini corpora – where next? Reflections on teaching translation and terminology through corpora.

14. Cadernos de Tradução	2003, v. 2, n. 12	M. S. Muñoz, J. S. Muñoz, V. C. Trejo	Propuesta de una unidad didáctica de traducción **científico-técnica** dirigida a alumnos universitarios (Proposing a didactic unit of **scientific-technical** translation for undergraduate students)
15. Tradução & Comunicação	2003, n. 12	D. C. Camargo	An analysis in electronic format of a parallel corpus of journalistic and **technical** texts
16. TradTerm	2004, v. 10	S.Tagnin, E. D. Teixeira	Linguística de Corpus e Tradução **Técnica**: relato da montagem de um corpus multivarietal de culinária (Corpus Linguistics and **Technical** Translation: reporting the organization of a multivaried corpus of cooking)
17. Cadernos de Tradução	2004, v. 2, n. 14	G.C.B. Ribeiro	Tradução **técnica**, terminologia e linguística de corpus: a ferramenta Wordsmith Tools. (**Technical** translation, terminology and corpus linguistics: the WordSmith Tools)
18. TradTerm	2005, v. 11	L. A. Barros	O discurso terminográfico na obra *De **Medicina** Brasiliensi* (1648), de Guilherme Piso (The terminographic discourse in the work *De **Medicina** Brasiliensi* (1648) of Guilherme Piso)
19. TradTerm	2005, v.11	C. R. Bevilacqua	Unidades fraseológicas **especializadas**: estado da questão em relação à sua definição, denominação e critérios de seleção (**Specialized** phraseological units: the state-of-the-art in relation to its definition, naming and criteria of selection)
20. TradTerm	2006, v. 12	S. Foley	Tradução e **Ciência** – algumas considerações (Translation and **Science** – some considerations)
21. TradTerm	2006, v.12	D. C. de Camargo	Tradução de textos de áreas **especializadas** e a presença de traços de normalização (Translation of **specialized** areas and the presence of normalization)
22. TradTerm	2006, v.12	V.Possamai	Marcadores textuais de textos **especializados** em tradução (Textual markers in **specialized** texts of the translation area)
23. Tradução & Comunicação	2007, n. 16	V.Soler	Simbiosis de lo linguístico y lo no-linguístico en la formación del traductor

			científico (Linguistic and non-linguistic symbiosis in the training of the **scientific** translator)
24. Cadernos de Tradução	2007, v. 2, n. 20	P. T. P.Paiva	Estudo de traços de simplificação e explicitação em artigos **científicos** de anestesiologia (Studying characteristics of simplification and explicitation on **scientific** papers in the field of anesthesiology)
25. Tradução & Comunicação	2007, v. 16	V. A. C. de C. Figueiredo	A dimensão pragmática da tradução no ensino-aprendizagem da língua estrangeira **especializada** (The pragmatic dimension of translation in the teaching and learning of foreign language in **specialized** fields)
26. Tradução & Comunicação	2009, n. 19	S. A.Polchlopek, M. de A.Aio	Tradução **técnica**: armadilhas e desafios (**Technical** translation: snares and challenges)
27. TradTerm	2009, v.15	E. D. Teixeira	Especificidades da tradução **técnica** de receitas – alguns problemas e possíveis soluções (Specialties in the **technical** translation of recipes – some problems and possible solutions)
28. TradTerm	2010, v.16	M. S. Santiago	Variação denominativa na terminologia **médica**: o caso da gripe A H1N1 (Denominative variation in **medical** terminology: the case of Influenza A H1N1)
29. Tradução em Revista	2010, v.8	A. R. De O. Harden	Manoel Jacinto Nogueira da Gama: **ciência** e tradução no final do século XVIII (Manoel Jacinto Nogueira da Gama: **science** and translation at the end of the eighteenth century)
30. Tradução em Revista	2010, v. 8	C. C. Rodrigues	O papel da tradução na pesquisa **científica** brasileira: primeiros movimentos (The role of translation in Brazilian **scientific** research: first events)
31. Cadernos de Tradução	2011, v.1, n 27	A.Galán-Mañas	Design da semipresencialidade na formação de tradutores **técnico-científicos**, do português ao espanhol. (Design of autonomous work in the training of the **scientific and technical translator** from Portuguese into Spanish)

