Quality and productivity: A comparative analysis of human translation and post-editing with Malay learners of Arabic and English

Muhamad Alif Bin Haji Sismat

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The candidate confirms that the work submitted is his own and that appropriate credit has been given where reference has been made to the work of others.

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Abstract

Translation into and between foreign languages has become a common practice in the professional setting. However, this translation directionality has yet to be thoroughly explored, especially when post-editing is involved. The present study conducts experiments on the application of machine translation (MT) and translation memory (TM) in a translation classroom setting. A group of Malay speakers, who are non-native speakers of Arabic and English, used MemoQ 2014 to translate technical Arabic and English texts by post-editing raw MT and modified TM outputs containing several errors. The non-native trainee translators' productivity was measured and the quality of the translation was assessed through error analysis approach based on the MeLLANGE error typology so that it could provide a comprehensive analysis of the types of errors commonly found in the non-native trainee translators' translations. The error annotation also aims to provide guidelines for translators who work with the Arabic-English language pair and non-native translators.

The present study revealed that the translation technologies helped improve the non-native translators' speed and quality. The study also discovered that syntactic and lexical errors are the most problematic in the PE tasks. The trainee translators tend to overlook the errors that were caused by cross-linguistic influence, such as articles, gender, number and the conjunction "*wa*". However, this could have been avoided if the participants revised their translations thoroughly because most of the errors are minor. The study also revealed that the non-native trainee translators could be as productive as the professional native translators because they managed to reach the average daily productivity for professional translators, which is at least 5,000 words per day.

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List of Acronyms

CAT	Computer-assisted Translation
LQA	Linguistic Quality Assurance
MT	Machine Translation
PE	Post-editing
PEMT	Post-editing machine translation
PETM+MT	Post-editing translation memory and machine translation
SMT	Statistical Machine Translation
TAUS	Translation Automation User Society
TFS	Translation from scratch
TM	Translation Memory
TQA	Translation Quality Assessment

Transliteration System

The present research adopts Hans Wehr's approach to transliterating the Arabic alphabet into the Latin alphabet, which is employed in the fourth edition of Hans Wehr dictionary (Wehr and Cowan, 1994), and in compliance with the following table:

Letter	Transliteration
ء	’
ا or ى	*ā* (long vowel)
ب	*b*
ت	*t*
ث	*ṯ*
ج	*j*
ح	*ḥ*
خ	*ḵ*
د	*d*
ذ	*ḏ*
ر	*r*
ز	*z*
س	*s*
ش	*š*
ص	*ṣ*
ض	*ḍ*
ط	*ṭ*
ظ	*ẓ*
ع	‘
غ	*ḡ*
ف	*f*
ق	*q*
ك	*k*
ل	*l*
م	*m*
ن	*n*

و	*w* (consonant), *u* (short vowel) or *ū* (long vowel)
ه	*h*
ي	*y* (consonant), *i* (short vowel) or *ī* (long vowel)

Note:

- The short vowel, *fatha* (ً), is represented as *a*.
- *Wāw* (و) and *yā* (ي) are represented as *u* and *i* after the short vowel, *fatha.*
- *Tā' marbuṭa* (ة) is not represented and normally the words that have it ends with *a* in the transliteration.

Chapter 1: Introduction

Technologies are fundamentally designed to meet the humans' needs, and along with constant changes in the world, technological changes are inevitable. Thus, consumers need to adapt to them in their daily life. Even so, technologies are not developed to replace humans but to assist them in maximising their daily productivity. In translation, for instance, technologies are developed to aid translators to simplify their everyday tasks and meet the growing demands from their clients. Because of the increase in demands, the practice of translation directionality has also changed. Despite the negative critics from the traditional scholars, the need for non-native translators is inevitable in some cases. We have also seen the changes in translator training where being native speakers is not necessarily a prerequisite inasmuch as they are near-native speakers, or the target language is their language of habitual use. In professional practice, translators need to adapt and fully utilise translation technologies such as machine translation (MT) engines and computer-assisted translation (CAT) tools, to meet their clients' demands and deadlines. Consequently, post-editing (PE) has become an integral part of translator training and professional practice to boost their productivity and improve the quality of their translation tasks.

This thesis is not about condemning traditional practices and views, but since there are demands for non-native translators (IAPTI, 2015), it is important to diversify knowledge by exploring the impact of these translation technologies on non-native translators' performance as there is scarce research in this field, particularly concerning post-editing (Sánchez-Gijón and Torres-Hostench, 2014, p.7). This research also aims to highlight the problems and provide solutions that can be used as guidelines for non-native translators. At the same time, the results from the analyses

could offer an insight for developers into what could be improved to optimise these technologies for better performance, especially when working with Arabic and English language pair. Additionally, this study can be a contribution to the field of translation technologies and translation between foreign languages (from a second language (L2) into a third language (L3) and vice versa), which involved a group of undergraduate language students in Brunei as trainee translators.

1.1 Hypotheses

It is commonly believed that translation into one's mother tongue usually offers better quality than the inverse translation does (Chesterman, 2004; Duff, 1989; Pavlović, 2007; Pokorn, 2005). However, in cases where native speakers are not present, the latter is inevitable and in fact, it has become an acceptable practice in the professional setting as reported by Campbell (1998) and International Association of Professional Translators and Interpreters (IAPTI) (2015). Quality remains a major issue in non-native translations among scholars (Chesterman, 2004; Duff, 1989; Pavlović, 2007; Pokorn, 2005) and yet there is very little amount of studies focusing on it, particularly in post-editing (Sánchez-Gijón and Torres-Hostench, 2014, p.7).

If the quality of L2 and L3 translation differ from that of translation into one's mother tongue (L1 translation), the results from the analyses of both translations could hypothetically differ. Moorkens and O'Brien (2015, p.80) report that the quality of professional translations may usually be better than that of trainee translators' work. Therefore, it is worth re-investigating the impact of these technologies especially on non-native trainee translators' performance by comparing speed and quality in three different tasks: translation from scratch, post-editing machine translation and post-

editing outputs from translation memories and machine translation. Therefore, the present study hypothesises:

Hypothesis 1: The productivity and quality of the translated/post-edited output increase with more resources in one translation environment.

Hypothesis 2: Non-native speakers can be as productive as native speakers in post-editing.

Hypothesis 3: Slower translators edit more and produce better translations than the fast translators.

Hypothesis 4: Longer sentences tend to cause many errors, which slow down the PE speed.

Hypothesis 5: Higher fuzzy match value increases the PE speed and quality.

1.2 Research questions

Several questions need to be investigated regarding the impact of translation technologies on the non-native translators' performance as very little research focus on the translation directionality as reported by Sánchez-Gijón and Torres-Hostench (2014, p.7). Furthermore, the present study focuses on translation from a second language (L2) into a third language (L3) and vice versa. The focus of this research is also the Arabic and English language pair. Therefore, this research attempts to answer the following questions:

RQ1: What are the differences between post-editing machine translation and post-editing the outputs from both translation memories and machine translation in terms of productivity and quality?

RQ2: What are the types of errors commonly found before and after PE in the English-Arabic combination? How many of them could be corrected by the

non-native trainee translators? How many of them are classified as major and minor errors?

RQ3: What are the sources of the errors? Do the errors exist before or after PE?

RQ4: Does the translation directionality have an impact on the PE speed and the translation quality?

RQ5: Does the sentence length have an impact on the PE speed and the translation quality?

RQ6: Does the fuzzy match value have an impact on the PE speed and the translation quality?

RQ7: Which source reference is better: Translation Memories (TMs), Google Translate or Bing Translator?

RQ8: If non-native trainee translators should be taught differently as suggested by Campbell (1998, p.12), what learning model or guidelines can be offered to them in translator training, especially concerning post-editing?

1.3 The significance of the study

The translation technologies have an impact on the translation industry, which has led to changes to the way the translators translate and meet the increasing demands from clients. According to a recent survey conducted by Common Sense Advisory, DePalma et al. (2016) found that the demand for language services and supporting technologies has increased at an annual rate of 5.52% and the number is estimated to increase considerably in the future. Due to the increased translation volume, Lommel and DePalma (2016) stated that “pure” human translation cannot cope with the growth in the translation volume. The increasing translation volume has forced professional

translators to adapt to the application of translation technology as an integral part of their profession.

The question arises as to what is the impact of the translation technologies, such as machine translation and translation memories, on the translators' performance in terms of productivity and quality. These advanced technologies have been proven to increase productivity and quality (Aranberri et al., 2014; Guerberof, 2012; Martínez, 2003; Tatsumi, 2009). However, these claims have not been sufficiently examined as there are still gaps in understanding the process of post-editing and its impact on the translators.

The translation directionality has also changed as the L2 translation has become a common practice in the translation industry as well as the emergence of L3 translation practice in some parts of the world as reported by IAPTI (2015). The increasing demands for translation have opened more doors of opportunity for non-native translators to accept more translation tasks. Therefore, the emergence of L2 and L3 translation practice has led to the identification of more research gaps, especially on the impact of the translation technology on the non-native speakers' performance, which remains highly under-researched.

Due to the lack of information on these practices, the present study attempts to investigate the impact of MT and TM on the non-native speakers through post-editing tasks. The results of the study would be beneficial in understanding the relationship between the translation technology and the translation process. Many factors could contribute to the impact of the translation technology on the non-native translators. To uncover these factors, the present study adopts error analysis approach to examine the pattern of errors commonly found in three different tasks: translation from scratch, post-editing machine translation and post-editing outputs from modified translation

memories and machine translation. The pattern of errors would help better understand the non-native trainee translators' tendencies in full human translation and post-editing tasks as well as identify the types of errors that MT and TM can help reduce and the non-native trainee translators manage to correct.

The present study also focuses on the Arabic and English language combination. Looking more closely at the survey conducted by Common Sense Advisory, Lommel and DePalma (2016) in a survey conducted with 900 global enterprises revealed that 23% of the surveyed enterprises translate their content into Arabic and 34% of them translate into English through post-editing machine translation. The results suggest that there is a strong demand for translation into both Arabic and English. Most importantly, Arabic and English are two of the six official languages of the United Nations. According to Ebrahim et al. (2015, p.531), "English-to-Arabic translation direction is highly under-represented in MT research compared to the other direction. Limited work has been done since 2007". Therefore, the present study focuses on both translation directions so that the findings could contribute to the development of both Arabic and English MTs and in this case, the statistical machine translation.

To date, many studies (Guerberof, 2012; Koponen and Salmi, 2015; O′Brien, 2008; Tatsumi, 2009; Tatsumi and Roturier, 2010) have explored the influence of sentence length and fuzzy match on the translators. However, none of these studies reflects on their findings based on the non-native translators and tends to generalise these findings based on the assumption that translation and post-editing should be done into the mother tongue. Therefore, the present study also attempts to investigate the influence of both TM and MT at segment level. The present study also attempts to provide PE guidelines for the Arabic-English language pair based on the data gathered from the research project.

Since the participants of the study are Bruneians, it would also be interesting to know the significance of the study to Brunei. Brunei lacks qualified translators, which could hinder the efforts to increase the translation activities. However, there is a growing interest in translation activities in Brunei as reported by Koo (2012). Even though the Arabic-English-Arabic translations are also practised in Brunei, particularly at the university level, the translation modules are conventional, which typically focus on the theories and practice. It does not, however, include translation technologies in the translation training programme. Therefore, the findings of the present study could hopefully encourage the local university to include the translation technologies in their translation modules and encourage more local translators to use translation technologies to enhance their daily productivity, regardless of language pairs.

1.4 Thesis structure

The thesis is presented in six chapters. Chapter 1 includes the introduction, hypotheses, research questions, the significance of the study and the structure of the thesis. Chapter 2 covers a literature review of translation into or between foreign languages (L2 and L3 translation) and post-editing. Chapter 3 presents the research methodology used in this study, which includes the subjects of this study, text selection, machine translation engines, computer-assisted translation tool, translation quality assessment and the project stages.

