Teaching and Learning Scientific Translation: Problems, Challenges, and Solutions

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ARTICLE DATA	ABSTRACT
	Scientific translation is not a kind of knowledge that could be gained by practice, or by implementation of certain techniques. Therefore, teaching scientific translation does not involve the demonstration of its techniques and strategies only. However, it also involves the awareness of the requirements for this type of translation such as the expertise needed in this area, the consequences of neglecting linguistic and grammatical rules when translating scientific prose, the different barriers encountered, and the preliminary steps taken before engaging in the translation. Similarly, learners of scientific translation should not only learn the rules of scientific translation, but also be aware of the scientific translator's job which is not the mere replacement of the source lexical terms with target ones. They should be learned that the translation of scientific prose, though non-literal, should render as directly as possible the exact meaning of the original. Accordingly, this paper highlights the problems encountered when teaching and learning English-Arabic scientific translation. One of them is the students' neglecting of the grammatical rules in scientific translation, which affects their translation of other text-types and influences and other modes of translation such as subtitling. The paper also attempts to offer solutions and establish possible factors that may lead to a methodology of teaching and learning this type of translation.

1. Introduction

Egypt's National Center for Translation held this year a symposium entitled "The Egyptian Translator and Scientific Translation, highlighting the importance of translating science during the recent decades that witnessed a technology-driven revolution in life sciences. Such a revolution stimulates the demand for a high standard of competence in this field of translation. Students learning this type of translation face a big challenge in acquiring different areas of expertise which should also be provided by qualified teachers, lecturers, and professors. Therefore, teachers of scientific translation should help students produce an accurate translation of scientific texts and tell them how to find the right equivalents to scientific terms, not just tell them these equivalents. To do so, they need to acquaint students with practical methods to gain the expertise needed in a highly-quality translation project.

2. Traditional Method of Teaching Scientific Translation

Many of us remember translation classes where a text is translated sentence by sentence discussing one of the students' translation along with the teacher's comments and correction of his/her mistakes, in which case the rest of the students are asked about their

suggestions. This frequently ends up with a translation that conforms to the teacher's ideas of an adequate rendering, what s/he calls "a model translation". To tell the truth, this method of teaching is beneficial to students because the student acquires his/her teacher's knowledge as much s/he can. This method is described by Kiraly (1997) as follows:

the traditional learning environment created for the teaching of translation skills . . . essentially involves a didactic performance by the teacher, who believes that she has access to the 'correct' translation, and who goes about filling in gaps in the students' knowledge so that they can also come up with the 'correct' translation. In such a classroom, it is clearly the teacher's job to 'teach' – i.e. to pass on knowledge, and the students' job to 'learn', i.e. to absorb the teacher's knowledge.

Unfortunately, this method fails to develop strong translation competences among students. Their search skills are not developed either. In addition, students suppose that there is nothing to study and all they have to do is attend classes and write down whatever translations the instructor may propose. But above all that, many students perform the role of "parroting", that is learn by heart the translations that the instructor dictated as model translations, and urge him/her to include them in the exam. In this respect, the instructor may include just one seen translation text and two unseen texts in the exam so that s/he makes sure that students apply rules of scientific translation correctly.

The problem is compounded by the fact that some doctors tell students to rely on machine translation, and consequently do post-editing, by which means some of them make amendments to the product. I strongly advise against relying on machine translation at undergraduate level because background knowledge is neglected in favor of a reviewed product which is delivered faster by students than is if started from scratch. Post-editing is recommended when carrying out translation projects and it is a popular service in the technical field. Post-editing should be done by professional linguists who review a text which undergoes machine translation so that the final product fulfills the necessary quality criteria.

