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MACHINE TRANSLATION AND POST-EDITING: PROFILES AND COMPETENCES IN TRANSLATOR TRAINING PROGRAMMES[1]

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Abstract

Studies of the professional translation market show that employers increasingly require translators to master tools related to machine translation (MT), compelling translator training centres to consider new professional profiles and the new competences students need. In this article we reflect on these two aspects on the basis of a literature survey and an analysis of the web pages of undergraduate and master's degrees in translation taught at Spanish universities in the academic year 2017–2018. Our analysis focused on the presence of MT and post-editing (PE) in descriptions of professional profiles, competences and contents. Our results indicate that learning to use MT and PE technology remains a marginal part of translator training programmes. The article concludes with a proposed general framework of profiles and competences which integrates MT and PE.

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Resumen

Los estudios sobre el mercado profesional de la traducción muestran que cada vez más los empleadores demandan que los traductores dominen las herramientas relacionadas con traducción automática. Esto obliga a los centros de formación de traductores a preguntarse cuáles son los nuevos perfiles profesionales y cuáles son las nuevas competencias que deberían adquirir los estudiantes. En este artículo reflexionamos sobre estos aspectos a partir de una revisión bibliográfica y del análisis de las páginas web de grados y másteres de traducción impartidos en las universidades españolas en el curso 2017-2018. Este análisis se ha centrado en la presencia de la traducción automática (ta) y posedición (pe) en los enunciados de perfiles profesionales, competencias y contenidos. Nuestros resultados indican que el aprendizaje de esta tecnología ocupa aún un lugar marginal en los programas de formación de traductores. El artículo concluye con la propuesta de un marco general de perfiles y competencias que integra la ta y la pe.

Keywords: Machine translation; Post-editing; Translator training; Professional profile; Technological competences.

Palabras clave: Traducción automática. Posedición. Formación de traductores. Perfil profesional. Competencias tecnológicas.

1. Introduction

Over the last few decades, technological development has changed the practice of translation. Machine translation (MT), understood as the production of texts translated from one natural language into another with or without human intervention, represents the most profound change in the role of the translator. It has entailed the emergence of new tasks, such as pre-editing and post-editing (PE). In a workflow involving MT, pre-editing basically consists of modifying the source text before MT is performed on it, so as to simplify the process and improve its end result, making PE less laborious. PE itself consists of editing and correcting MT output. Depending on pre-established quality requirements, partial or full PE may be carried out. Generally speaking, the aim of full PE is to provide an end product comparable to human translation, whereas that of partial PE is to obtain a text its recipient can understand.

Owing to the importance of translation in international communication, companies and public institutions are investing a large amount of resources in developing and improving MT systems. With its 24 working languages, the European Union regards MT as a strategic sector. Different reports (including DePalma, Hegde, Pielmeier & Stewart 2014; Several authors —EUATC— 2017; and Van der Meer & Ruopp 2014) stress that companies and professional translators see MT as the tool of the future. The use of translation tools in general and MT tools in particular is expected to increase because of a growing volume of material to be translated, in which case demand for translators capable of using MT systems effectively will also rise.

In the language service sector, the use of computer-assisted translation (CAT) tools is well established among companies and professionals alike. Translators use them not only for actual translation but also for tasks such as terminology and project management (Zaretskaya, Corpas Pastor & Seghiri Domínguez 2015). In the last 25 years, there have been no fundamental changes in CAT tool features, and what innovations there have been in that respect have had little impact on the translation process (Sánchez-Gijón 2016: 154). In contrast, beginning to use an MT system involves major changes in the way translators work, with translating no longer consisting of producing

a target language text on the basis of a source language text but rather of validating MT output. While that statement can and should be qualified, the change it describes is probably the reason for different studies showing the spread of MT to be a major cause for concern, particularly among professional translators. According to a study by the Tradumàtica group (Presas, Cid-Leal & Torres-Hostench 2016) from the Universitat Autònoma de Barcelona (UAB), such concern is largely due to translators lacking specific training.

Language service companies and professionals can opt to work with custom MT systems or general-purpose systems freely available on the internet. In the case of custom systems, a distinction must be made between those that companies develop themselves and those that third parties develop for them. Platforms such as KantanMT and LetsMT enable companies to train cloud-based custom MT systems without the need for installation. Custom systems adapt to each company's specific needs and, depending on the language combinations and subject matter involved, can attain adequate performance levels, although they may be expensive and require a significant initial investment in terms of time and human resources. Free systems (such as Google and DeepL) tend to be less useful in professional contexts as they do not adapt to individual needs. Furthermore, with certain exceptions (such as offline installation in the cases of Apertium and Lucy), free MT systems accessible via a web browser do not guarantee the confidentiality of information entered into them. In any case, there are a number of free and open-source programs and toolkits, such as Moses (a statistical MT system), MTradumàtica (a statistical MT system based on Moses) and Apertium (a rule-based MT system), which enable users to create MT engines or adapt them to their specific needs using their own parallel corpora (such as translation memories or free collections of texts available on the internet), depending on the language combinations they work with.