32. Cadernos de Tradução	2011, v. 1, n. 27	C. C. Rodríguez	La alineación de un corpus paralelo multilingüe: propuesta de fases para la didáctica de traducción **especializada** inversa. (The alignment of a multilingual parallel corpus: proposing steps for the didactics of **specialized** translation into a second language)
33. TradTerm	2012, v. 20	L. Zilio	Colocações **especializadas** em alemão e português na área de Cardiologia (**Specialized** collocations in German and Portuguese in the field of cardiology)
34. TradTerm	2013, v.21	L. M. R. Esteves	**Ciência** em tradução: uma visão panorâmica (**Science** in Translation: an overview)

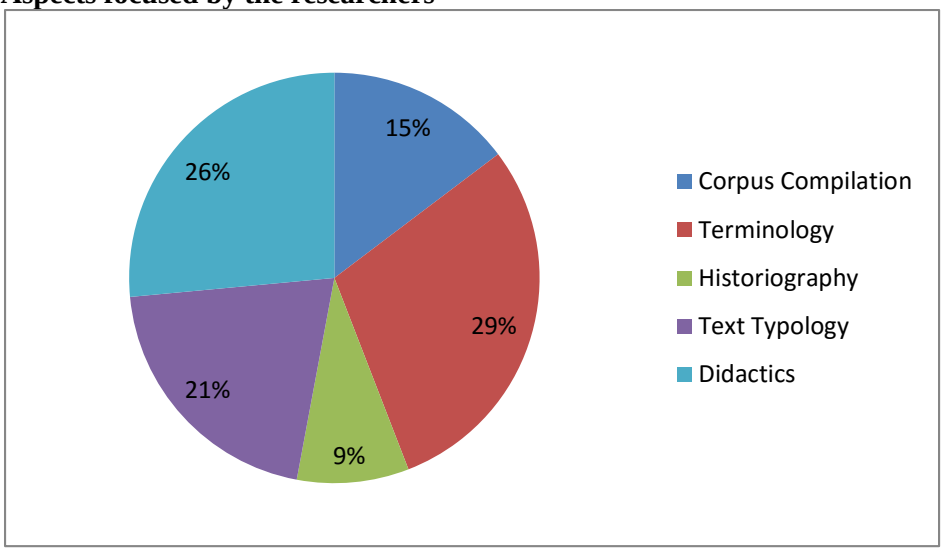
Even though 14 journals in the fields of Linguistics, Applied Linguistics and Literature present special or thematic issues on translation, only the journals on translation (Table 1) published papers on the topic of scientific and technical translation: Tradterm (17 papers), Cadernos de Tradução (9 papers), Tradução & Comunicação (6 papers), and Tradução em Revista (2 papers).

3. Results and Discussion

As presented in Table 3, we found 34 articles dealing specifically with scientific and technical translation. Twenty-five were written in Portuguese, six in Spanish, one in French and two in English.

Examining the corpus, it was possible to identify that the authors focused their discussions on five prominent aspects, relating their investigations of scientific and technical translation to: Corpus Linguistics, Terminology, Historiography, Text Typology, and to the Didactics of specialized translation. Graph 1 shows the aspects chosen by the authors to discuss scientific and technical translation.

Graph 1 – Aspects focused by the researchers



Papers with the same or similar focus were grouped together. For the sake of conciseness, these aspects will be summarized and discussed below, and, when appropriate, some papers will be cited or generally mentioned with the purpose of illustrating the chosen aspect.

3.1 Translating Scientific and Technical Texts: The corpus compilation aspect

Based on the selected corpus, five papers deal with the importance of corpus compilation and the search for original and translated text patterns in order to better translate scientific and technical texts (Camargo, 2001; 2003; Tagnin & Teixeira, 2004; Ribeiro, 2004; Paiva, 2007).

For these authors, Corpus Linguistics demonstrates its efficacy as a methodology. In the words of Tagnin & Teixeira (2004: 313): "Corpus Linguistics, as a methodology, has been shown to be extremely valuable for Technical Translation, both for translation practice and terminological research." Motivated by the ever-growing number of European Portuguese cookbooks sold in Brazil, they constructed a multivariant corpus of cooking recipes in Brazilian and European Portuguese and American and British English. The authors concluded that:

> The investigation of our corpus has revealed that the lexical, syntactic and cultural differences between the Portuguese variants are more expressive than those between the English variants. We claim that this would justify Brazilian translations of these books and terminological reference works which make these differences explicit. (2004: 314)

Tagnin & Teixeira (2004) and the other authors report on the importance of syntactic and cultural differences between languages which can be provided when the translator decides to use a corpus compilation approach, establishing contact through statistics with linguistic differences or similarities.

Using WordSmith Tools or other similar software, the authors present lexical and grammatical property trends using parallel corpora.