Chapter 4 presents the results of the study, which covers the productivity and quality. Chapter 5 provides PE guidelines, especially for those who are working with the Arabic-English language combination and those who are translating into or between foreign languages.

Chapter 6 offers the final conclusions, answering each research question and validating the hypotheses of this study, and providing the contribution of the present study to knowledge as well as the limitations of the present study and the implications for future research.

1.5 Conclusions

The first chapter introduces the present study and its significance in various fields. First and foremost, due to the growing demands of translation and post-editing services, more translators are needed to meet these demands and deadlines from clients. Therefore, L2 translation has become a common practice and even L3 translation has also started to emerge in some part of the world as reported by (IAPTI (2015). Due to the scarce research on these practices, the present study aims to contribute findings that could benefit many researchers, developers, translators and post-editors, particularly those who are non-native speakers of Arabic and English.

This chapter also highlights the hypotheses of the research, which address the impact of translation technologies on the non-native speakers' performance. It also outlines a list of research questions that cover the quality and productivity of the non-native speakers when translating from scratch and post-editing outputs from MTs and TMs. The present study also seeks to identify the common types of errors that contribute to the design of PE guidelines and training for non-native speakers, particularly Malay learners of Arabic and English. This chapter also addresses the need for more qualified translators in Brunei because there is a growing interest in translation activities in Brunei as reported by Koo (2012), explaining that the translation practice in Brunei is still conventional and needs to encourage the application and teaching of the translation technologies in classroom and workplace.

Chapter 2: Literature review

This chapter provides a literature review of previous research that is related to the present study, focusing on translators' performance in post-editing machine translation and translation memories. The chapter covers a literature review of previous studies on translation into a foreign language and non-native translators as they are also the foci of the present study.

2.1 Translation directionality

2.1.1 Translation directionality in translation studies

In general, directionality refers to "whether translators are working from a foreign language into their mother language or vice versa" as defined by Beeby (1998, p.63). Having said that, directionality does not necessarily involve translations from and into foreign language only but it may involve translations between the first and third languages or between the second and third language, depending on the number of languages the translators master.

Fundamentally, the term 'mother tongue' is the first language that humans learned "through interaction with their mother, at an early age" (Fuentes, 2014) and the foreign languages are the languages that a person has learned or is learning in chronological order. However, this is not always the case among some scholars. Pedersen (2000, p.109), for instance, defines the first language as "the language that is most readily available". This is typically the case of translators who have resided in a foreign country for a long period or most of their lives for some. Thus, they master the local language in the same way the native speakers do. In some cases, people who were born and lived most of their lives in a foreign country cannot even speak in their

supposed ‘mother tongue’ because they were brought up abroad and have spoken the local language since an early age; they rarely communicate in their mother tongue at home. Thus, their supposed second language becomes their language of habitual use.

Various scholars gave different terms for translation from or between foreign language(s) and each term may be different to some of them. Newmark (1988, p.52) prefers the expression “service translation” for translation into a foreign language. However, this expression is not widely used by other scholars. Some scholars (Pavlović, 2007; Stewart, 1999) prefer the terms L1 and L2 translation. Other popular terms, such as reverse, inverse, native, non-native, direct and indirect translation, are widely used to indicate the translation directionality.

Apart from the various terms, scholars also have different views of the translation directionality whether or not translators should only translate into their mother tongue. Most scholars seem to agree that translators should always translate into their mother tongue. They criticize the quality of L2 translation, mentioning the unnaturalness as its main weakness (Duff, 1989, p.11) and non-native translators cannot master a target language in the same manner as the native speakers of that language as stated by Dollerup (2000, p.4) and Samuelsson-Brown (2010, p.27) in their respective study. Chesterman (2004, p.38) also points out that non-native translators are less likely to notice unnaturalness in the target language.

Aside from unnaturalness, other scholars point out other L2 translation’s flaws. Pavlović (2007), for instance, conducted a study on directionality in collaborative translation process and the results show that L1 translation tend to be of higher quality and the target texts seem more fluent. Jakobsen (2003) also conducts a research on L1 and L2 translation. The results indicate that L2 translation is slower than L1 translation

and presents a greater number of segments in the final product. These findings have also been supported by Buchweitz and Alves (2006) in a similar study.

Newmark (1988), on the other hand, does not completely oppose the L2 translation practice inasmuch as the target language is one's language of habitual usage. In fact, according to Institute of Translation and Interpreting's (2013) code of professional conduct, "members shall translate only into a language that is either (i) their mother tongue or language of habitual use, or (ii) one in which they have satisfied the Institute that they have equal competence. They shall translate only from those languages in which they can demonstrate they have the requisite skills". However, Newmark (1988, p.6) also adds that the final translation should be revised by a native speaker of the target language.

Unfortunately, many theorists have accepted the norm of L1 translation, ignoring the fact that L2 translation is a common practice in many countries as Pokorn (2005, p.30) states:

> "The most common approach to the problem of directionality in translation theory is, however, a silent acceptance of the "traditional" conviction of the necessity to translate into one's mother tongue. Most translation theoreticians do not discuss openly the possibility of choosing one's TL in translation; however, they do covertly express their conviction that only translation into one's mother tongue guarantees a good translation".

This supports the claim that research on L2 translation is scarce (Apfelthaler, 2013; Heeb, 2016, p.76) because theorists tend to indirectly generalise their findings, dismissing the fact that L2 translation is different from L1 translation, or they simply just ignore or does not have interest in researching L2 translation. Zahedi (2014, p.47) also expresses his views on the L2 translation's position in translation studies, pointing

out that “L2 translation has turned into an invisible activity in the eyes of translation scholars”. He (ibid, p.46) added that issues in translation are always concentrated on L1 translation, positioning it to the center and “L2 translation at the periphery of discussions about translation”. Similar to his view, Hansen (1998, p.59) addresses that scholars put so much focus on theoretical work with regard to L1 translation that “[their findings] could be generalized to apply to translation into the foreign language too”.

2.1.2 Translation into foreign language as a common professional practice

In some cases, L2 translations are allowed and in fact, required because in many parts of the world, translation into second language is a regular and acceptable practice especially when the native speakers of the target language are not available. Additionally, the increasing demands for translation service and insufficient number of L1 or native translators have forced translation companies to hire non-native translators to complete the tasks. With respect to professional practice, The International Association of Professional Translators and Interpreters (IAPTI, 2015) made an online survey that indicates more than 50% translators practice L2 translation with approximately 17% of them also offers translation from a non-native into another non-native language (L3-L2). Over 30% respondents also stated that 20-100% of their work comes from L2 translations. This significant amount of work indicates that L2 translation is minor concern to clients.

In a study on Polish-English translation market, Whyatt and Kościuczuk (2013, p.73) states three possible reasons why clients would hire L2 translators:

1. L2 translators are easier to recruit and offered more competitive rates.

2. Clients believe that professional translators are competent enough to work in either direction.
3. Clients trust their regular translators to work into their L2 language when required to do so.

2.1.3 Directionality in the translation process

With regard to translation process, Campbell (1998, p.57) stresses the difference between L1 and L2 translation:

> "The two activities are in a way mirror images. In translating from a second language, the main difficulty is in comprehending the source text; it is presumably much easier to marshal one's first language resources to come up with a natural looking target text. In translating into a second language, comprehension of the source text is the easier aspect; the real difficulty is in producing a target text in a language in which composition does not come naturally".

Dimitrova (2005, p.57) also expresses the same opinion mentioning that L1 translation may require more resources in the comprehension process. Pokorn's (2005) study also shows results that support the previous statements. She reveals that both L1 and L2 translators made mistakes both in conveying the content and in providing a natural-sounding translation. Rogers (2005) also conducts a case study on L1 and L2 translation and the findings indicate that the competent L2 translators provided solutions that were informatively more reliable than those produced by the least successful L1 translations. However, she also stresses that the successful L2 translations lacked naturalness in comparison with successful L1 translations.

In the case of English as the foreign language, some scholars like McAlester (1992, pp.292-293) perceive that translators who are non-native speaker of English may be as good or even better than a native speaker because a non-native translator may produce a simple English text which may be more suitable and easier for the target readers of non-native speakers of English to comprehend. Campbell (2000, p.212) also suggests that translations into English as a second language (TRESL) need "to be assessed both as translations and as an evidence of target language competence". This suggests that L2 translation is not only different from L1 translation but also from a simple non-translation L2 output. Therefore, there is a need for special assessment method for TRESL and perhaps, L2 translation in general.

2.2 Post-editing

2.2.1 Definition and types of post-editing

The term "post-editing" (PE) is commonly associated with machine translation (MT) as Allen (2001, p.26) described the practice as correcting texts that have been pre-translated from a source language into a target language by a machine translation system. It is worth broadening the definition of post-editing to correcting fuzzy matches from translation memories as the current professional translation practice involves post-editing outputs from machine translation and translation memories to produce better-quality translation in a shorter amount of time.

Researchers proposed the types of post-editing, differing on the number of corrections and efforts required to achieve the desired translation quality. One of the early studies on post-editing typology is the work of Laurian (1984, p.237) who proposes two major types of post-editing: *rapid* and *conventional PE*. The former involves correcting texts

without paying attention to the style whereas the latter suggests correcting the texts to produce high-quality translations as similar as to human translations. Allen (2003, pp.304-306) suggests different terms for the two types of post-editing: *minimal PE* for the former and *full PE* for the latter. Similarly, TAUS (2010) proposes *light PE* to achieve "good enough" quality and *full PE* to achieve quality similar or equal to human translation.

2.2.2 Post-editing and speed

2.2.2.1 Comparison of speed between post-editing MT and TM

In post-editing, Sharon O'Brien's work is among the most cited studies. She has conducted several studies, uncovering different aspects of post-editing such as productivity and cognitive effort. In a pilot study, O'Brien (2006) applies an eye-tracking technique to measure cognitive load when dealing with different types of fuzzy match retrieved from the Translation Memories (TMs). Four professional translators participate in this study: two native speakers of French and two native speakers of German. They are required to translate an English source text on SDL Translator's Workbench, using Translation Memories provided by Symantec. In situations where no match is found in the TMs (referred as MT match), the translators are required to post-edit MT outputs from Systran. The results indicate that the cognitive load increases as the fuzzy match decreases. However, the cognitive load for MT matches is similar to that of 80-90% fuzzy matches. In a similar eye-tracking study, O'Brien (2011) measure post-editing speed and cognitive effort and investigate if there is any correlation between speed, cognitive effort and automatic MT metric scores. A group of seven French native professional translators participates in this study. The experiment selects two automatic MT metrics: General Text Matcher

(GTM) and Translation Edit Rate (TER). The results suggest that the time and cognitive effort required for post-editing segments with high GTM and TER scores are substantially lower when compared to segments with medium or low scores. Even though the two previously mentioned studies used different types of methodology, we can safely assume that segments with high fuzzy matches or automatic MT metric scores will likely require less cognitive effort, which can lead to saving more time. The challenge then is whether MT between English and Arabic is good enough to produce such high-score output.

Following O'Brien's (2006) finding regarding a correlation between MT matches and 80-90% fuzzy matches, Guerberof (2009) initially conducted a pilot study based on that finding to investigate whether the time spent on PEMT corresponds to post-editing the 80-90% matches. However, the results could not be validated since the PEMT speed seems to be higher than that of post-editing fuzzy matches. Then, in her Ph.D. thesis, Guerberof (2012) increases the percent range to 85-94% and the results indicate that the processing speed in the PEMT task corresponds to that of editing 85-94% fuzzy matches. In relation to her findings, the present study attempts to look into the impact of the fuzzy match on the non-native translators in terms of speed.