As stated in the *Libro Blanco: título de grado en traducción e interpretación* (Several authors —ANECA— 2004) on the design of undergraduate degrees in translation and interpreting, technological competence is one of the competences that such degrees should develop, and the contents used to that end in each programme should be specified. In Spain, translator training was adapted relatively quickly to the labour market's uptake of technologies in general and CAT software in particular, and both undergraduate (Piqué & Colominas 2013) and postgraduate (Veiga Díaz 2013) syllabuses include the corresponding training to some extent. Nonetheless, there is a lack of studies on the inclusion of training in MT and PE.

The incorporation of translation technologies into translator training has led centres to consider what knowledge of tools students should acquire and what types of tools they should use in classrooms (Bowker 2015). Answers to the first question, which constitutes a theory versus practice dilemma (O'Brien & Kenny 2011), generally mention that tools evolve quickly, making it preferable for students to assimilate the general principles of different kinds of tools, and highlight the need for students to have the chance to use different tools of each kind. There are two aspects to the question regarding types of tools. The first is of an economic nature, given that universities must meet the cost of licences if they want to offer training in a particular variety of programs (Flórez & Alcina 2011), a consideration that has prompted some authors to advocate the use of free software (Cánovas & Samson 2011; Flórez & Alcina 2011). The second aspect corresponds to the categories of tools that training ought to encompass. Broadly speaking, the tools that may be relevant to translators range from word processors to MT systems, with, to give just a few examples, electronic dictionaries, terminology management systems, CAT tools and project management tools somewhere in between. Other kinds of tools, such as subtitling and dubbing programs, are deemed more appropriate to specialised training. Other, new tools must also be taken into consideration, such as collaborative translation platforms that combine translation memories, MT, and terminology, workflow and project management (O'Brien 2011: 19). Bearing in mind that 'employability' is a keyword in syllabus design in the European Higher Education Area (EHEA), it seems evident that translator training centres must ask themselves to what extent the tuition in MT and PE they offer fulfils the labour market's present and future demands on graduates.

Our article aims to clarify what profiles and competences employers look for as far as MT and PE are concerned, to identify the status of MT and PE in Spanish universities' undergraduate and master's degree programmes in translation, and to put forward a framework that integrates MT and PE profiles and competences. To do so, in section 2 we present a survey of studies of the use of MT and PE carried out among employers, whose perspective we complement with professional translators' thoughts on their training and the competences they consider most useful. In section 3 we describe the methodology and results of our analysis of the web pages of Spanish universities' undergraduate and master's degree programmes in translation, with a focus on profiles, competences and contents related to MT and PE. In section 4 we present a profile and competence framework based on the translation process model of Martín-Mor, Piqué & Sánchez-Gijón (2016).

2. MT and PE in the labour market

Translators' new professional profile can be considered part of the paradigm brought about by the development of the internet (Vargas Sierra & Ramírez Polo 2012), three significant characteristics of which are ease of access to information, new forms of working together, and a need for new forms of specialisation in the use of technological resources. The conclusions of the various studies that have helped establish translators' current professional profile point to an ever greater presence of MT and PE in the sector. However, as we will see, profiles and competences related to MT and PE have yet to be clearly defined.

2.1. MT and PE in language service companies

In terms of international studies, the first of note, chronologically speaking, is the ambitious survey led by Rinsche & Portera-Zanotti (2009), which mainly focused on the size of the language industry but included questions on technology use. While 562 language service providers answered those questions, only 36 (3.26%) said they used MT. In a survey of language service companies from Europe, Asia and the Americas, which TAUS (the Translation Automation User Society) conducted to find out about the practice of post-editing MT output, almost half (49.3%) of the 75 respondents said they offered such a service (Joscelyne & Brace 2010). In a study of professional translators performed by TradOnline (Several authors —TradOnline— 2011), 48% of the 1330 participants thought that technology would cause a slight change to the way they worked; only 22% believed the change would be significant. In a study carried out by Zaretskaya, Corpas Pastor & Seghiri Domínguez (2015), 36% of 736 professional translators said they used MT. A report entitled *The Language Services Market* (DePalma, Hegde, Pielmeier & Stewart 2014) found that 38.63% of survey respondents offered MT services, against a backdrop of an annual growth rate of 6.23% in demand for language services. In a similar vein, the results of the TAUS study *MT Market Report 2014* (Van der Meer & Ruopp 2014) suggested that MT would become more widely used in the future and develop towards integration with other translation technologies, such as CAT tools. This last study is of particular interest because it involved interviews with not only language service companies but also MT system developers, companies that market such systems, consultants and users. None of the other studies mentioned here encompassed such a broad range of respondent profiles.