3. Steps of incorporating background knowledge in teaching of scientific translation

Gaining background knowledge on the topic is crucial. Zheng (2018) highlighted the importance of self-learning by encouraging students to do some documentary research on the translation text. However, it is the researcher's conviction that background knowledge is incorporated in teaching scientific translation by both the teacher and students. It should be acquired by both the student and the teacher who should impart such knowledge to his/her students. Scientific translation cannot be a self-study course. The teacher should put a lot of efforts in acquiring background knowledge and impart it to students before he asks them to acquire it through documentary research. This knowledge helps produce translations with fewer accuracy errors. That is why students are encouraged to read articles and acquire fundamental knowledge on the topic in both the source and target languages. By doing so they will be able to find the right equivalents to the scientific terms.

Students' understanding of the topic must be very good so that they can use the most appropriate target-language equivalents. This understanding is gained through essential and background reading on the topic and related keywords. There is no doubt that the meaning of a word in a scientific context differs from that in other contexts. Therefore, reading is necessary for an accurate translation. One example of a word whose translation differs according to the context is the Arabic lexical item كرة /kura/. It is usually translated into English as ball. However, a translation of the Arabic term كرة /kura/ as "ball" will not be acceptable if the word in a scientific text means sphere. When asked about the translation of this sentence into English النجم كرة من الغازات المتوهجة all students in my class translated كرة /kura/ as "ball". According to Raffel (1993), the translator is required to produce a comprehensible document to grapple with the lexical and syntactic features of both the source and target languages

One practical way to overcome the students' lack of expertise is to encourage them to conduct documentary research by themselves after having explained the subject matter generally to them. which will fill in the gaps in their knowledge and help

them develop their search skills and translation competence. Students familiarize themselves with the topic by means of this documentary research before engaging in the translation itself. In addition, having scientific and technical knowledge of the topic of the translation text help students to discern the right meaning of a scientific text and, consequently, produce an accurate translation. The translation of such texts requires not only linguistic knowledge but also scientific or technical knowledge of the text to be translated. There is no doubt that such knowledge is acquired by doing research using specialized articles, reference books, and surfing relevant websites.

The class is divided into groups and a set of roles is distributed appropriately withing each group, which leads to efficient collaborative work. The source text consists of about ten lines. The class which consists of thirty-nine students is divided into 8 groups. Each student in the group is responsible for translating two lines and writing a paragraph in the report. The group leader is responsible for revising the translation and achieving consistency. Consequently, students do not feel exhausted when doing the research and translation. In this respect, the teacher solves the problems that students face in the assignment at hand instead of providing them with a prepared model translation. Furthermore, the group's research effort can be directed towards producing highly readable texts and increasing their translation productivity.

The author of this research practices the following method in her teaching of scientific translation, a course unit taught as part of the undergraduate degree program in the Department of Applied Languages run by Alexandria University and affiliated to the Faculty of Arts.

First, the teacher presents, explains to students a certain scientific topic and terms pertinent to the topic under discussion, classify these terms, and tell them their equivalents orally to make sure that students are attentive. Second, students are asked to repeat these terms and their translations. Third, students are asked to do documentary research on the topic to gain some fundamental knowledge on it. By doing so, students are able to find appropriate equivalents to scientific terms in the source text. Fourth, each group presents its research findings in Arabic and English orally and answers other students' questions, before translating the material on a certain subject in class. Fifth, the group leader reads the translation done by them in class and explains their choices. The teacher highlights wrong words, sentence structure and metaconules details about translation. She also notes the students' related translation methods applicable to the translation material at the end of the class.

Finally, to encourage reflection on the translation process and to enhance their ability to engage in interpretive analysis of the data, students are required to submit a 400-word written report on the translation task using the following queries:

1. What are the main objectives of your documentary research?
2. What are the sources of information did you use in your research?
3. What are the difficulties that you encounter in the documentary research and the translation process? How did you overcome them?
4. What are main findings of your documentary research?
5. How did your research contribute to your understating of the source language and accuracy of your translation?
6. What are the skills and procedures of translation that you learn from this translation task?