2.2.2.2 Comparison of speed between human translation and post-editing

In another study, Zampieri and Vela (2014) studies the influence of MT output on the translators' performance. The MT output is stored in translation memories for the post-editing tasks. 15 German-native beginner translators participated in this study and translated English source text into their mother tongue, and each translator was required to complete three different tasks: translation without using TM, translation using TM containing modified MT output, and translation using TM containing

unmodified MT output. The results indicate that there is a substantial difference between the tasks. When compared to the first task, the participants translate 28.87% and 52.82% faster in the second and third task respectively. There is also a considerable increase in productivity between Task 2 and 3 with an average of 33.77%. The present study also attempts to apply similar method but instead of storing MT output in the TMs, the present study uses the integration of MT in MemoQ and combines TMs and MT in one of the tasks. Also, the TMs were also intentionally seeded with errors to see whether the non-native trainee translators can notice and correct them.

2.2.2.3 PE speed and language pairs

In a study on productivity in post-editing machine translation (PEMT), Zhechev (2012) tests on ten languages (including the source language, English) that belong to three different groups: Romance, Slavic and German, and Asian group. Four translators are recruited for each target language. The results show that overall the productivity gain in PE varies for each language, within the range of 37-92%, when compared to translation from scratch. From this study, we can assume that language pairs may affect the productivity because the quality of the data trained for each pair may differ. Therefore, it would be interesting to see how the Arabic-English language pair would affect the non-native translators' processing speed.

2.2.2.4 PE speed and sentence length

Apart from the language-pair-related factor, researchers (Popovic et al., 2014; Tatsumi, 2009; Tatsumi and Roturier, 2010) also argue that sentence length can affect productivity rate. In a pilot study, Tatsumi (2009) explores the correlation between

automatic evaluation metric scores and PE speed on the segment level. The results indicate that very short or very long sentences may slow down the PE speed, but the influence differs depending on the sentence structures. However, she suggests that source text characteristics and MT errors may also have an impact on PE speed. In a study on five different types of PE operations, Popovic et al. (2014) attempt to relate the PE operations to the cognitive and temporal effort. The five different types of edit operations are correcting word form, correcting word order, adding omission, deleting addition and correcting lexical choice. The results show that correcting lexical errors requires the most time but suggest that PE time varies strongly depending on sentence length. They also find out that reordering and mistranslation have a strong correlation with the quality level, indicating that mistranslations are the main error found in the translation outputs. Koponen and Salmi (2015) investigate the type of errors that can be identified and corrected without reference to the source text. They find that editing long sentences and sentences with a great amount of errors are more challenging. In relation to the effect of the sentence length on productivity, the present study attempts to investigate how the sentence length would affect the PE speed of the non-native translators.

2.2.2.5 PE speed and translation experience

Other studies such as (De Almeida, 2013; Guerberof, 2012) attempt to relate post-editors' performance to their experience. In her Ph.D. thesis, Guerberof (2012) attempted to investigate whether the more experienced translators would display more productivity gains but the results indicate that the least experienced translators demonstrate the highest productivity gains. In a similar study, De Almeida (2013) also has similar findings and suggests that PE effort and PE performance is too complex to

be explained only by analysing productivity gains. These findings may also suggest that the more experienced translators are only slower because they may be more critical in the translation process than the less experienced translators.

In contrast, the present study employs language students, who have very little background knowledge of translation and do not have any experience with post-editing and translation technologies. Therefore, it would be interesting to compare the trainee translators' processing speed in the human translation and post-editing.

2.2.2.6 PE speed and familiarity with subject matter

Familiarity with certain topics or fields of expertise could help increase productivity and quality. Aranberri et al. (2014) compare PE productivity between six professional translators and six lay users. The lay user group consists of lecturers from the University of the Basque Country, who are not specialized neither in translation nor linguistics. Both groups are required to translate two English texts into Basque, with a trained statistical English-Basque MT system on a web-based translation management tool developed by Bologna Translation Service (BTS). The results show that overall the productivity increases by an average of 17.66% and 12.43% for the translators and users respectively. The researchers also suggest that the productivity gain is text-dependent as they state that "(the lay user group) seem to benefit from the MT outputs especially when working on their domain of expertise", which is scientific research.

2.2.3 Post-editing and quality

2.2.3.1 Quality in post-editing MT

Quality has also been an issue in post-editing studies. Researchers used different approaches to assess translation quality to provide valuable findings that may help improve the MT quality and post-editors' performance. The present study attempts to find patterns of Arabic and English MT errors. Such findings could be valuable for developers and researchers, who are investigating the same language pair. Also, it could be used as guidelines for post-editors to avoid errors. In a study involving monolingual PE, Koponen and Salmi (2015) conduct an experiment with a group of 48 translation students who are majoring in different languages. The participants are required to post-edit English-Finnish MT outputs without referring to the source texts. The results show that the students manage to translate 29.5% correctly, but another interesting focus here is to find out the type of errors that can be identified and corrected without referring to the source texts. The data shows that word form errors are easy to identify and correct whereas omission and mistranslations appear to be difficult to identify. In her masters dissertation, Koponen (2016, p.48) also finds that word order is not particularly easy or difficult because Finnish has "relatively free word order".

In a study, Daems et al. (2014) attempt to identify the MT errors and examining whether the errors still exist after PE. The results indicate that five types of grammatical errors are among the ten most common errors in MT: superfluous or missing articles, incorrect verb forms, agreement issues, word order problems and missing constituents, but none of these errors appears to be the most problematic in PE. In fact, the most problematic errors in PE are wrong collocations, word sense and misspelled compounds and according to the data, these errors are caused by MT. The

present study also attempts to investigate the MT errors for the Arabic-English language pair as well as comparing the errors before and after PE to determine the causes of these errors. Such information could be valuable to academics, researchers and developers, who are working to improve the MT systems.

2.2.3.2 Comparison of quality between post-editing MT and TM

Guerberof (2012) hypothesised that the quality of post-edited MT is higher than that of editing fuzzy match segments but the results do not show any significant difference in quality between the two types of segments whereas the quality of post-edited segments is higher than that of no-match segments. The results also indicate that language, terminology and style errors are more common in no-match segments while accuracy errors are more common in fuzzy match segments, and mistranslations are more commonly found in MT matches. Therefore, the present study also attempts to adopt a similar approach but the difference is the present study includes all fuzzy matches in the analysis to see if the results differ from Guerberof's findings.

2.2.3.3 Comparison of quality between human translation and post-editing

Researchers have also conducted studies on quality by comparing full human translation to post-editing. Bowker (2005), for instance, conducts a study on the correlation between translation productivity and quality by comparing results from three different tasks carried out by three groups (one task for each group): translation without TM, translation with raw TM outputs and translation using TMs with seeded errors. Nine participants participate in this study and translate a French source text into English. The results show that the productivity increases when using TMs. She suggests that the translators are not critical in spotting and correcting the seeded errors.

The method here is similar to the one used in the present study but the only difference is the present study combines the MT and TM in one of the tasks. Her study also revealed that the quality of the translations using the TM with the seeded errors is lower than that of using unmodified TM and full human translation.

Daems et al. (2013) attempted to investigate translation problems by comparing human translation to post-editing MT outputs. The translation quality is assessed based on the guidelines and categorization provided by Daems and Macken (2013). The errors are classified into two categories: adequacy and acceptability errors and each category is divided into sub-categories. The study involves sixteen Master's students who have no experience with PE and specific training prior to the study. The results show that in terms of acceptability, the post-editors seem to struggle with grammar and syntax, and lexical problems whereas style and registers issues are more common in the human translation. As for the adequacy errors, addition and omission errors are more common in the human translation while word sense and misplaced word are more common in post-editing. Overall, meaning shift is the most common problem in human translation while wrong word sense disambiguation and wrong collocation appear to be the most problematic errors in PE. The origin of these errors is not clear.

2.2.4 Directionality in post-editing

Sánchez-Gijón and Torres-Hostench (2014, p.7) state that directionality has not been largely explored so far in post-editing studies. Some studies may have included non-native speakers in their study but they tend to generalise their findings. A possible explanation for this is that post-editing tasks are assumed to be carried out by native translators only or directionality is not the focus of their studies. However, the reality

is L2 translation is a common practice in the professional setting and post-editing has become an integral part of the current translation process. Therefore, studies on L2 post-editing are worth investigating in order to improve L2 post-editing in particular and L2 translation in general. In a pilot study, Sánchez-Gijón and Torres-Hostench (2014) attempt to investigate the level accuracy and linguistic correctness non-native translation trainee can produce in PE. They experimented with a group of 12 Spanish non-native English speakers and a group of 3 native English speakers. Based on the overall results, the native trainee translators performed better than the non-native trainee translators but the results also suggest that the most successful non-native translators performed as good as the native speakers in the "good enough" PE task, suggesting that good non-native translators can be suitable for *light PE* tasks.

2.2.5 Post-editing in the Arab world

The translation industry in the Arab world is still highly under-researched, particularly on the use of the translation technologies. Perhaps, the main possible reason for it is the industry lacks the integration of these technologies with the professional life, which may be due to the lack of trained translators in the field. Fatani (2010) addresses this issue, stating that in many cases the translators still prefer the conventional approach to translation by looking terms in dictionaries. Furthermore, many private and public sectors in Saudi Arabia resort to bilingual individuals rather than trained professional translators. She also describes that many translation agencies in the kingdom "are rather crude" as, at that time, translation software is only used by a few companies.

In a recent survey on the use of MT in the Arab world, Almutawa and Izwaini (2015) explored the practice of post-editing and general assumptions of using MT in the

professional settings in Saudi Arabia. Despite the increasing interest in MT technology and the growing demand for translation, the survey indicates that:

- only 20 of 44 Saudi organisations are using or planning to use MT;
- they think Google Translate is good for lexical translation and is much easier to use and time-efficient.

However, 24 of 44 organisations refused to use MT for the following reasons:

- Translation memories are more reliable than MT;
- MT cannot translate complex sentences;
- MT is only good for gist translations, arguing that there is artistry in translation that can only be achieved by humans.

Despite the drawbacks, Almutawa and Izwaini stress that MT is not designed to replace translators but to assist them, suggesting translators should take advantage of MT to perform better. They also suggest that MT in the Arab world is still under-researched and more attentions are needed to help improve the available Arabic MT systems. Based on this case study, we can assume that the Saudi organisations and translation agencies still prefer the conventional human translations but some of them still show some interests in MT despite having to deal with the drawbacks. Perhaps, the lack of interest in using MT may be due to a lack of technical knowledge and training that could hinder them from using MT. Hence, there is a need for translator training so the translators can utilise the technologies to its maximum potential and explore which one of them is more suitable for them to enhance their productivity. It is difficult to find a detailed information on the professional practice of post-editing in the other Arab countries as there is a lack of reports or surveys being published or available online. However, many translation companies in the Arab-speaking

countries, such as Egypt, the United Arab Emirates and Saudi Arabia, now provide post-editing services as published on their websites.

At the academic level, translation programmes are mostly linguistic-oriented as reported by Thawabteh (2013, p.81). This is supported by a case study at Saudi universities conducted by Abu-ghararah (2016, p.81), reporting a lack of technology and learning resources in the translation programmes. However, there is a growing interest in offering training in translation technologies in the Arab-speaking countries, such as Al-Quds University in Palestine, Yarmouk University in Jordan, and the American University of Sharjah in the United Arab Emirates, among others.

2.2.6 MT problems and error typologies for the Arabic-English language pair

Error analysis is tedious and time-consuming. However, the findings are beneficial particularly for improving the quality of the MT outputs in this case, as they will give an insight to MT researchers and developers to focus on the types of MT errors as well as providing solutions that can stop the MT from making the same errors. In the case of the Arabic-English language pair, researchers categorise the errors differently. For example, Izwaini (2006) investigate the problems of Arabic MT by evaluating the outputs of three online system: Google, Sakhr and Systran. He classifies the problems into two categories for the Arabic-English translation: 1) problems of lexis and 2) problems of grammar and syntax, and three categories for the English-Arabic translation, adding style and spelling to the previous categories in the opposite direction. The results of the study reveal that the major problems found in Google output are addition and deletion in the Arabic-English translation whereas in the opposite direction, deletion is the only major problem.