In Spain, the *Estudio de mercado de la traducción en España: 2004* (Several authors —ACT— 2005), a study of the country's translation service market carried out by the ACT, a group of specialised translation centres, is noteworthy for its wide-ranging scope. In a section entitled 'technologies', it analysed the use of not only CAT tools and MT systems but also desktop publishing and multimedia systems. In 2004, the year in which the study's data were collected, just 10.91% of the participating companies used MT systems. The level of use of MT remained low 10 years later (Bel & Rigau 2015), although the use of language technologies in general, especially in the case of Spanish, is forecast to grow.

In 2015, the Tradumàtica group carried out a survey of language service companies in Spain to analyse the extent of their use of MT and PE (Presas, Cid-Leal & Torres-Hostench 2016). Of the 55 companies that took the survey, 52.7% said they did not use MT. Although the remaining 47.3% did work with MT, the actual level of use was low, as almost half of them (45.5%) used it for no more than 10% of their projects. Of the 80% that offered PE services, 47% reported that PE represented under 10% of their volume of work. The survey also provided data on translators' attitudes towards PE, revealing a certain degree of rejection of the task. Surprised by some of the results obtained, Tradumàtica's researchers complemented their quantitative study with a qualitative study involving a focus group session with experts. Due to space restrictions, we will mention just two of the points discussed during the session here, both of them related to mistrust or rejection of MT and PE. The possible reasons the participants identified were certain prejudices held by translators, who think MT is causing changes in their professional activity; and, probably more significantly, translators' lack of training and the difficulties companies face in meeting the cost of implementing a custom MT system and training its users. Both arguments are related to quality, in that translators need to know how to use such systems properly to achieve a high level of quality. The experts felt that acceptance of PE might increase as MT becomes more widely used. They added that older translators would probably object more than their younger, more receptive counterparts. Nonetheless, they did not regard the absence of reservations as necessarily positive, as in some cases it could simply stem from novice translators' lack of awareness or experience of the quality problems MT can entail. Notably, they agreed that, economically speaking, using MT makes companies more productive in the long term, despite initial implementation costs.

2.2. MT and PE in professional practice

On the whole, the studies outlined in section 2.1 show that, while developers and institutions view MT as the tool of the future, most companies and professional translators are still a long way from seeing it as an opportunity. To complement that perspective, this section looks at what professional translators regard as the most useful or sought-after competences related to MT and PE. Carried out between 2010 and 2013, the OPTIMALE (Optimising Professional Translator Training in a Multilingual Europe) project had the general goal of enhancing the visibility and relevance to professional practice of university-level translator training in Europe (Several authors —OPTIMALE— 2013). To that end, its more specific objectives included identifying what were then the European translation industry's current and emerging competence requirements. It involved a survey that 680 employers answered between April and October 2011, the results of which were intended to be a guide for both job-seeking graduates and coordinators of translator training programmes aiming to improve graduates' job prospects. As far as competences related to MT and PE are concerned, 76% of the respondents deemed the ability to use translation memories 'essential' or 'important'. However, PE skills were considered 'essential' or 'important' by only 28%, and pre-editing skills by just 18% (Several authors —OPTIMALE— 2012).

In 2014, CIUTI (the Conférence Internationale Permanente d'Instituts Universitaires de Traducteurs et Interprètes) ran a survey of translation programme graduates, obtaining responses from 2813 graduates from 42 training centres in 19 countries (Schmitt, Gerstmeyer & Müller 2016). Of the 10% of respondents who worked with a MT system, 70% used Google Translate and less than 20% used a custom program. Almost 50% of the respondents felt that translator training ought to place greater emphasis on technological tools.