For example, in the paper titled *Estudo de traços de simplificação e explicitação em artigos científicos de anestesiologia* (Studying characteristics of simplification and explicitation on anesthesiology papers), Paiva (2007) examines aspects of simplification and explicitation presented in anesthesiology papers translated from Brazilian Portuguese into English. According to the author, the main difficulty which arises in the translation of scientific and technical texts is the lack of information about the trends followed by translators, i.e., how professional translators deal with medical terminology.

Paiva (ibid.) reports on corpus-based research with a descriptive-comparative approach, in which 15 parallel texts in the pair of languages Brazilian Portuguese-English were selected and analyzed. The author concludes that the translations of scientific and technical texts present more simplification characteristics (use of shorter sentences in the translation through punctuation change) compared to explicitation (use of expressions like *reason, due to, lead to, because of, therefore, consequently*, etc., which tends to explain implicit information present in the original), claiming that those data can contribute to the translator's work and should always guide scientific and technical translation practices.

3.2 Translating Scientific and Technical Texts: the terminological management aspect

Ten papers focus on the relationship between terminology and scientific and technical translation (Gomes, 1995; Boulanger, 1996; Valente, 2000; Aubert, 2001; Braga, 2002; Bevilacqua, 2002, 2005; Barros, 2005; Santiago, 2010; Zilio, 2012).

In general, these authors state that the translation practice for scientific and technical texts may induce impromptu discourse or mistranslations, resulting in uncontrolled expansion of synonyms (exaggerated use of synonyms), discrepancies between institutional dialects, crystallization of some lexical items, morphosyntax, and structures.

According to them, scientific and technical translations may become idiomatically unsatisfactory and that is why translators should use the contributions of terminological studies.

Aubert (2001), for example, claims that:

> […] it raises again the perception that terminology and terminography present a great contribution to the translation practice. Although the materials that represent this contribution require strong growth, especially in the case of Brazilian Portuguese, the consensus is that terminology and terminography constitute important auxiliary instruments to translation. This relationship between terminology and translation is positive. (Aubert 2001:44, our translation)

For Aubert (2001), and also for the other authors who relate scientific and technical translation to terminological studies, professional scientific and technical translators have become the most interested users of different terminological resources, including monolingual materials, especially with the purpose of avoiding terminological variation.

In the four-part-paper titled *Variação denominative na terminologia médica: o caso da gripe A H1N1* (Denominative variation in the medical terminology: the case of Influenza A H1N1), Santiago (2010) shows the process of terminological genesis and how the proliferation of new terms takes place. As evidence of the relation between terminology and medicine, the author states that the variation of a single term (in this case *Gripe A H1N1*, which has been receiving different names over the years, such as *Spanish Influenza, Avian Influenza, Swine Influenza, Influenza A, New Influenza*) can lead to difficulties in the communication of scientific discourse. According to Santiago (ibid.), professionals who deal with scientific and technical translation should pay attention to the social-discursive and institutional forces which may influence the denominative variation terms, making them change from specialized to ordinary language.

The studies which focus on the relationship between scientific and technical translation and terminology seem to alert translators to the importance of multi-word terms, such as in the example "avian influenza" given by Santiago (ibid.), for more satisfactory translation results or products.

3.3 Translating Scientific and Technical Texts: the historiography aspect

Three articles show the contribution of translation practice during the course of history to the evolution of Brazilian science.

The authors affirm that translation contributes to the production and diffusion of science. However, no effort has been made to reveal how translation benefits the evolution of science in Brazil (Esteves, 2013; Harden, 2010; Rodrigues, 2010).

The three authors examine the contributions of Brazilian translators who, at the turn of 19th century, translated important scientific documents and treatises into Brazilian Portuguese. They mention that this was a period when translators used innovative translation strategies, such as the use of neologism, to translate scientific and technical texts and to enrich the local language and science.

3.4 Translating Scientific and Technical Texts: the aspect of text typology

Seven papers reflect on the characteristics of scientific and technical texts and their translations (Azenha, 1996; Vieira, 1997; Camargo, 2006; Foley, 2006; Possamai, 2006; Polchlopek & Aio, 2009; Teixeira, 2009).

The authors claim that the difficulties in translating this sort of text reside not only in terminology, conventionally and culturally marked linguistic systems and properties, but also in the text typology.

The authors suggest that trainers of the scientific and technical translator need to consider many variables in the translation of scientific and technical texts other than terminology, showing students that this is a complex process in terms of how the text structure reveals cultural issues and the way a community expresses its scientific and technical ideas.