In another study, Al-Samawi (2014) outlines similar types of errors but classifies the errors differently: syntactic, grammatical and semantic errors. In the grammatical error category, he identifies two additional types of errors: 1) using a noun in place of a verb and 2) using a verb in place of a noun. The results of the study reveal that omitting functional morphemes, such as prepositions and articles, are the errors most commonly found in the MT output, with 14.8% of 366 errors, followed by adding an unnecessary word, preposition, article before a word (13.9%), and violating the whole phrase structure (13.7%). Overall, the grammatical errors have the highest number of errors with 47.5% of the total errors, followed by the semantic errors with 37.4%, and the syntactic errors with 15.1%. From here, we can see that not only that the researchers have different approaches to error typology but they also outline some errors that may not exist in other studies and vice versa, depending on the texts or text types, language pair or direction, and the types of MT systems. This is also evident in other studies such as Zaghouani et al. (2014) who classify the errors into seven categories. In addition to the types of errors outlined in the existing studies, they add another two types of errors: proper name errors and dialectal usage correction. They address (ibid, p.2365) that "most of the texts provided for annotation are in MSA (Modern Standard Arabic), but dialectal words are used sometimes".

Therefore, the present study adopted MeLLANGE error typology for the error annotation, which classifies the errors differently from the existing studies. Similar errors may be identified but the number of occurrences may differ, as different texts were used for the project and the quality of the MT systems may have differed at the time when the MT outputs were generated. Nevertheless, the main objective of the error annotation was to find the common types of errors which are specific to the non-

native speakers and in this case, the Malay learners of Arabic and English (L2-L3 translation trainees).

2.2.7 PE training and guidelines

Gaspari et al. (2015) conducted a survey of machine translation competencies, which highlighted the increasing use of translation technologies in the translation industry. This increase has led to a strong need for post-editing training, which does not only require linguistic skills but also technological skills according to the needs of the translation and localisation industry.

Suggestions for PE training courses have been addressed since the early 2000s. One of the most noticeable papers was O'Brien's (2002) proposal for PE training course content. In her paper, she emphasises the importance of teaching PE skills because she believes that it could help meet the growing demands for translation in a limited amount of time. She suggests a list of PE skills that a post-editor should have: knowledge of MT, terminology management skills, pre-editing/controlled language skills, programming skills, and text linguistics skills. In addition, she also states that a post-editor should also have a positive attitude towards MT. In order to acquire PE skills, O'Brien suggests a PE training course, which covers important topics, such as introduction to post-editing, MT technology, controlled language, terminology management, text linguistics and programming skills.

PE guidelines should also be included in PE training as they determine the quality level of the translations, depending on the clients' requirements. However, according to DePalma (2013) and TAUS (2016), there are no standard guidelines as many companies tend to develop their own PE guidelines according to their needs. Most of these guidelines are not publicly available as they are designed for internal use only.

Among a few published, and perhaps, the most referred, PE guidelines is TAUS (2016; 2010) PE guidelines, which were designed to help post-editors and clients to set the expected quality of the translations.

Among other published PE guidelines are those of developed by Flanagan and Christensen (2014), and O'Brien (2010). The former adopted TAUS PE guidelines to tailor their own set of guidelines for translator training purposes. O'Brien suggests that guidelines may need to be developed for specific systems and languages. This may be true because the quality of the MT output would vary, depending on the type of MT systems and the language pairs. O'Brien also suggests that a post-editor should have good revision skills, quick quality assessment skills and the ability to adhere to guidelines as well as a positive attitude towards MT.

In addition, the translation directionality would also play an important role in designing a PE training course and guidelines because non-native trainee translators have different needs and as a result, they should be taught differently as suggested by Campbell (1998, p.12). Therefore, to design a PE training course for non-native translators, particularly for those who are working with the Arabic-English language pair, the present study attempts to investigate the needs of non-native translators to successfully produce high-quality or at least publishable translations by adopting an error analysis approach to identify the common types of MT errors and those of the non-native translators tend to make. The availability of this information could potentially be useful for PE course providers as they could adopt similar approach to training non-native post-editors according to their needs.

2.2.8 The teaching of English and Arabic in Brunei

The Sultanate of Brunei is a Malay Islamic country, which is governed by the constitution according to the concept of *Melayu Islam Beraja* (Malay Islamic Monarchy) which comprises three key components: Malay culture, Islam as the official religion, and monarchy as the political system of the country. Despite the importance of Malay as the official language of Brunei, the government emphasises the importance of teaching other languages in all academic levels, particularly English and Arabic. The former is due to the importance of English as the universal language and the latter is related to Islam, as it is the language of the Quran and Hadith. Other languages are typically taught at the university level as optional modules such as Mandarin, French, German, Italian, Spanish, Japanese and Korean, among others[1].

2.2.8.1 The teaching of English in Brunei

Haji Othman and McLellan (2014, pp.488-489) report that the education system in Brunei became fully bilingual in 1985 so that Bruneians can learn both Malay and English through schools. Since then, traditionally most Bruneians grow up with Malay as their mother tongue and English as their second language. In some cases, some Bruneians speak English as their first language because they were brought up in English-speaking families or have lived abroad since they were little. The bilingual education system was criticised for focusing more on the English language rather than on Malay and since 2008, it has been replaced by SPN-21, the National Education System for the 21st century, which was designed to balance between the use of Malay and English as a medium in teaching subjects at school. However, Deterding and Sharbawi (2013, pp.13-21) feel that the new education system has not successfully

[1] http://lc.ubd.edu.bn/courses.html

solved the imbalance of use between the two languages as concerns regarding the code-switching habit among many Bruneians arose as reported by Daud (2012). This code-switching is called as *Bahasa Rojak* in Malay ('salad language'). Since the bilingual educational system, English has become a core subject in all academic levels as well as one of the basic entry requirements to study at some of the local universities.

2.2.8.2 The teaching of Arabic in Brunei

The teaching of Arabic in Brunei is somewhat different from that of English because it is typically taught in Arabic schools since the primary or preparatory levels (Year 5 or approximately at the age of 10). Religious subjects and the Arabic language itself are taught mostly in Arabic and sometimes in Malay whereas other non-religious subjects are typically taught in English and Malay. For those who do not attend Arabic schools, they learn some Arabic words or phrases through attending religious schools as they are taught how to recite the Quran and prayers as these practices are the essential parts of being a Muslim. However, the teaching of Arabic in the religious schools is not as intensive as the teaching of Arabic in Arabic schools.

At the secondary level, more subjects are taught in Arabic in Arabic schools and the teaching of the language itself becomes more intensive as they progress to the pre-university or college level, which includes advanced Arabic grammar and syntax, and Arabic literature in the curriculum. At the university level, particularly at Sultan Sharif Ali Islamic University, most modules are taught in Arabic, depending on the course. As reported by Abdullah (2014, p.15), for the students who major in the Arabic language, the course involves core modules such as advanced Arabic syntax and morphology, Arabic literature, comparative literature, Arabic rhetoric, and translation, among others. As in the case of English, code-switching has also become a habit

among the Malay learners of Arabic and English, particularly when they speak Malay as the language itself borrowed many terms from Arabic and English, such as *solat* (prayer), *mustahil* (impossible), *haiwan* (animal), *sains* (science), *system* (system), *biskut* (biscuit) and many other terms that could also be borrowed from other languages.

The present study involves the Malay learners of Arabic and English. Therefore, with their linguistic backgrounds of more than 10 years, it would be interesting to see the common types of errors they tend to make in the human translation and post-editing and see whether they can be as productive as professional native speakers.

2.3 Conclusions

This chapter covers the literature review of the existing research that is related to the present study. The first part of the chapter focuses on the translation directionality and emphasises the emergence of L2 and L3 translation practices and its significance in both translation studies and industry. It also highlights the difference between translation into one's mother tongue and translation into or between foreign languages, which led to the hypotheses of the present study and raised a list of questions that need to be investigated.

The second part of the chapter provides the literature review of the post-editing practices that particularly involve the productivity and quality of the human translations and post-edited outputs from TMs and MTs and consequently, raises several research questions, such as RQ1, 2, 4, 5 and 6. The literature review also highlights the findings of the existing studies, using different approaches such as experimenting with different language pairs, MTs and TMs and measuring PE speed at the segment level. Since the present study also adopts a different research

methodology that will be discussed in Chapter 3, it has led to several additional research questions, such as RQ2, 3 and 7.

The second part of the chapter also describes the state of post-editing practices in the Arab world and the teaching of Arabic and English in Brunei and highlights the existing studies that involve the types of Arabic-English MT errors and error typologies used in the studies. These types of errors are later discussed in Chapter 4 and 5 to identify the common types of MT errors for the Arabic-English language pair and the errors that the Malay trainee translators left unchanged or unnoticed after PE. Other than RQ2, these findings will hopefully answer RQ8, which particularly addresses the design of PE training and guidelines for L2 and L3 post-editors, particularly the Malay learners of Arabic and English, based on the findings of the present study.

Chapter 3: Methodology

In this chapter, I will describe the methodology adopted in this study and the processes involved in the research project.

3.1 Research design

3.1.1 Sample

3.1.1.1 Criteria for selecting translators

In view of this study's focus on L2 and L3 translation, it required participants who are competent to do so. To participate in this research, the participants must at least have a good command of both English and Arabic and be able to translate into a foreign language. This means that they must have the necessary knowledge of English and Arabic, and are able to at least understand and write well in the two target languages. To find the suitable participants, I approached a lecturer at Sultan Sharif Ali Islamic University in Brunei, inquiring on the list of final year students who majored in Arabic language and have a good command of English. In addition, they must be willing to participate throughout the whole research project.

Once the main criteria were met, the participants were required to translate a short text into their second language in order to see their level of linguistic and translation competence. This translation task was one of the three tasks that the participants needed to do in the research project. At the end of the project, I gave the participants a short questionnaire (Appendix C) designed to find out their years of learning English and Arabic, their level of knowledge of translation, their first and second language(s) as well as feedback from the participants regarding their experience during their project.

3.1.1.2 Research ethics

The present study involves human participation in the research project, which required approval from the University of Leeds to ensure that the present study was conducted according to the university's values and policies. The research proposal was reviewed by the Arts and PVAC (PVAR) Faculty Research Ethics Committee and approved in the first year of the study. Prior to the research project, the participants attended an introductory session, in which they were provided with the project information sheet (Appendix A), which includes a brief explanation of the study. The researcher also informed the participants that the participation was voluntary and they could leave the project without giving any reason. Also, they were informed that their participation is kept unanimous and strictly confidential. Once they agreed, they were required to sign a consent form (Appendix B).

3.1.1.3 Translators

The research project was experimented with six Malay students who are non-native speakers of Arabic and English. This experiment was conducted at Sultan Sharif Ali Islamic University in Brunei. The participants were undergraduate students of the university, studying Arabic linguistics as their major at the time of the project. Four of them stated that they have basic background knowledge of translation methods and strategies that they learned in one of their final year modules. They had previously used MT engines but have no knowledge of CAT tools and post-editing.

As most students who are currently studying at the university, these trainee translators have studied Arabic since preparatory level (Year 5) and English since pre-school or even earlier than that as parents in Brunei nowadays are mostly well-educated and

often speak English with their children at home. In addition to Malay and English, Arabic schools in Brunei mostly offered modules through the medium of Arabic. At the university level, proficiency in Arabic language is one of the requirements to study Arabic medium degree programmes. In addition, the university's students are required to take English language module as part of their programmes to improve their proficiency in English at the same time. Therefore, their proficiency in Arabic and English is good enough to entitle them to participate in this project. In the questionnaire, four participants stated that English is their second language whereas the other two stated that both English and Arabic are their second languages.