In 2015, the European Master's in Translation (EMT) conducted a study in which over 1700 graduates from European universities participated, the results of which were presented by Krause (2017: 150). In response to a question designed to identify which of the competences acquired through university training were most useful in professional practice, 38% of the participants considered CAT tool skills useful and 13% reported so regarding PE skills. Surprisingly, the question lacked a specific option corresponding to MT skills. The EMT competence framework is regularly updated by a group of experts, and the most recent update (Several authors —EMT— 2017) establishes five areas of competence, namely language and culture; translation; technology; personal and interpersonal; and service provision. The technology area

includes mastering the basics of MT and its impact on the translation process; and assessing the relevance of MT systems in a translation workflow and implementing an appropriate system where necessary.

All the above leads us to conclude, as Krause did (2017: 155), that future-oriented translator training should include specific subjects on MT, PE, pre-editing, automated quality control and project management.

3. MT and PE in translator training

In the context described in the previous section, translator training programmes must rise to the challenge of determining which competences related to MT and PE students should acquire, which tools they should work with, and at what stages of training and in which subjects such tools should be introduced. Programmes must, in other words, define the specific technological competences 'use of IT tools' and 'proficiency in assisted translation/localisation techniques', which the *Libro Blanco* (Several authors —ANECA— 2004: 85) defined generically, for MT and PE.

As the previously mentioned studies by Veiga Díaz (2013) and Piqué & Colominas (2013) made clear, the training in translation tools that Spanish universities' undergraduate and postgraduate programmes offered at the time focused on the use of CAT and localisation resources. Five years later, we felt it necessary to analyse to what extent Spain's undergraduate and master's degrees in translation have been modernised and incorporated MT and PE into their profiles, competences and contents. Our analysis was designed to answer the questions of whether such programmes identify a specific profile related to MT and PE; whether they seek to develop competences related to MT and PE; and whether they include contents and methodology related to MT and PE.

3.1. Methodology

We opted to analyse web pages for two basic reasons. Firstly, Spanish universities are required to publish their syllabuses and teaching guides, and their programmes' web pages thus offer researchers wide-ranging and highly diverse material. Secondly, such web pages provide future students with an insight into each programme's orientation and the career prospects it entails. We conducted our analysis in the first half of the academic year 2017–2018.

In total, we analysed the web pages of 23 undergraduate degrees taught at 26 universities (three of which share a programme) and of 22 master's degrees taught at 19 universities (three of which share a single programme),

all of which can be considered translator training. We omitted master's degrees in literary translation and interpreting. Our initial list of undergraduate and master's degrees comprised those registered at the 2017 meeting of the Spanish Association of Translation and Interpreting Centres and Departments (CCDUTI), and we performed a complementary search to ensure maximum exhaustivity.

We recorded each undergraduate and master's degree's competence and professional profile descriptions exactly as they were worded on its web page.

In the case of undergraduate degrees, we examined the teaching guides of core, compulsory and optional subjects focused on the use of translation tools. The guides in question generally have the same sections: introduction, competences, learning outcomes, contents, training activities and/or methodology, assessment system and bibliography. However, the level of detail provided in each section varies depending on the university and the programme involved. We used the guides to record each subject's descriptive elements (name, type, number of credits and year within programme) and its explicitly stated competences, contents and methodology related to MT and/or PE.

We also examined the master's degrees' teaching guides. Owing to the programmes' different structures, the term 'subjects' cannot be applied in all cases. For example, some universities organise their training into modules that are then divided into contents, which they may or may not call 'subjects'. In other cases, there are no modules, only compulsory and optional subjects. In still other cases, contents/subjects are divided into 'specialisations', 'specialities', 'pathways', 'subject units' or 'tracks'. This terminological diversity complicated our systematisation and analysis of data, and for ease of understanding we use the term 'subjects' in this article. The subjects we analysed included contents related to translation tools, specialised translation (business, administrative, legal, economic and financial, scientific, technical, medical, institutional), audiovisual translation and localisation. Where the same subject or contents was or were taught for different language combinations, we analysed just one combination, generally English–Spanish. As we did in the case of undergraduate degrees, we used the guides to record each subject's descriptive elements (name, type, number of credits and year within programme) and its explicitly stated competences, contents and methodology related to MT and/or PE.

We compiled data from a total of 42 undergraduate degree subjects. In the case of master's degrees, we identified 167 subjects but 43 of them had no published teaching guide, so the total number of guides we analysed was 124.

In summary, for undergraduate and master's degrees alike, we examined the following:

- Each programme's general and specific competence descriptions.
- Each programme's general professional profile descriptions.
- Each subject's descriptive elements (name, type, number of credits and year within programme).
- Each subject's explicitly stated competences related to MT and/or PE.
- Each subject's explicitly stated contents related to MT and/or PE.
- Each subject's explicitly stated methodology related to MT and/or PE.