Azenha (1996: 142), for example, bases his work on an analysis of Reiss and Snell-Hornby's models of text typology to conclude that a scientific and technical text written in German has greater presence of nominalizations regulating the format and content of the texts, compared to its Brazilian Portuguese translation, which not only has greater use of adverbs and attributes modifying the subject in an indefinite way, but also presents inaccurate terminology and grammar structures.

The authors argue that scientific and technical translation problems have their start point in the translators' lack of knowledge concerning the special characteristics of this sort of text, which require different translation procedures.

According to Vieira (1997), translators should aim for uniformity of verbs and structures, especially when dealing with scientific and technical texts:

> [...]The role of the translator is not to perform a literal translation, but to choose the most adequate words from the ST to the TT and to be consistent with these choices. She or he has to be aware of how the choice of those words will influence the reader's inference process. Consequently, the general comprehension and use of a scientific-technical text may be positively or negatively affected. (Vieira 1997:441-442).

3.5 Translating Scientific and Technical Texts: the didactic aspect

Nine papers were found on the relationship between scientific and technical translation and its teaching and learning aspects, bringing didactic procedures into perspective. The following papers deal with how to approach scientific and technical texts in class (Muñoz & Muñoz, 1999; Soler, 2002; Maia, 2002; Tarp, 2002; Muñoz et. al. 2003; Soler, 2007; Figueiredo, 2007; Galán-Mañas, 2011; Rodriguez, 2011).

From those nine papers, one was discarded since its purpose is to discuss how to teach specialized translation to language students, especially in English for Specific Purposes (ESP) courses. This paper highlights the importance of the use of translation as an auxiliary pedagogical method in the teaching and learning of foreign languages (Figueiredo, 2007). The paper does not discuss any implications for the translation field itself.

Generally speaking, the other eight papers argue that students of translation, whose training is usually given in the area of Humanities, are unfamiliar with specialized, scientific and technical language. In view of this consideration and according to the authors, scientific and technical translation courses must approach:

- a varied range of possible receptors of the scientific and technical discourse which involves different genres, among them the highly specialized discourse (highly and semi-specialized), scientific diffusion discourse and scientific pedagogical discourse (pedagogical discourse of science);
- difficulties in relation to monolingualism (prevalence of English in the market place) and its conventions, dealing with the lack of equivalences, standard conventions, and problems with the specialized language that depicts scientific and technical content;
- non-linguistic difficulties that affect the translator's work, such as limited interaction between scientists and translators, place of work, daily routine, deadline for text delivery;
- new technologies, documentation and collaborative work that will make teachers avoid choosing texts to be used in the translation classroom randomly. It rather helps teachers to think about the progress of the activities, considering the difficulties of the taught content;
- the importance of the alignment of multilingual parallel corpora for scientific and technical classes, showing students that this is the most important process before managing successfully all the texts contained in a multilingual parallel corpus; the purpose must be to extract all the benefits from the contrastive analysis of translations into another language. This preliminary task will help students of translation, and future professional translators to assess the quality of the translations and to become active participants in the learning process.

From our analysis of the papers, we conclude that they mention aspects which make the translation of scientific and technical texts a complex task for students. Firstly, it is advisable for students to identify the difficulties these texts present, to understand their content and detect the most common problems they bring. Secondly, with these tasks at hand, the translator can solve comprehension or cultural problems using external resources such as dictionaries, encyclopedias, terminological banks, web search, and parallel texts. Thirdly, students can turn to the collaboration of subject matter experts who can be useful particularly because they are ideal readers of the scientific and technical texts and their comments on the finished target text are very valuable (Montalt & Davies, 2007: 227).

Figure 1 summarizes the most common difficulties in the translation of scientific and technical texts perceived by the authors of the analyzed corpus.

Figure 1 Scientific and technical translation difficulties

Summary of the most common difficulties mentioned in the corpus
● Recognition of and access to scientific and technical documents other than dictionaries; ● Awareness of translation strategies applied to scientific and technical texts/discourse; ● Terminological variation; ● Lack of terminology studies and bidirectional/bilingual materials; ● Cultural aspects of the source and target texts; ● Problems in recognizing the intended audience; ● Linguistic and non-linguistic characteristics of scientific and technical texts; ● Objective, precise and accurate language; ● Lack of pedagogical paths for the education of scientific and technical translators; ● Recognition of the thematic field of scientific and technical texts; ● Access to terminological databases; ● Use of appropriate terms and standard conventions; and ● Knowledge of a variety of types and genres within the scientific and technical area.