Apart from translators' background, Table 1 also shows the participants' translation test scores in both translation directions, which were initially assessed using Waddington's (2001) holistic approach to translation quality assessment. The results indicate that the translators had higher scores in the English-Arabic translation than they did in the Arabic-English translation. This may suggest that the translators were more competent in the English-Arabic translation. Later in the analysis, the translators' test scores were compared to the quality of their translations in the post-editing tasks to see whether the quality had improved.

Translator	AR-EN translation test	EN-AR translation test	Second language	No. of years of learning	Third language	No. of years of learning
1	3	5	English	15	Arabic	11
2	3	5	English	18	Arabic	11
3	4	5	English	-	Arabic	11
4	4	6	English and Arabic	17 & 13	-	-
5	3	5	English	16	Arabic	12
6	4	5	English and Arabic	17	-	13

Table 1: Translators' background and translation competence tests' results.

3.1.2 Source text selection

In view of the participants' different levels of competence in both Arabic and English, it was difficult to find suitable texts for each of them. Therefore, I have prepared a collection of technical texts: legal and journalistic, both in Arabic and English. The sample texts had to be non-literary because translating literary texts poses more challenges to the participants as they hardly had any specific training in translation. Furthermore, providing training in literary translation requires more effort and time.

In the research project, the participants managed to translate 11 source texts: 6 English and 5 Arabic texts. Generally, the texts range from 116-311 words. Initially, the participants were required to translate short texts so that they would become familiar with the post-editing task on a commercial CAT tool before they could deal with longer texts. The following table is a list of the texts used in this study in the order they were translated:

Text	Topic	Genre	Translation direction	Word count	Task
1	Political system in Brunei	Political	EN-AR	129	Translation from scratch
2	Astronomy	Scientific	AR-EN	116	Translation from scratch
3	UN peacekeeping operations in Egypt	Journalistic	AR-EN	151	PEMT
4	Financing of the support account for peacekeeping operations	Legal	EN-AR	162	PEMT
5	Immigration	Journalistic	EN-AR	238	PEMT
6	Dubai hotels	Journalistic	AR-EN	264	PEMT
7	Morocco	Tourist	AR-EN	308	PETM+MT
8	Brunei's economy	Journalistic	EN-AR	311	PEMT
9	Marib	Documentary	AR-EN	309	PETM+MT
10	Proposed budgetary levels for peacekeeping operations	Legal	EN-AR	216	PETM+MT

11	Approved budgetary levels for peacekeeping operations	Legal	EN-AR	297	PETM+MT

Table 2: A list of texts used in this study, which indicates text type, translation direction, word count and type of task.

According to the data, the average sentence length in the Arabic texts ranges from 19-38 words per sentence, which are longer than the average English sentence length, ranging from 12-24 words per sentence. Al-Taani et al. (2012, p.109) state that "the average length of an Arabic sentence is 20 to 30 words, and in some sentences, the number of words exceeds 100". Therefore, I have decided to use the 20-to-30-word range as the threshold set for the average or medium sentence length in the analysis. In contrast, the average sentence length in English is 15-20 words as suggested by Cutts (2013, p.xi). Therefore, it would be interesting to see the dynamics of the dissimilarity in the sentence length between both languages could affect the PE speed and translation quality.

3.1.3 Machine Translation engines

In this project, I have opted two state-of-the-art statistical machine translation (SMT) engines: Google Translate and Microsoft's Bing Translator. The machine translation (MT) was integrated into MemoQ 2014 through plug-ins. The MT outputs were generated during the project. Hence, the analysis of the MT outputs is only limited to the data generated within the project's timeframe. The data is also limited to the Arabic-English language pair as it is one of the foci of the study.

3.1.4 Computer-assisted translation tool

3.1.4.1 MemoQ 2014

For the purpose of the study, MemoQ 2014 was adopted because it offers many features that are needed to gather and analyse the data of the project. The software offers a track changes feature, which is used for identifying the changes made during the translation process and the source of the post-edited outputs. This allows to measure the number of errors corrected and newly introduced in the PE tasks.

For post-editing tasks, MemoQ 2014 offers two useful features: Edit Distance and Editing Time features, which allow the researcher to measure the effort made and record time spent in post-editing.

Another useful feature in MemoQ is linguistic quality assurance (LQA). It allows users, especially reviewers and researchers, to annotate errors and generate an automated TQA report by using existing TQA models or creating a new one from scratch. Most CAT tools, including MemoQ, consist of the main subsystems, such as Translation Memory, terminology database (termbase) and MT integration. Overall, MemoQ is a useful and user-friendly tool for various processes.

3.1.4.2 Translation Memories

For this study, I have compiled a collection of the United Nations English-Arabic parallel texts, which consist of resolutions and annual reports. These documents were collected from the MultiUN parallel corpus, which was developed by EuroMatrixPlus. The current version of the corpus is extracted "from the United Nations official documents from the (Official Document System) ODS of the United Nations where most of the documents are encoded in Microsoft Word DOC format. The bulk of the data obtained is from the years 2000 up to 2009" (Eisele and Chen, 2010, p.2869). The

documents are downloadable for free on the EuroMatrixPlus website[2]. In addition to these documents, I have used translation work done by the University of Leeds' MA students in their specialised translation classes.

All parallel texts were stored in translation memories, which the participants used as reference in the post-editing TM+MT task. The TM outputs had been deliberately modified to include errors to increase the difficulty level of the task and to see how critical the translators are in performing their task. Within limited amount of time, we only managed to use four source texts for this task in Brunei: two Arabic and two English source texts as shown in Table 2. Therefore, I have run analysis on the source texts and existing translation memories using MemoQ to generate statistics report for fuzzy matches and repetitions. The statistics are as follows:

Type	**AR-EN**		**EN-AR**	
	Number of segments	Number of words	Number of segments	Number of words
Repetition	0	0	2	5
101%	0	0	6	14
100%	9	96	6	40
95-99%	1	5	2	33
85-94%	2	57	0	0
75-84%	1	32	3	102
50-74%	8	161	5	193
No match	12	266	4	126
Total	33	617	28	513

Table 3: Statistics for fuzzy match analysis on the 4 edited source texts and existing TMs.

[2] http://www.euromatrixplus.net/multi-un/

3.2 Project stages

As previously mentioned, this study was conducted at Sultan Sharif Ali Islamic University in Brunei over a 6-week period from February to April 2015.

3.2.1 Pre-task stage

At the beginning of the project, the participants were provided with basic knowledge of translation methods and strategies. In addition, they were given an introduction on how to use MemoQ 2014 as this is the CAT tool they were required to use in the experiment. Handouts were provided so that they could follow along while I was demonstrating and then they could practice afterwards. The introduction consists of basic instructions on how to utilise the tool such as creating a project, terminology database, translation memory and post-editing.

For this study, the translators were required to complete three different tasks: translation from scratch (TFS), post-editing machine translation (PEMT) and post-editing modified translation memory and raw machine translation outputs (PETM+MT). In the first task, the translators were required to translate a short text in both Arabic and English (as shown in Table 2) with resources of their choice. This task was designed to evaluate their language and translation proficiency, which were later compared with their performance in the other two tasks. The reason for choosing the particular texts is their familiarity with Islam and the political system in Brunei. Therefore, it was assumed that it is easier for them to translate such texts.

3.2.2 Post-editing stage

In the post-editing stage, the translators were required to complete the remaining two tasks repetitively as post-editing is one of the main focuses of this study. Task repetition can result in some improvements in linguistic competence, such as fluency and accuracy (see examples in Bygate, 2009; Lynch and Maclean, 2000). The translators had an hour to complete each task and the duration of each task was also recorded individually. In the second task, the translators were required to translate by post-editing MT outputs in MemoQ. In the study conducted in Brunei, the translators managed to translate 3 English and 2 Arabic texts (as shown in Table 2).

In the final task, the translators were required to translate by post-editing TM outputs. Even so, they were allowed to refer or choose to post-edit MT outputs only when they could not find any usable suggestion. The source texts for this task were edited because the translations of these texts were compiled in the translation memory used for this task. Therefore, having the same source texts as the ones restored in the TM, would make the task very easy and redundant. As mentioned previously, the TM outputs had also been deliberately modified to include errors to increase the difficulty level of the task and to see how critical the translators are in performing their task. In the study conducted in Brunei, the translators managed to translate 2 English and 2 Arabic texts as shown in Table 2.

3.2.2.1 Instructions and guidelines for post-editing

For the purpose of this study, the participants were not specifically required to perform light or full post-editing but instead they were required to do as many edits as they considered necessary. The purpose of this instruction was to investigate to which PE type the non-native trainee translators were inclined and how critical they are in

carrying out the tasks. The present study adopted TAUS post-editing guideline (2010) for the PE tasks, which could be used for achieving good enough and publishable quality.

To achieve a good enough quality, the post-editor needs to:

- "Aim for semantically correct translation.
- Ensure that no information has been accidentally added or omitted.
- Edit any offensive, inappropriate or culturally unacceptable content.
- Use as much of the raw MT output as possible.
- Basic rules regarding spelling apply.
- No need to implement corrections that are of a stylistic nature only.
- No need to restructure sentences solely to improve the natural flow of the text".

To achieve a publishable quality, the post-editor needs to:

- "Aim for grammatically, syntactically and semantically correct translation.
- Ensure that key terminology is correctly translated and that untranslated terms belong to the client's list of "Do Not Translate" terms.
- Ensure that no information has been accidentally added or omitted.
- Edit any offensive, inappropriate or culturally unacceptable content.
- Use as much of the raw MT output as possible.
- Basic rules regarding spelling, punctuation and hyphenation apply.
- Ensure that formatting is correct".

Prior to the post-editing tasks, the participants were advised to enable the MT plug-ins and time tracking feature in the settings. They were also advised to use the provided TMs accordingly. The outputs of MT and TM are automatically generated and can be seen on the translation results pane, which is usually located in the upper-right corner

of the MemoQ translation window. Figure 1 displays the suggestions retrieved from the MT and TM outputs. Each source is colour-coded and can be customised in the settings. In the figure, the maroon tab represents the output from the TMs, the orange tab represents the output from the MTs and the yellow one represents the terms retrieved from the glossary.

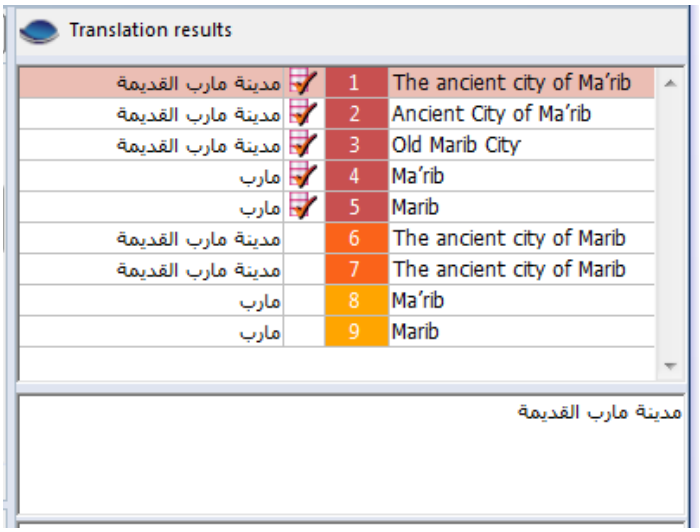

Figure 1: Translation results pane in MemoQ

The minimum threshold of the TM coverage for this study is 70%. Therefore, the pane will only show suggested translations that reach the minimal matching threshold. Any matches with a similarity score lower than 70% will not be shown but in this instance, MemoQ will automatically attempt to retrieve any possible match using its automated concordance or longest substring concordance (LSC) hits. If the translators cannot find any usable suggestions from the concordance, they were allowed to choose and post-edit any outputs from MT.

3.2.3 The annotation stage

In the annotation phase, I have adopted MeLLANGE error typology to classify and quantify the number of errors and find out the error regularities that the participants made. At the beginning of this stage, I have manually annotated and quantified the errors using MeLLANGE error typology. As previously mentioned, the error annotation using this method is very time-consuming. Therefore, I resorted to MemoQ's LQA feature to boost the annotation process.