3.2. Results

With regard to the undergraduate degrees whose web pages we analysed, their general and/or specific competence descriptions mention 'technological resources', 'IT tools', 'assisted translation', 'localisation' and 'ICTs applied to translation'. MT is mentioned by just one university, as an example of an ICT, and no mention whatsoever is made of PE. None of the professional profile descriptions mention career prospects explicitly linked with MT and/or PE.

Only three of the 42 subjects we looked at explicitly include MT and/or PE in their names ('Machine and assisted translation', 'Machine translation and post-editing', and 'Post-editing'). The names of the rest include terms such as 'tools', 'technologies', 'technological resources' and 'IT', all used generically. Eight of the subjects are optional and the others are either core or compulsory subjects. They are mainly taught in the first, second or third year of their programme, and most are worth six credits.

In our analysis of teaching guides, we found that only 10 subjects explicitly mention MT and 4 mention PE in their competence descriptions; 15 include contents related to MT and 5 to PE; and 3 refer to MT and 3 to PE in relation to their methodology. It is worth pointing out that a subject may include MT and/or PE in its contents without mentioning them in relation to its methodology or even in any of its specific competences. The lack of methodological information linked to contents on MT and PE prevented us from finding out whether the two are taught as separate or interconnected tasks.

The above is summarised in figure 1:

MT and/or PE explicitly mentioned in:	MT	PE
Competence description	10 subjects (23.8%)	4 subjects (9.5%)
Contents description	15 subjects (35.7%)	5 subjects (11.9%)
Methodology description	3 subjects (7.1%)	3 subjects (7.1%)

Figure 1. MT and PE in undergraduate degree subject competences, contents and methodology.

In the case of master's degrees, only two programmes explicitly include MT in their general and/or specific competence descriptions, and just one explicitly includes PE.

Only one programme mentions MT and/or PE in a professional profile description, that of a 'translator specialising in translation technologies (use of MT, translation memories, terminology managers, text editing, etc.)'. The rest merely make general references to the technologies and tools necessary to perform translation tasks, without going into greater detail.

Looking at teaching guides, we found that 4 of the 124 subjects explicitly mention MT and 9 mention PE in their descriptions of specific competences; 6 include contents related to MT and 3 to PE; and none of them refer to MT or PE in relation to methodology (see figure 2). Here too, the lack of methodological descriptions prevented us from finding out whether or not MT and PE are taught as interconnected tasks.

MT and/or PE explicitly mentioned in:	MT	PE
Competence description	4 subjects (3.2%)	9 subjects (7.2%)
Contents description	6 subjects (4.8%)	3 subjects (2.4%)
Methodology description	0 subjects	0 subjects

Figure 2. MT and PE in master's degree subject competences, contents and methodology.

In summary, the data we collected provide the following answers to the questions posed at the beginning of this section:

– In general, neither undergraduate or master's degree programmes identify a specific professional profile related to MT and PE.

- Competences related to MT and PE have a relatively low level of presence in undergraduate degree programmes, and only a token presence in master's degree programmes.
- MT and PE are referred to more often in the contents and methodology descriptions of undergraduate degree programmes than in those of master's degree programmes.

The results of our analysis indicate a very low level of presence of MT and PE in Spanish universities' translator training. Nonetheless, the possibility of technology lecturers actually including MT and PE in their subjects under generic terms such as 'IT tools' or 'technological resources' must be borne in mind.

4. MT and PE profile and competence framework

There can be no doubt that the implementation of specific technologies in the translation sector has been and will continue to be the driving force behind a redefinition of the translation profession, one that has seen it characterised, possibly over-optimistically, as 'multilingual multimedia communication engineering' (Gouadec 2007: 123). It certainly seems that, as García (2010: 3) observes, the translation service sector is experiencing a shift from computer-assisted human translation to human-assisted MT, following the model put forward by Hutchins & Somers, with human assistance consisting of interactive participation before (pre-editing), during or after (PE) the process (Hutchins & Sommers 1992: 150). In this situation, translators can opt to specialise in areas in which MT is not yet capable of outperforming humans, or to acquire new skills as pre or post-editors, linguistic consultants or quality assurance experts (García 2010: 6). However, as the studies referred to in section 2 of this article suggest, if such an evolution is to take place, professional translators must overcome their reluctance to perform tasks related to MT and PE. Given that their reservations are largely attributable to a lack of training, translator training programmes must incorporate the relevant profiles and competences. As Cadwell, O'Brien & Teixeira (2017) state, professionals' view translation tools more positively if they are involved in controlling them. That observation chimes with the Science with and for Society programme, which the European Commission is promoting as part of the Horizon 2020 research strategy (European Commission 2018), and which recommends researchers, citizens, policy makers, businesses, third sector organisations and other societal actors working together throughout the research and innovation process with a view to bridging the gap between the scientific community and society.