4. Scientific Translation and Corpora

Consulting monolingual and bilingual dictionaries is part and parcel of the translation process, but they cannot answer all questions. Translators do not work with isolated word, but with a full text. Unfortunately, dictionaries cannot provide students with enough examples of word usage and equivalents for a certain word in a certain context. That is why consulting monolingual and parallel corpora is essential. It is essential to consult monolingual corpora because translators benefit from existing corpus-

linguistic techniques, e.g. keyword-in-context (KWIC) concordances, collocations, strings, phrases, automatic frequency counts of words and the like. More importantly, a word is limited to a certain part of speech by adding this part of speech as a tag at the end of this word as in the searches record_n or attack_n. All these features are found in a monolingual corpus such as BNC (British National Corpus) and COCA (the Corpus of Contemporary American English). Such a corpus provides a wealth of examples of the lexical item in context. In addition, more sophisticated corpus techniques, notably tools for corpus annotation, corpus maintenance and corpus query as they have been developed for monolingual corpora, have only recently started to be employed. (Lüdeling & Kytö, 2008).

Sometimes parallel corpora are regarded as comprising two types, translation corpora and comparable corpora. Occasionally, the term translation corpus is applied to a text collection of translated texts without the originals, as in Baker's Translational English Corpus. (Lüdeling & Kytö, 2008). In general, parallel corpora are essential for translation as they help translators to find translational equivalents between the source and the target language. They supply translators with information on the specific uses of lexical items as well as collocational and syntactic patterns. One of the most useful parallel corpora in scientific transition is Health Information Translation where articles on health are written in parallel in both Arabic and English.

Students are instructed to translate a text after having read certain articles, searching the parallel corpus as well as monolingual and bilingual dictionaries for the most difficult lexical items. Next, they submit a written report on the translation task. They are also asked to cite or document the articles, the corpora and dictionaries in which they found the most appropriate equivalents to the source lexical items. Furthermore, concordance-based learning of scientific vocabulary can also help learners expand their vocabulary and use the

language more idiomatically. The following figures show BNC and COCA concordance lines for "early pregnancy":

Figure 1 Some of the records produced by the monolingual corpus BNC for the query "early pregnancy"

Figure 2 Some of the records produced by the monolingual corpus BNC for the query "early pregnancy"

Figure 3 a record produced by the parallel corpus Health Information Translations for the query "early pregnancy"

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5. Correctness and Clarity

According to Park (as cited in S.Wright and L.Wright 1993), the ability to use the specialized language is an important measure of knowledge of the field. The writer and the translator must be always careful to be precise and knowledgeable. One error in terminology can discredit the whole text. Accordingly, mistakes in the translation of scientific and technical terms are different from these in general words and phrases. Since the students' language and translation skills affect the overall product, grammatical and terminological mistakes are checked. However, each type of mistakes is checked separately to stress the great importance of specialized terminology which is the main feature of scientific texts. Since no omissions or additions should be made in the translation of scientific texts, the TTs are checked for errors, major omission or addition of specialized terms.

If the syntactic and lexical features of the source and target languages differ, clarity often requires that the sentences in the target language be completely reformulated. (Herman, 1993). For example, infixing languages such as Arabic has long chunks of paragraphs, sentences or clauses, with many referents and pronouns and keep the overall meaning clear, while English needs rechunking and more clarity. Furthermore, denominalization is a procedure often used when translating from Arabic into English due to the syntactic differences between the two languages. A case in point is the following Arabic sentence:

سبق أن علمنا أن النجوم كرات ضخمة من الغاز المتوهج، أي أنها تنتمي إلى النوع العام نفسه الذي ينتمي إليه الشمس. فإذا تأملنا مدى زيادة سطوع الشمس حتى عن أشد النجوم سطوعًا، استطعنا أن نتوصل إلى نتيجة طبيعية وصحيحة وهي أن النجوم تبعد عن الأرض مسافة تزيد عدة مرات على بعد الشمس عنها.