According to MeLLANGE (2007), "The error typology is not meant to contribute to any evaluative process, the focus being on describing and studying specific translation phenomena rather than giving any quality judgment". However, the purpose of using the MeLLANGE error typology is to provide a comprehensive error analysis that quantifies the number of each type of errors which can help us understand the cause of these errors, especially in the post-editing tasks. Thus, we can also identify which text, segment, translation direction or even translator contributes the most errors. The MeLLANGE error typology distinguishes between content- and language-related errors. Each of these categories is divided into subcategories such as distortion, syntax, terminology and lexis as shown in Table 4.

Content transfer	**Language**
Omission	Syntax
Addition	Wrong preposition
Distortion	Inflection and agreement: • Tense/aspect • Gender • Number

SL intrusion: • Untranslated translatable • Too literal • Units of weight/measurement, dates and numbers	Terminology and lexis: • Incorrect • Term translated by non-term • Inconsistent with glossary • Inconsistent within TT • Inappropriate collocation Hygiene: • Spelling • Incorrect case (upper/lower) • Punctuation Style: • Awkward • Tautology

Table 4: MeLLANGE error typology

The disadvantage of using this approach is that error classification is very time-consuming and sometimes can be tedious and complicated because categorising the errors is an annotator's subjective judgment.

3.2.4 Variables

According to TAUS (2010b), "the overall aim of any translation automation solution is to accelerate throughput at consistent quality levels". Therefore, the present study aims to measure both PE speed and quality of the translations produced in the research project.

3.2.4.1 PE speed

To calculate the PE speed, the total number of word is divided by the total time spent on the task. Since the present study also investigates the PE speed at segment level, the total number of word of both ST and TT sentence is divided by total time spent on translating or post-editing the sentence. Therefore, the study mostly uses words per minutes (WPM) to indicate the PE speed and words per day (WPD) to validate Hypothesis 2. To validate the hypotheses of this study, the average PE speed of each task was compared to observe the differences in speed.

- Word count

  To ensure the consistency of the word count, the present study only uses one software program, MemoQ 2014, since it also offers a feature for project analysis report. The report typically offers word count of both source and target texts, fuzzy matches, number of segments, which translators uses to create quotes for their translation services.

- Time

  The total time spent on the tasks were recorded by means of a built-in feature which the translators were required to activate before commencing the post-editing tasks. However, this feature could be unreliable if the same segment is post-edited and saved more than once. Therefore, to ensure the accuracy of the time spent on each segment, the translators were advised to only confirm the target segment when they are confident that the segment does not need further changes.

3.2.4.2 Quality

As previously mentioned, an error analysis approach was adopted to determine the quality of the translations. To observe the differences in quality, the present study compared the quality of the translations of each task. The present study adopted the MeLLANGE error typology for the error analysis approach, which could also help the researcher identify the types of the errors the non-native trainee translators made.

In addition, I adopted MemoQ's LQA feature to generate an error analysis report automatically based on the MeLLANGE error typology. Each error is penalised based on the level of severity. Major errors are penalized with 5 points whereas minor errors with 1 point. The reason for including the level of severity in the analysis is because the number of errors can be overwhelming. Two translations, for example, may have similar amount of errors but the quality may vary because one may have fewer major errors than the other.

MemoQ's LQA feature automatically calculates the normalised score of the translations. The pass mark threshold normally depends on the clients' requirements. For this study, I have adopted the 0.90 or 90% pass mark threshold according to the European Commission's standard quality threshold as reported by Paspartu (2016). Since the participants are translation trainees, I have also used the threshold Temizöz (2013) used in assessing translation quality, which is 0.85 or 85%.

3.3 Conclusions

This chapter provides the methodology adopted in this study, describing the research design and the processes involved in the research project. The first part of the chapter aims to shed some light on the research design, which involves the Malay trainee translators as the subjects of the study, the research ethics which was approved by the

University of Leeds' Arts and PVAC (PVAR) Faculty Research Ethics Committee, the 11 source texts used in the research project, Google Translate and Bing Translator as the SMT engines used to generate the raw MT output for the project, and MemoQ 2014 as the computer-assisted tool to gather and analyse the data of the project. The translation memories (TMs) for this research project had been deliberately modified to include errors to increase the difficulty level of the task and to see how critical the translators are in performing their tasks.

The second part of the chapter describes the project stages. The pre-task stage involves the introduction of the translation methods and strategies and the basic knowledge of using MemoQ 2014 and post-editing. As mentioned previously, the research project involves three different tasks and one of them is translation-from-scratch (TFS) tasks given to the participants to evaluate their language and translation proficiency. Hence, the findings will be discussed in Chapter 4, in which they will also be compared with the results from the analysis of the post-editing tasks.

In the post-editing stage, the Malay trainee translators were required to do two types of post-editing tasks: post-editing MT output (PEMT) and post-editing output from the TMs and MTs (PETM+MT). Also, in the PETM+MT tasks, the trainee translators were advised to prioritise the output from the TMs. If they cannot use any suggested translations retrieved from the TMs, they could choose and post-edit any MT output.

The last stage of the project is the error annotation, which adopts MeLLANGE error typology to identify the types of errors commonly found in the three different tasks. These findings will eventually answer RQ2, 3 and 8. In addition to the error annotation method, variables, such as PE speed and quality, are measured. The PE speed is measured by words per minute (WPM) to answer RQ1, 4, 5, 6 and 7, and by words per day (WPD) to validate Hypothesis 2, which assume that non-native speakers can

be as productive as native speakers in post-editing. The quality of the translations in the three different tasks will also be measured using MemoQ's LQA feature to generate error analysis report. Each error is penalised based on the level of severity: 5 points for major errors and 1 point for minor errors. To measure the translation quality, the present study also uses the 0.90 or 90% pass mark threshold according to the European Commission's standard quality as reported by Paspartu (2016), and the 0.85 or 85% threshold that Temizöz (2013) used in assessing the quality of the translations done by trainee translators.

Chapter 4: Results

This chapter presents the results of the analysis of the data gathered from the research project conducted with the non-native trainee translators. This chapter begins with the discussion on productivity, which covers the non-native trainee translators' speed and the number of edits involved in each task. The second part of the chapter discusses the quality of the non-native trainee translators' translations in all three tasks, the error classification, the number of corrected and newly introduced errors as well as the source of the errors.

4.1 Productivity

This section discusses the non-native trainee translators' processing speed and the number of edits involved in the PE process, and then the results of each task are compared to one another in order to see any differences in speed and edit distance. Also, the section aims to see if there is any correlation between speed and the number of edits. The hypotheses for this section are as follows:

1. Productivity increases with more resources in one translation environment.
2. The non-native speakers can be as productive as native speakers in post-editing.
3. The slower translators edit more content than the fast translators.
4. Longer sentences tend to cause more errors, which slow down the PE speed.
5. Higher fuzzy match values increase the PE speed.

4.1.1 Processing speed

4.1.1.1 Speed in three different tasks

In this section, the processing speed for each task was compared to see whether the translation technologies can help increase the non-native trainee translators' speed through post-editing. As previously mentioned, the processing speed for each task was measured by words per minute (WPM). The results in Table 5 show the differences in speed in all three tasks in each translation direction.

Translator	**AREN**			**ENAR**		
	TFS	PEMT	PETM+MT	TFS	PEMT	PETM+MT
1	1.32	22	19	0.81	19	32
2	1.28	17	16	0.91	17	18
3	1.2	14	11	0.98	5	7
4	1.25	9	13	0.86	11	12
5	1.29	11	11	0.85	16	16
6	1.3	13	15	0.87	12	27
Arithmetic mean	1.27	14	14	0.88	13	19

Table 5: Comparisons between the average processing speed for each task, in words per minute (WPM).

As we can notice from the results, the non-native trainee translators have equal average processing speed in the TFS tasks. The reason for this was the translators did not manage to finish their translations on time. Therefore, they were required to complete the translations at home and submit them in the next session. Unfortunately, there was no record of the number of words they managed to translate. Therefore, I had decided

to measure their performance in that task based on the number of words in their translations and the duration of each task.

$$\frac{No.\,of\ words\ in\ the\ translation}{120\ minutes} = average\ TFS\ speed$$

As we can see in Table 5, all translators have shown productivity gains in the post-editing tasks. In the Arabic-English translation, the average processing speed for the PEMT and PETM+MT tasks was 11 times faster than that of the TFS task. Similarly, in the English-Arabic translation, there is also an increase in speed in both PE tasks, indicating that the translators were about 14-15 times faster in the PEMT tasks and approximately 21-22 times faster in the PETM+MT tasks. The considerable increase in the average processing speed shows that both machine translations and translation memories could help improve the non-native trainee translators' speed through post-editing. These results support Zampieri's and Vela's (2014) findings in a similar study which compares the average processing speed in three different tasks, indicating that the average processing speed in both post-editing tasks increased by 28.87% and 52.82% respectively.

When compared to the PEMT tasks, however, the average PE speed for the PETM+MT only increased in the English-Arabic translation by 46.2%. A possible explanation for this is the quality of the English-Arabic MT outputs for the UN documents was good enough and did not require many changes. Furthermore, the modified translation memories were also of good quality. This can be seen in the number of remaining and corrected errors in section 4.2., in which the results indicate that the non-native trainee translators produced and corrected fewer errors in the English-Arabic translation in the PETM+MT tasks. Nevertheless, the overall results

indicate that the non-native trainee translators performed faster in the post-editing tasks when compared to their average processing speed in the TFS tasks.

4.1.1.2 Daily productivity: non-native trainee translators' performance

As mentioned in the previous section, post-editing can increase translator's productivity, but the question here is whether or not non-native translators can reach the average daily productivity for native translators, which is 5,000 words per day (De Almeida and O'Brien, 2010, no pagination). According to KantanMT (no date), a localisation company that provides a cloud-based statistical machine translation platform, the company "works with many companies whose translators are post-editing at a rate over 7,000 words per day, compared to an average of 2,000 per day for full human translation". Therefore, to validate the second hypothesis, the translators need to reach the average daily productivity, which is at least 2,000 words per day in the TFS tasks and at least 5,000 words per day in the post-editing tasks.

Translation from scratch			
AR-EN		EN-AR	
Words per minute (WPM)	Words per day (WPD)	Words per minute (WPM)	Words per day (WPD)
1.27	610	0.88	422

Table 6: Processing speed in the TFS tasks.

Table 6 shows the average processing speed in the TFS tasks, which was measured per minute (WPM) and words per day (WPD). The words per day were measured by 8 hours per day (De Almeida and O'Brien, 2010, no pagination). As we can see from

the results, the average daily productivity in the TFS task is approximately 610 words per day in the Arabic-English translation and 422 words per day in the English-Arabic translation. The average number of translated words here is relatively low when compared to the average number of words produced by native translators per day. In this study, the translators have failed to reach the average daily productivity for full human translation. However, it is unfair to compare non-native trainee translators to professional native translators. With proper training and years of translation experience, I believe that these translators can potentially be as productive as professional native translators because overall, they have successfully reached the average daily productivity in the PE tasks.

Translator	**PEMT**				**PETM+MT**			
	AREN		ENAR		AREN		ENAR	
	WPM	WPD	WPM	WPD	WPM	WPD	WPM	WPD
1	22	10,560	19	9,120	19	9,120	32	15,360
2	17	8,160	17	8,160	16	7,680	18	8,640
3	14	6,720	5	2,400	11	5,280	7	3,360
4	9	4,320	11	5,280	13	6,240	12	5,760
5	11	5,280	16	7,680	11	5,280	16	7,680
6	13	6,240	12	5,760	15	7,200	27	12,960
Arithmetic mean	14	6,720	13	6,240	14	6,720	19	9,120

Table 7: Processing speed in the post-editing tasks in each translation direction.