The technological competences of translators in general have been defined in various works, including those of Austermühl (2013), Doherty & Moorkens (2013), Enríquez Raído (2013), Samson (2013) and Torres del Rey (2005) to name but a few. Additionally, a number of proposals regarding training in PE (Rico & Torrejón 2012; Sánchez-Gijón 2016; (Several authors —ISO— 2017)) and in MT (Kenny & Doherty 2014; Doherty & Kenny 2014; Rico 2017) have been made. In this section we examine those proposals and present a framework of our own that integrates profiles and competences related to MT and PE.

4.1. MT profiles and competences

MT competence proposals are based on reflection on translators' relationship with technology and aim to avoid reducing them to mere revisers.

The approach to teaching and learning the use of MT advocated by Kenny & Doherty (2014: 290), for example, is holistic and proactive, and develops five competences that combine MT and CAT (Doherty & Kenny 2014: 299), namely showing an understanding of the principles of CAT technology; being able to use at least one commercial CAT tool; showing an understanding of the principles of contemporary MT, including rule-based and statistical MT; managing entire workflows involving CAT and MT; and critically evaluating contemporary translation technologies and texts produced using them.

Rico (2017: 76) states that the industry's objective of maximising productivity and quality while minimising costs might diminish the work of human translators, which could be limited to revising individual segments of translations produced by a computer program. She suggests reviewing technology's role in the translation process and analysing its interaction with users, and calls for training in MT to provide translators with the competences and abilities necessary to control the process (Rico 2017: 89). On the basis of a cyclical model of the translation process, she establishes two groups of competences, one related to the MT process and the other to MT output. The competences in the former group reflect the relationship between users and computers. The latter group comprises competences that have traditionally been included in the concept of technological competence, such as advanced skills in the use of different types of MT systems and familiarity with PE techniques (Rico 2017: 86).

4.2. PE profiles and competences

Sánchez-Gijón (2016) distinguishes between two profiles related to PE. The first, which is more limited but more established in language services, consists of editing and validating MT output. The second includes editing MT output too, but also involves preparing PE materials and, in general, managing MT systems. The difference between the two lies in the degree of technological proficiency they entail. Editing MT output only requires the use of editing tools, following pre-established parameters. Preparing PE materials involves interacting with a MT system and even developing lexicography and terminology resources. Managing MT systems involves tasks such as creating or optimising statistical MT engines or modifying and improving rule-based MT systems (Sánchez-Gijón 2016: 156-157).

One of the authors who are representative of the former conception is Pym (2013: 493), who observes that translators' function has switched from solving translation problems to selecting solutions proposed by a computer program. Taken to the extreme, the conception entails translation/PE competence being basically reduced to linguistic competence and the ability to carry out work with 'justified confidence' (Pym 2003: 489).

Rico & Torrejón (2012: 169-170), on the other hand, define PE competences from the broadest perspective, based on the view of PE as a profession in its own right. They establish three categories of such competences, namely core competences, linguistic skills and instrumental competences. Core competences are attitudinal and strategic in nature. Attitudinal competence enables post-editors to deal with subjectivity and uncertainty in defining and applying PE specifications, as well as with clients' expectations as to text quality. Strategic competence helps them make informed decisions when choosing between alternative solutions. Instrumental competences, meanwhile, include knowledge of MT, terminology management, translation memory and MT system dictionary maintenance, and basic programming skills. The authors also integrate PE tasks into a translation project framework in which the factors relevant to PE include client description, text description and the MT engine to be used. In summary, the professional profile they describe includes the ability to manage MT systems, interact with translation tools and resources according to each project's requirements, and manage any task a translation project involves.

Similarly, Sánchez-Gijón (2016) presents translators as professionals who, rather than just producing texts in a target language, can be active in every stage of the process and, furthermore, are capable of choosing different strategies

on the basis of each translation brief. A translator/post-editor might thus participate in, manage and/or carry out a translation or a PE project, be it an individual or a group undertaking.