A literal translation into English which is done by a student is as follows:

We already know that stars are huge balls of glowing gas, which means that they belong to the same general criteria as the Sun. If we contemplate the extent to which the Sun's brightness is increasing even from the brightest stars, we can come to the natural and correct conclusion that the stars are several times as far away from Earth as the Sun.

Due to the grammatical and terminological mistakes, this translation needs more work on the part of the translator not just looking up words in a dictionary. Based on these mistakes, background knowledge on the topic is a must. The translator had to decide that كرة usually translated as "ball", here means "sphere", that متوهج is better rendered here by the more specific word

"incandescent", that علمنا usually translated as "know" is better translated here as "learned", that نتيجة is better denominalized and rendered as "conclude" not "conclusion", and that تأمل usually translated as "contemplate" is better rendered as "observe". All these modifications are made due to the specificity of the text. In addition, the present simple tense in the first sentence must be replaced with the present perfect.

We have already learned that stars are massive spheres of incandescent gas, that is, they are classified under the same general type as the sun. If we observe the extent to which the sun is brighter than even the brightest stars, we will reasonably and correctly conclude that the stars are many times more distant from the earth than the sun is.

Now the text is scientifically and grammatically correct, but it is not literal at all. Translations of this type, which is meant to be read on their own, without access to the original, cannot be literal in a word-for-sense. (Herman, 1993). The word زيادة is left out completely in addition to dividing the Arabic sentence into two English sentences. Since it is not appropriate syntactically and stylistically, it should be eliminated. Also, the repeated verb "تنتمي'' is used once in English for syntactic and stylistic reasons. The first condition of if should be used although the Arabic verb is used in the past. More strikingly, most students used the second condition, which is totally incorrect. Such mistakes draw attention to the linguistic preparation in the training of scientific and technical translators and interpreters.

6. Linguistic and Scientific Preparation in the teaching of Scientific and Technical translators

Students that are proficient in one foreign language may have deficiency in their mother tongue. It is a frequent complaint that translation students have insufficient command of their own native language. Since they do not have sufficient command of their own native language, they have most probably insufficient command of the foreign language. Nord (2005) argued that if translation is taught too early, that is before the students have reached a sufficient command of language and culture, translation classes will degenerate into language acquisition classes without the students – or the teachers – even realizing it. This is something that I realized when I found myself teaching students basic linguistic Arabic rules in my translation classes. Therefore, students must take language tests that consist of essay and grammar questions. Not only should they get high grades in Arabic and English, but they should be also tested before enrolling in the translation section. Their Arabic and English proficiency should be tested at entrance. Such tests determine whether students are qualified enough to enroll in the translation program and will keep translation classes from degenerating into language ones. Examples of students' fatal mistakes and their failure to convey the right content, which necessitates the linguistic preparation, are as follows:

At Time of Examination

1-Both Kidneys are unremarkable showing no stones or backpressure.

2-The urinary bladder is partially filled with no detectable stone or mass.

فى وقت الفحص

كلا الكليتين غير ملحوظتين ولا تظهر أى حصوات أو ضغط خلفى

تمتلىء المثانة البولية جزئيًا بحصوة أو كتلة غير مكتشفة.

This student and many others delivered a completely incorrect content. Their translation does not convey the right meaning and contains a lot of linguistic mistakes. First, *kila* is used instead of *kilta*, which means 'both' feminine in Arabic. The adjective "unremarkable" here means that both kidneys do not have any disease, but students changed the meaning altogether. Moreover, there is no stone in the bladder, but the student wrote the opposite in the aforementioned translation. Also, no collocations are

used, and the overall translation reads like a translation. It does not sound natural and lacks fluency as is the case with "كتلة غير مكتشفة". Language students are not supposed to make such mistakes, that is why the linguistic preparation is a must.

A readable translation of the source text is as follows:

كلتا الكليتين سليمتان ولا يوجد أي حصوة أو ضغط عكسي.