As can be seen in Table 7, the non-native trainee translators collectively managed to reach the average daily productivity in the PE tasks, with an average of 6,240-6,720 words per day in the PEMT tasks and approximately 6,720-9,120 words per day in the PETM+MT tasks. However, individually, Translator 3 did not manage to reach the

average daily productivity in the English-Arabic translation in both PE tasks, indicating that the translation direction affected her PE speed. A possible explanation for this is that she might have struggled with typing in Arabic as standard keyboard layout does not display Arabic letters. Hence, it slows down her PE speed. Her reading speed may also have affected her PE speed. Unfortunately, the present study does not provide such data as it is beyond its scope.

Similarly, Translator 4 could not reach the average daily productivity in the Arabic-English translation in the PEMT tasks but she managed to improve her PE speed in the PETM+MT tasks. Nevertheless, the increase in speed suggests that the translation technologies could help improve the non-native trainee translators' speed and the non-native trainee translators (Malay speakers in this case) can be as productive as the native translators.

Overall, the productivity gain may not always reflect the quality of the non-native trainee translators' work at this stage but given that they had little knowledge of translation and using the technology, their progress is promising as Vasconcellos (1986, p.145) states that post-editors may take a while to develop their skills to their maximum potential.

4.1.1.3 Speed at segment level

This section attempts to investigate whether sentence length and fuzzy matches affect the translators' performance in terms of speed. Logically, the shorter the sentence is, the easier and faster it is to translate, and the same applies to the sentence with higher percentage fuzzy match. However, Tatsumi (2009, p.7) conducted a similar test study on the effect of sentence length on the PE speed, and the results show that "very short or very long sentences seem to slow down the PE process". In her thesis, Tatsumi

(2010, p.146) also studied the effect of 75-99% matches on the PE speed and the results suggest that "the average PE speed for MT output is *at least* faster than the average editing speed for 75-79% matches". Guerberof (2012) also had a similar test study on fuzzy matches, but she only focused on the 85-94% matches. The results of her study show that the average processing time for MT matches is the fastest, followed by the fuzzy matches (85-94%), and lastly, the no match segments. However, in this study, I included all fuzzy matches as well as the no match segments, which retrieve outputs from the automated concordance search and MT engines.

In contrast to Tatsumi's (2010, 2009) studies, the present study measures the average PE speed by both source and target sentence length because post-editing requires the post-editors to focus on both source text and target outputs. The results in Table 8 shows the average PE speed in the PEMT tasks by sentence length. The blue background represents the fastest speed, the red background represents the slowest, and the yellow background represents the value between the highest and lowest speed. The results indicate that the non-native trainee translators performed the fastest when translating long sentences, with an average of 18 words per minute in both translation directions. Not only does this contradict Hypothesis 4 but also the findings of the previous studies (Koponen, 2016; Tatsumi, 2009, 2010; Tatsumi and Roturier, 2010) because the analysis of the present research data also revealed similar results when measuring the average PE speed by the source sentence length.

Sentence length	PE Speed (word per minute)			
	Source text		Target text	
	AREN	ENAR	AREN	ENAR
Short	8	5	14	9
Medium	13	12	-	12
Long	14	13	18	18

Table 8: Average PE speed in the PEMT tasks by sentence length.

Table 9 indicates mixed results of the non-native trainee translators' average PE speed in the PETM+MT tasks. Nevertheless, the overall results suggest that the translators are more likely to perform the fastest when translating long sentences. Short sentences, however, are more likely to slow down their PE speed, which is also evident in the PEMT tasks.

Sentence length	PE Speed (word per minute)			
	Source text		Target text	
	AREN	ENAR	AREN	ENAR
Short	9	9	18	10
Medium	15	24	16	14
Long	15	13	20	14

Table 9: Average PE speed in the PETM+MT tasks by sentence length.

The results in Table 10 indicate that the average PE speed for the context matches (100-101%) is the slowest with an average of 11 and 6 words per minute respectively. In fact, it is even slower than the no match segments. The results also show that the PE speed increases when translating higher percentage fuzzy matches. Even so, the results also indicate that the translator performed faster when translating the no match segments, with an average of 14 words per minute, than they did when translating the 50-74% matches, with an average of 12 words per minute.

The results also suggest that the average PE speed for no matches is closer to the average PE speed for the 75-84% matches. This may suggest that the PE speed for the no match segments, in general, is not considerably lower than or the 75-84% matches. In contrast to Guerberof's (2012) findings, the present study revealed that the average PE speed for the MT matches is slower than the 85-94% TM matches.

Text	**Fuzzy match (Word Per Minute)**						
	101%	100%	95-99%	85-94%	75-84%	50-74%	No match
7	-	16	4	20	19	23	11
9	7	6	-	29	-	9	12
10	7	11	-	-	8	6	18
11	5	12	76	-	17	8	14
Arithmetic mean	6	11	40	25	15	12	14

Table 10: Average PE speed in the PETM+MT tasks by fuzzy match.

4.1.2 Edit distance

Previously, I have investigated and validated the first two hypotheses. Now, I am focusing on the next hypothesis: slower translators edit more than the fast translators. It is worth noting that other possible factors can slow down the translation process. However, the focus here is to see if there is any correlation between speed and edit distance.

Translator	AREN		ENAR	
	Speed	Edit distance (%)	Speed	Edit distance (%)
1	22	94.29	19	86.3
2	17	91.94	17	99.47
3	14	89.64	5	85.29
4	9	91.05	11	83.57
5	11	88.77	16	91.16
6	13	93.99	12	87.86
Arithmetic mean	14	91.61	13	88.94

Table 11: PE speed and edit distance in the PEMT tasks.

As previously mentioned, this study uses MemoQ's editing time and fuzzy edit distance features to approximate the PE speed and the number of edits involved in the translation process. To determine whether the translators are fast or slow, I have set the thresholds by measuring the mean of the PE speed and edit distance. The results in Table 11 indicate that Translator 3, 4, and 6 are the slower translators in the PEMT tasks in both translation directions whereas Translator 5 only slowed down in the Arabic-English translation. The overall results indicate that the slower translators in the PEMT tasks are more likely to make more edits than the fast translators, except in two instances where Translator 6, who is a slow translator in the Arabic-English translation, made fewer edits whereas Translator 1, who is a fast translator in the English-Arabic translation, made more edits.

Translator	AREN		ENAR	
	Speed	Edit distance (%)	Speed	Edit distance (%)
1	19	94.67	32	90
2	16	94.59	18	94.14
3	11	86.7	7	84.01
4	13	86.34	12	88.71
5	11	86.55	16	83.82
6	15	92.02	27	94.22
Arithmetic mean	14	90.15	19	89.15

Table 12: PE speed and edit distance in the PETM+MT tasks.

In the PETM+MT tasks, Table 12 also revealed similar results, indicating that the slower translators are more likely to make more edits than the fast translators, except in one instance where Translator 2, who is a slow translator, made fewer edits in the English-Arabic translation. A possible explanation for this is that both MT and TM outputs are of good quality and do not require major changes.

4.1.3 Conclusions on productivity

I have tested my hypotheses regarding productivity and found out that the trainee translators managed to complete their PE tasks although they failed to finish their TFS tasks on time. Therefore, they had to finish the tasks at home. To validate Hypothesis 1 and answer RQ 1, their processing speed in all three tasks was compared. When compared to their processing speed in the TFS, the results showed that they could

complete both PEMT and PETM+MT tasks approximately 11 times faster in the Arabic-English translation whereas in the English-Arabic translation, they were approximately 14-15 times faster in the PEMT tasks and 21-22 times faster in the PETM+MT tasks. When compared to the PEMT tasks, the average PE speed in the PETM+MT only increased in the English-Arabic translation by 46.2%. Nevertheless, the overall results answered RQ1 and validated Hypothesis 1, suggesting that both MT and TM outputs helped improve their speed

Despite not being able to reach the average daily productivity for full human translation (at least 2,000 words per day), the non-native trainee translators managed to reach the average daily productivity for post-editing, which is at least 5,000 words per day (De Almeida and O'Brien, 2010, no pagination), except Translator 3 in the English-Arabic translation and Translator 4 in the Arabic-English translation. Nevertheless, the overall results validated Hypothesis 2, showing that the non-native trainee translators can be as productive as professional translators, especially given that they had very little knowledge of translation and no experience in post-editing and showed progress within a limited time frame.

I also looked further into the variation in the PE speed based on both source and target sentence length to answer RQ5 and validate Hypothesis 4. The findings of the analysis could not validate Hypothesis 4 but the overall results indicate that the non-native trainee translators are more likely to perform the fastest when translating long sentences in both translation directions, in contrast to the findings of the previous studies (Koponen, 2016; Tatsumi, 2009, 2010; Tatsumi and Roturier, 2010), which revealed that very long sentences slowed down their post-editors' speed. Regardless, the results of the present study also support the findings of the previous studies,

suggesting that short sentences slow down the PE speed. The variation of speed at the segment level suggests that sentence length could affect the PE speed (RQ5).

It was also hypothesised that the higher the fuzzy match value, the faster it takes to translate the segment. However, Hypothesis 5 could not be validated because the translators performed faster when post-editing 'No Match' outputs than they did when post-editing the outputs of 50-74%, 100% and 101% match values. This may suggest that they did not blindly accept the TM outputs and are aware of some errors seeded in the TMs. The results also revealed that post-editing MT matches is slower than post-editing the 85-94% matches in contrast to Guerberof's (2012) findings. Nevertheless, the findings answered RQ6, suggesting that the fuzzy match value could affect the PE speed.

The study also demonstrated positive results when testing Hypothesis 3 whether the slow translators made more edit than the fast translators. However, there was no indication that the translation technologies influenced the number of edits because the analysis showed mixed results.

4.2 Error analysis and quality assessment

In this section, I will investigate the validity of the remaining hypothesis regarding quality:

1. The quality increases with more resources in one translation environment.
2. The slower translators produce better translations than the faster ones.
3. Longer sentences tend to cause many errors, which slow down the PE speed.
4. Higher fuzzy match values increase the translation quality.

In this section, the errors are analysed and classified based on MeLLANGE error typology. As the number of errors increases, the quality decreases. However, the total

number of errors may be overwhelming because two translations, for example, may have a similar amount of errors but one translation may have more major errors while the other may have a higher number of minor errors. Therefore, it is important to consider the severity levels of the errors (major and minor errors) in the analysis. The foci of the error analysis are as follows:

- to examine the types of errors commonly found before and after PE by measuring the number of errors the non-native trainee translators managed to correct;
- to investigate the source of the errors such as source references (MT and TM), linguistic interference or source text features;
- to study the quality of the translations based on the sentence length and fuzzy match.

4.2.1 Quality evaluation

4.2.1.1 Quality in three different tasks

As previously mentioned, this study focuses on translation between second and third languages: English to Arabic or vice versa. The translators participated in this study are Malay native speakers and were required to work with both translation directions (EN-AR and AR-EN) in each task. It is interesting to see whether the directionality may affect the quality of the translations produced by the non-native trainee translators.

The results in Table 13 show the normalised score of the translations, which was automatically calculated by MemoQ's linguistic quality assurance feature. The pass mark threshold is 0.90 or 90% according to the European Commission's standard quality threshold as reported by Paspartu (2016), which is indicated in blue font.

According to Temizöz (2013), the minimum acceptable level of quality is 0.85 or 85%, which is indicated in yellow font whereas the translations that failed to score above the quality threshold are indicated in red font.

Based on the results in Table 13, the translators did not pass the quality threshold set by both European Commission and Temizöz (2013) in both TFS and PEMT tasks. However, in the PETM+MT tasks, only 2 out of 6 translators passed the quality threshold set by the European Commission in the Arabic-English translation whereas 3 out of 6 translators passed in the English-Arabic translation. Based on the quality threshold set by Temizöz, 5 out of 6 translators passed the threshold in the Arabic-English translation whereas, in the English-Arabic translation, all of them reached the acceptable level of quality. The positive results in the PETM+MT tasks indicate that the integration of both TM and MT helped improve the quality of the translations and perhaps, could help meet the standard quality set by the clients.