Technological training for post-editors is emphasised in the international standard ISO 18587:2017 (Several authors —ISO Technical Committees— 2017: 9). In addition to translation, documentation, linguistic, cultural and thematic competences, the standard's authors call for advanced knowledge of MT and CAT tools, terminology databases and word processors, as well as experience in both types of PE and of using quality control tools. This model is based on specification of the tasks a post-editor should perform, i.e. reading MT output and deciding whether it needs to be reformulated; understanding source language content so as to use it as a reference and make the necessary corrections; and producing target language content, either on the basis of MT output or by performing a new translation.

4.3. MT and PE profile and competences

In the EHEA teaching model, a competence is defined as 'complex know-how' concerning how to act (Lasnier 2000: 32) not in general but rather in 'a class of comparable situations' (Perrenoud 2005: 3). Formulating profiles and competences thus involves establishing not only the theoretical knowledge (know-what) and practical skills (know-how) students should acquire, but also, above all, the situations in which such knowledge and skills can be applied (know-why). The models analysed in sections 4.1 and 4.2 define competences on the basis of at least one of those factors, but do not, in our view, combine the three in each competence.

Our proposal aims to solve the theory versus practice dilemma, and it takes into account the stages and tasks the process involves, along with their objectives (situations), the tasks to be performed in each stage (practical skills), and knowledge of the tools required in each stage (theoretical knowledge). Full acquisition of its competences should mean attaining expertise, which is characterised by good, effective performance, without the need for external monitoring (Pozo 1996). As our proposal is general, it omits crucial aspects of each specific situation, such as the language pair involved and the text's area of knowledge and level of specialisation (Presas 2008). It should be noted that the proposal's competences are geared to improving students' ability to work with custom MT systems, as recommended by Gaspari, Almaghout & Doherty (2015).

The proposal is based on a model of translation process digitisation (Martín-Mor, Piqué & Sánchez-Gijón 2016) in which the process is seen as a sequence of stages to which different tasks correspond, with possible variations in the sequence depending on each translation brief. The model reflects the tasks commonly performed in translation work that involves CAT tools and MT tools, as well as the different tasks for which each of type of tool is used (see figure 3). From the point of view of translator training, it allows for knowledge transfer between the two technologies but also for the definition of specific profiles. Lastly, it places the tasks that can be deemed part of actual translation in the more general context of a workflow. The first and final stages, 'receipt of assignment' and 'delivery of completed translation' respectively, consist of file management and communication with clients. The 'analysis' stage comprises tasks for obtaining information on the final text with a view to determining what tasks need to be carried out and how long they will take. In the 'preparation' stage, the materials that will be used in the 'initial translation' stage are readied. The 'post-production' stage involves correction and optimisation.

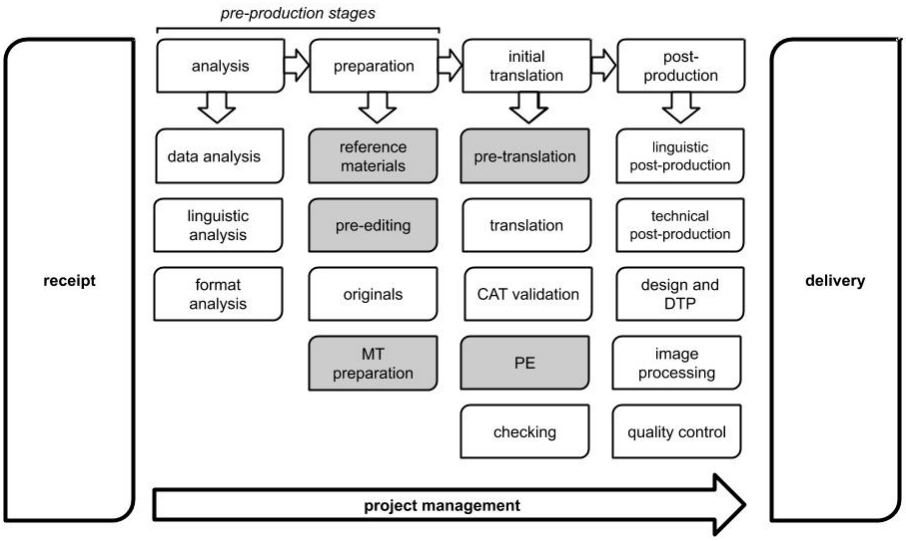

Figure 3. Translation process digitisation model (adapted from Martín-Mor, Piqué & Sánchez-Gijón 2016: 34). Tasks specifically related to MT and/or PE are coloured grey.