In order to deal with the difficulties mentioned, the papers studied suggest the following global strategies:

Figure 2 Translation Strategies – Global perspective

Global strategies suggested in the corpus
• To search for synonyms, equivalences and etymology not only in dictionaries, but also in other documents, i.e., to use medical textbooks; • To be aware of possible translation strategies to follow when translating; • To recognize variation and to be aware of notions of style; • To have terminological knowledge; • To search for cultural aspects involved in scientific and technical translation and how they influence the audience; • To have background knowledge in scientific and technical language and its characteristics; • To know the difference between scientific and technical discourse and other kinds of discourse; • To be aware of the theme and thematic field of the scientific and technical text; • To acquire theoretical knowledge of the translation process; • To identify and manage informational sources to find out and use appropriate terms and standard conventions; and • To recognize different types and genres.

In general, to operate within the (con)text sphere (adopting global strategies) and generate reliable translations, the authors of the papers we examined also state that the translation of scientific and technical texts requires criticism, reflection and sense of word building, based on terminological and terminographic tools. Notions about the senders and receptors must be acquired by the translator, mainly because there is something in common among them, i.e., they have a common interest in a specific field and theme, although the general audience sees the specific vocabulary as semi-autonomous and with low discourse variation (Aubert, 2001: 45).

Concerning specific decisions at the level of words, expressions or structures, the authors of the investigated papers affirm that some local strategies should be adopted by translators as shown in Figure 3.

Figure 3 Translation Strategies – Local Perspective

Local strategies present in the corpus
• To use specific strategies such as omissions and additions where necessary; • Not to use literal translation, but informed choices to accomplish a functional translation; • To choose appropriate lexicon and know the word etymology; • To select varied terminology according to the audience; • To use accurate translations of scientific and technical terms; • To know about specific terms and their use in the target language; • To recognize the degree of specialization of the text and authors enabling correct term choices; • To be able to identify the importance of non-verbal codes and be able to understand them; and • To search for pertinent equivalents.

In general, to operate within the structure, idea or item sphere (local strategies), the authors of the papers whose focus was on didactic procedures, highlight that the translation of scientific and technical texts requires more than specific terminological knowledge, which will enable the translator to compare the languages involved in the translation process in order to empower their decisions and selections of terms, as shown in Figure 3.

As already mentioned, the authors focused their discussions on five prominent aspects, relating their investigations of scientific and technical translation to: Corpus Linguistics, Terminology, Historiography, Text Typology, and to the Didactics of specialized translation. Although we can consider that the aspects overlap, that is, corpus compilation should be considered as an important pre-translation didactic procedure in the scientific and technical classroom, there has been progress in the field. The data show that aspects other than terminology are relevant to the practice of scientific and technical translation.

4. Final Remarks

We concluded that in spite of the wide range of communicative situations where scientific and technical translation may be required (Montalt and Davies, 2007: 21), only 34 papers were found under the topic scientific and technical translation published in Brazilian journals of translation, since their creation in the 80s up to 2013, a period of approximately more than 30 years.

The literature studied here reveals that the majority of the authors center their discussions in terminology studies (29%) when dealing with the study of scientific and technical texts. For the authors, it is possible to affirm that terminology remains as one of the key factors in the translation of scientific and technical texts, asserting its importance (Montalt & Davies, 2007).

Other aspects related to corpus compilation (15%), historiography (9%), text typology (21%), and how to teach and learn scientific and technical texts (26%) were also studied by the authors.

Even though we still have much uncovered data to search, we hope this first literature review on scientific and technical translation published in Brazilian journals can provide a better understanding of the current conceptions on the topic in Brazil, with the purpose of leading future researchers, teachers, students and practitioners to continue seeking for emerging developments in scientific and technical translation.

The results of this literature review may also be indicative of the need of translation trainers to design ways to invite students to reflect on the importance of considering scientific and technical translation an interdisciplinary professional practice which involves management of scientific and technical knowledge, an important aspect that has not been mentioned by the authors selected for this study.

Some suggested actions deserving further analysis and research comprise a systematized study of how the collaboration of subject experts can be established (Montalt & Davies, 2007), and how the local history of science may play a role in the translator's current choices (Olohan, 2014: 10), fostering an analytical appreciation for the varieties of discursive practice, which was still modest in the data collected here (historiography: 9%).

It will be interesting to watch progress in the field over time in Brazil as more research on scientific and technical translation becomes available particularly online, and as training strategies are developed on the basis of ongoing research.

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