المثانة ممتلئة جزئيًا ولا يوجد بها حصوات أو أي كتلة ظاهرة.

Traditionally, some translation scholars believe that translation cannot be a collaborative process between translators and specialists. They believe that a trained translator who has a degree in translation can translate any type of text, and do special language translation by himself/herself without the help of any specialist and without the need for scientific preparation. On the other hand, translation and interpreting companies select candidates proficient in at least one foreign language and teach them techniques for specialized translation such as medical, technical, scientific translation after subjecting them to evaluation exams in all languages and all fields.

However, some scientific fields require preparation, without which translation will be inaccurate. Accordingly, the European Common Market Translation Center in Luxembourg began hiring bilingual technicians instead of graduates from translation schools whose performance was not adequate. (Niedzielski &Chernovaty,1993). In addition, very few theoreticians have agreed to the view that bilingual technicians can translate texts better than such graduates.

Several translation theoreticians and translator trainers have recently tried to resolve the dilemma over linguistic or technical priority by combining the teaching of both sets of skills from the very beginning in LSP (language for special purposes) courses. Such courses may begin with a common general scientific or technical trunk and break down into more narrowly specialized fields. By doing so, translation students will gain the expertise needed to translate more narrowly defined arenas (medicine, law, finance).

7. A Brief Discussion on Medical Translation

Snell-Hornby (1988/1995) categorized science/technology and medicine under special language translation. In other words, medicine is not categorized under scientific translation according to her. She states that the main fare of the modern professional translator, in the training institutes the major areas are law, economics, medicine, science and technology. Unlike the classification proposed by Snell-Hornby 1988/1995), technical texts are viewed here in their broadest pragmatic definition and include any text that contains some elements of technical or specialized information. (Niedzielski &Chernovaty,1993).

Part of the medical translation syllabus that I taught during scientific translation is related to consecutive interpreting because healthcare is not restricted to written documents only. Students should be accustomed to medical interpreting and get familiar with all market needs, both translation and interpreting. In response to the pandemic, there has been a massive demand for telehealth systems usage, making telephonic interpretating and video remote interpretating (VRI) which is crucial in cases where a language barrier exists.

Every type of translation is challenging without doubt, but when it comes to healthcare and medical translation, it is rather a bit extra difficult. Medical terminology rests firmly on the twin pillars of Latin and Greek, which may account for this difficulty. According to Fischbach (1993), medical terminology in both microscopic and macroscopic terms continues to be coined with Greco-Latin prefixes and suffixes. When teaching such medical terminology, students should learn how the medical term is built. Learning medical terms is like learning a new language and the best approach is to study the various morphemes and know how to analyze them. Prefixes and suffixes modify the word root. Combining vowels are placed between word morphemes to make the term easy to pronounce. In most cases the combining vowel is an O but it can also be an I or A. It is placed between two roots

or between a word root and a suffix that begins with a consonant. The following table illustrates prefixes and the combining vowel O:

Latin Root	English Equivalent
Cardi/o	Heart
Enter	Intestine
Gastr/o	Stomach
Dermat/o	Skin
Nephr/o	Kidney
Hepat	Liver
Hemat/o	Blood
Pulmon/o	Lung
Path/o	Disease
Ot/o	Ear
Gynec/o	Female

Illustrating the Latin roots, prefixes and suffixes with tables helps students to overcome the difficulty of medical terminology. Students learn these roots and prefixes and listen to examples said by the lecturer and researcher orally so that they can translate any term not mentioned in the lecture by themselves. If they learn and understand these roots, prefixes and suffixes, they will be able to breakdown any term in the quiz given to them. For instance, the medical term "bradycardia" consists of the Latin prefix which means "slow" and the Latin root "cardia" which means "heart". Therefore, it is easily translated as "بطء القلب" The following table illustrates prefixes with combining vowels:

Combining Form	Definition
A Or An- (Anuria)	Without
Auto- (Autoinfection)	Self
Hypo- (Hyposmia)	Insufficient or low
Hyper- (Hypertension)	Excessive
Pre- (Preanal)	Before
Post- (postnatal)	After
Brady- (Bradycardia)	Slow
Tachy- (Tachycardia)	Fast

Trans- (Transfusion)	Across
Hemi- (hemialgia)	Half
Quadri- (quadriceps muscle))	Four
Tri- (Triceps muscle)	Three
Bi- (Biceps muscle)	Two
Dys- (Dysuria)	Difficulty with pain

The same applies to suffixes. Students learn the Latin roots and their English and Arabic equivalents such as Hepat, the Latin root for "liver", and "itis", a Latin prefix which means "inflammation". Therefore, the medical term "hepatitis" is easily translated into Arabic as التهاب في الكبد. Similarly, they were asked to translate the term "gastritis" in the quiz, and they were able to translate it as "التهاب في المعدة". An additional example is "enterocentesis" which consists of "enter" which is a Latin root that means "intestine", the combining vowel "o", and the Latin suffix "centesis" which is the act of puncturing a body cavity or organ with a hollow needle to draw. Therefore, students can easily translate this medical term as "بزل الأمعاء". The following table illustrates suffixes along with their Arabic equivalents:

Suffix	Definition	Translation
-ia	Condition	حالة
-itis (arthritis)	Inflammation	التهاب
-logy	Study of	دراسة
-logist	The one who studies	أخصائي
-megaly	Enlarged	متضخم
-pathy	Disease	اعتلال
-oma	Tumor	ورم
-sclerosis	Hardening	تصلب
-stenosis	Narrowing	ضيق
-algia	Pain	ألم
-malacia	Abnormal softening	لين غير طبيعي
-ectomy	Surgical removal	استئصال جراحي
-plasty	Surgical repair	ترقيع
-pexy	Surgical fixation	تثبيت جراحي
-scope	Instrument for viewing	منظار
-gram	Record	رسم بياني
-centesis	Fluid withdrawal	بزل

8. Conclusion

This paper sets out to produce highly trained people with scientific knowledge and technical expertise at the highest level. One's background knowledge about subject areas let him/her surpass several translators who do general translation. A translator specialized in one of the scientific or technical fields is not just a translator. S/he is a translator who knows well how challenging the task s/he is entrusted with and how heavy the responsibility s/he shoulders. Just as a student specialized in nuclear engineering, a scientific translator is a unique person who should bring a unique combination of skills to such translation projects.

Teaching, learning and doing scientific translation are such extremely challenging tasks. To overcome this difficult challenge is to acquire the related background knowledge and to do the adequate linguistic and scientific preparation for such a task. Students of scientific translation must be prepared and must prepare themselves linguistically to avoid fatal language mistakes which change the content completely. As for background knowledge, it can be acquired through conducting documentary research before engaging in the translation itself. Linguistic and scientific preparation in the teaching of scientific translation is must. The teaching of both sets of skills can be combined from the very beginning in LSP. Hence, translation students will gain the expertise needed to translate more narrowly defined scientific texts. Also, the difficulty of medical terminology can be overcome by breaking down the medical terms into prefixes, roots, and suffixes.

It is worth noting that teaching scientific translation is avoided by many translation lecturers due to its highly considerable difficulty. This difficulty lies in the background knowledge, which is needed to understand, and consequently, translate any text in the scientific domain. There are important methods to acquire such important knowledge. The method discussed in this paper stresses the roles of student and teacher together in acquiring such knowledge. The teacher explains to students a certain scientific topic and terms related to the topic under discussion. The teacher's role in demonstrating the appropriate search skills necessary to find the correct scientific and medical terms are also so important. Next, students read scientific articles in the source and target languages and conduct documentary research so that they do an accurate translation of the scientific text.

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