In the model, the tasks that are specifically related to MT are performed in the 'preparation' and 'initial translation' stages. The model describes the tasks, functions and tools that are part of each stage in detail:

- The 'preparation' stage includes the tasks of preparing reference materials (terminology and corpus management), pre-editing, preparing originals, and preparing MT engines. Preparing reference materials consists of creating and configuring materials, such as terminology databases, translation memories and linguistic guidelines, which will be used during translation. Pre-editing consists of adapting the original text for MT, including reducing natural language's inherent ambiguities and simplifying syntax, usually following specific guides. Word processors and terminology managers may be used here to automate the work involved. Preparing MT engines consists of creating or configuring the engines that will be used during translation. In the case of statistical MT, for example, it may be necessary to use new texts to train an engine. In the case of rule-based MT, it may be necessary to establish new rules to solve particular problems.
- The 'initial translation' stage includes the tasks of pre-translation, translation, CAT validation, PE and checking. Pre-translation and PE are specifically related to MT. In pre-translation, a raw text that can be considered a starting point for PE is obtained using a MT engine. The most important part of pre-translation is estimating the quality of the raw text based on a sample, to which end different types of procedures and tools (metrics) are used. PE is the final task related to MT performed in the 'initial translation' stage, and it essentially consists of correcting the raw translation to obtain a text that meets pre-established quality requirements.

As formulating the specific contents and competences of a syllabus is the responsibility of each faculty, here we simply present a general framework without specifying whether a particular competence is best suited to undergraduate or master's degrees in translation. In our proposal we associate competences with the kind of situations in which it should be possible to apply them (i.e. specific tasks) and with the categories of tools used for each task. Additionally, we define competences on the basis of three types of knowledge, namely conditional knowledge (know-why), which we describe by means of the gerund 'understanding'; operational knowledge (know-how), which we

describe by means of the gerund 'using'; and theoretical knowledge (know-what), which we describe by means of the gerunds 'being familiar with' and 'understanding'.

- Reference material preparation competence. This includes understanding the objective of using materials, essentially corpora and terminology databases; being familiar with corpus and terminology management tools and understanding their function in the preparation of materials and in workflows; and using tools for aligning corpora, extracting terminology, entering new terms and revising glossaries.
- Pre-editing competence. This includes understanding the objective and the necessity of pre-editing tasks depending on the MT system to be used; being familiar with and understanding appropriate tools for performing pre-editing tasks; and using tools to reduce natural language's ambiguities and simplify syntax.
- MT engine preparation competence. This includes understanding the objective and appropriateness of using MT engines; being familiar with and understanding the different types of engines; and training engines for statistical and neural MT systems, and modifying rules for rule-based MT systems.
- Pre-translation competence. This includes understanding the objective and necessity of estimating MT output quality; being familiar with and understanding quality criteria and the tools used for such estimations; and estimating the quality of raw MT output by means of the appropriate tool.
- Post-editing competence. This includes understanding the objective and necessity of revising raw MT output; being familiar with and understanding PE guides and guidelines, PE quality levels, and technological resources for performing PE; and modifying raw MT output by means of the appropriate tool.

5. Conclusions

Translators must have more and more technology-related competences to bring their profile into line with employers' demands. The use of technologies is constantly being redefined on the basis of their own evolution and labour market requirements.

MT is considered a strategic sector that generates a very substantial turnover. The use of MT is by no means exclusive to language service companies;

it is widespread in new sectors, such as the press, public administration and publishing.

Translator training should take into account professional profiles that are conducive to graduate employability. It is thus necessary to be aware of current labour market demands and anticipate their evolution.

We have established that Spanish universities' translator training includes subjects on technological tools for translation, most of them as part of core or compulsory training. The contents of undergraduate degree programmes mainly focus on CAT tools, and MT and PE feature little in syllabuses. Undergraduate degrees do not mention MT and PE in their general competence descriptions, and do not describe professional profiles or identify prospective careers related to MT and PE. In master's degree syllabuses, the presence of MT and PE is even lower. The situation in question is at odds with labour market trends and demands. To improve graduate employability, MT and PE should feature more prominently in syllabuses, and training programmes should include competences and knowledge related to the stages and processes of translation workflows that involve MT and to the tasks that translators could perform in such workflows.

Our work has painted a general picture of the presence of MT and PE in university-level translator training in Spain. A future survey of translator trainers will enable us to look more closely at specific aspects, such as whether generic terms like 'IT tools' and 'technological resources' include MT and PE; to what extent MT and PE are taught as interconnected tasks in subjects that specifically deal with them; and to what extent such subjects are coordinated with translation subjects. Additionally, aspects of the competences we propose, such as what tools students should use in classrooms, and at what point in training and in which subjects they should be introduced, will have to be defined more precisely in a necessary future debate.

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