Translator	**AREN**			**ENAR**		
	TFS	PEMT	PETM+MT	TFS	PEMT	PETM+MT
1	0.43	0.73	0.85	0.37	0.78	0.86
2	0.54	0.71	0.89	0.77	0.75	0.91
3	0.42	0.77	0.91	0.65	0.8	0.91
4	0.53	0.73	0.94	0.77	0.84	0.91
5	0.46	0.72	0.81	0.6	0.74	0.87
6	0.54	0.74	0.85	0.41	0.69	0.89
AVG.	0.49	0.73	0.88	0.6	0.77	0.89
TOTAL		(49%)	(79.6%)		(28.3%)	(48.3%)

Table 13: The normalised score of the translations in three different tasks.

Even though the translators did not pass the quality threshold in the TFS and PEMT tasks, the overall quality of the translations in the PEMT tasks increased by 49% in

the Arabic-English translation and 28.3% in the English-Arabic translation when compared to their translation score in the TFS tasks. This increase supports the findings of the previous studies (Daems et al., 2013; Garcia, 2011), suggesting that the quality of the translations increased through PEMT when compared to full human translation. In fact, the present study's results also support Garcia's (2011, p.229) findings, suggesting "post-editing seems to help when translating into the second language".

In the PETM+MT tasks, the overall quality also increased by 79.6% in the Arabic-English translation and 48.3% in the English-Arabic translation. This increase suggests that both machine translation and translation memories helped the non-native trainee translators to greatly improve their translation quality in both translation directions. When compared to the PEMT tasks, the overall quality of the translations in the PETM+MT tasks also increased by 20.5% in the Arabic-English translation and 15.6% in the English-Arabic translation. This increase suggests that the integration of both TM and MT helped the non-native trainee translators to optimise the quality of their translations in both translation directions even though the TMs were seeded with errors. These results contradict Bowker's (2005) findings, suggesting that the quality of the translations using the modified TMs is lower than that of using the unmodified TMs and full human translation.

4.2.1.2 Comparisons between speed and quality

Previously in section 4.1, I have investigated the non-native trainee translators' average PE speed. In this section, I attempt to compare their speed to the quality of their translations to validate Hypothesis 3, which supposes that the slower translators produce better translations. The results in Table 14 represents the comparisons

between speed and quality in the three tasks. Similar to the previous section, I have set the threshold here by measuring the means of the PE speed and quality. The translations with slower processing speed are shaded in red background and the translations that of better quality are shaded in blue.

As can be seen in Table 14, there were 32 occurrences when the translators completed their tasks at a lower speed and 22 occurrences when the translators completed their tasks at a higher speed. There was no strong indication whether the slower translators produced better translations. However, there were 18 out of 32 occurrences (56.25%) when the translators produced better translations at a slower speed, suggesting that slower translators are more likely to produce better translations than the fast ones. Also, the analysis could not validate whether the fast translators produce better translations than the slower ones due to equally mixed results.

However, it is evident in the results that the speed and quality differ among the translators, who can be categorised into three groups:

1. The fast translators who tend to produce better translation: Translator 1 and 2.
2. The slower translators who tend to produce better translation: Translator 3 and 4.
3. The slower translators who tend to produce poorer translation: Translator 5 and 6.

From here, we can see that the speed and quality greatly depend on the individual and resources used for the translation project. Nevertheless, the data analysis showed a considerable increase in the PE tasks when compared to the TFS tasks (as shown in section 4.1), suggesting that both MT and TM output used in this project helped the non-native trainee translators improve both their PE speed and translation quality.

Translator	PEMT										PETM+MT							
	AREN				ENAR						AREN				ENAR			
	Text 3		Text 6		Text 4		Text 5		Text 8		Text 7		Text 9		Text 10		Text 11	
	SPD	Qlty.	SPD	Qlty.	SPD	Qlty.	SPD	Qlty.	SPD	Qlty.	SPD	Qlty.	SPD	Qlty.	SPD	Qlty.	SPD	Qlty.
1	26	0.71	17	0.75	10	0.76	19	0.73	29	0.86	21	0.91	17	0.78	22	0.88	41	0.88
2	14	0.73	19	0.69	19	0.84	16	0.61	15	0.8	17	0.9	14	0.88	15	0.91	20	0.93
3	16	0.69	12	0.84	4	0.91	4	0.63	7	0.86	11	0.92	10	0.9	7	0.92	7	0.88
4	9	0.64	8	0.81	8	0.9	11	0.76	15	0.87	12	0.96	13	0.92	13	0.86	11	0.91
5	10	0.69	11	0.75	10	0.83	15	0.61	22	0.8	13	0.77	9	0.84	20	0.95	12	0.9
6	12	0.75	14	0.72	9	0.7	14	0.61	14	0.76	17	0.8	12	0.89	31	0.93	22	0.92
Arithmetic mean	15	0.7	14	0.76	10	0.82	13	0.66	17	0.83	15	0.88	13	0.87	18	0.91	19	0.9

Table 14: Comparisons between speed and quality in the post-editing tasks.

4.2.2 Error analysis

4.2.2.1 Error classification for the TFS tasks

Before investigating the types of errors commonly found in the PE tasks, it is crucial to identify the types of errors commonly found in the TFS tasks. The data revealed that the non-native trainee translators produced both content- and language-related errors. Lexical errors were the most problematic in the Arabic-English translation, which account for 18.4% of the total errors, followed by number, distortion in meaning, too literal, awkward style and syntactic errors. In the English-Arabic translation, there were only four errors commonly found. Syntactic errors were the most problematic in the English-Arabic translation, which account for 37.1% of the total errors, followed by gender, lexical errors and awkward style. Unlike in the Arabic-English translation, the top common errors in the English-Arabic translation are all language-related, suggesting that the translators' translations are comprehensible and they are more competent when translating from English (L2) into Arabic (L3).

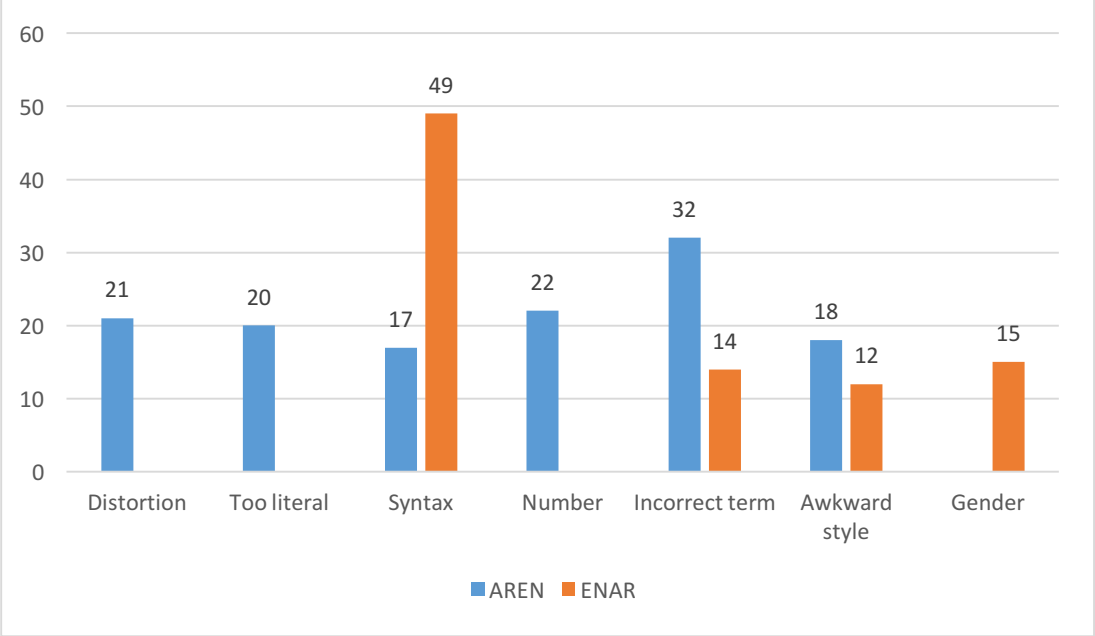

Table 15: The types of error commonly found in the TFS tasks.

4.2.2.2 Error classification for the PEMT tasks

Even though the analysis shows more positive overall results, it is also crucial to investigate the number of errors based on the type of errors and the severity level of errors in the PEMT tasks. The findings could give the researchers and developers more insight into the types of errors that the researchers and developers should focus on in improving the MT quality. In fact, post-editors could also benefit from listing the types of errors commonly found in a language pair, so that they could avoid making recurrent errors.

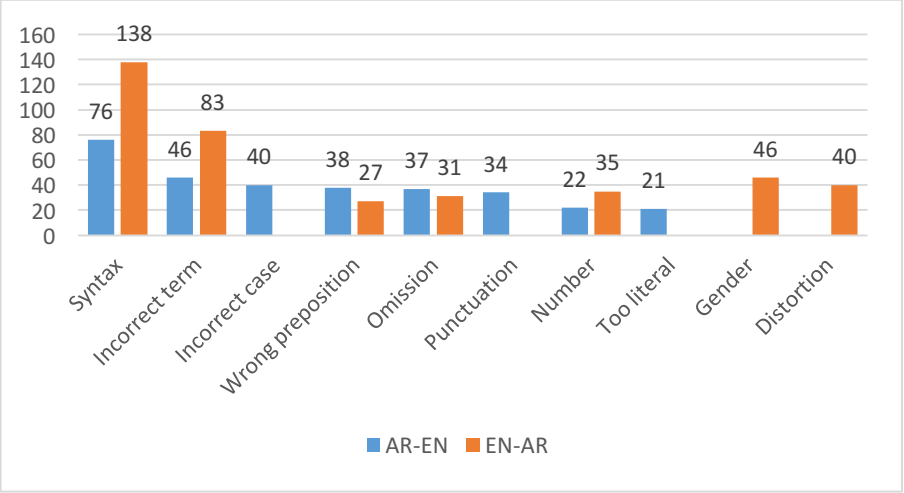

Figure 2: The types of errors commonly found in the PEMT task.

The results in Figure 2 show the types of errors commonly found in each translation direction in the PEMT task, suggesting that syntactic and lexical errors contributed the most errors in both directions.

- Syntactic errors

The results revealed that the highest number of errors is associated with syntactic errors in both AREN and ENAR directions with a total of 76 (19.3%) and 138 (29.9%) errors respectively. The results indicate that the non-native trainee translators were not paying attention to three types of syntactic errors, which can be corrected if pointed out to them:

1. Articles

According to the data, articles account for 56.6% of the syntactic errors found in the AR-EN direction. In the case of article-related errors, it may be difficult for Malay speakers to notice them because articles in Malay may be different from Arabic and English depending on the context in which they are used. The definite "the" and "ال" (al) is equivalent to "itu", which can alternatively mean "that" in English and "ذلك" (ḏālik), for example, in Arabic. The indefinite articles in Malay are frequently expressed by quantity words or classifiers, which may or may not have direct equivalents in Arabic or English. For example, the Malay term "sebuah", which is a classifier for "rumah" (house). It has no direct equivalent in Arabic and English, but it can only be compensated with the indefinite article "a" (a house) in English or omitting "ال" from the noun "بيت" (bayt) in Arabic.

2. Conjunction "و" (wa)

Another common type of syntactic errors commonly found in the non-native trainee translators' translations is the missing conjunction "و" (wa), which

accounts for 46.4% of the syntactic errors found in the EN-AR direction. There are a few possible explanations for this:

- The translators' L1 (Malay) and L2 (English) may have influenced their translations because Malay and English rarely use the conjunction "and" or the Malay equivalent term "dan" to introduce sentences in written English and Malay. In contrast, the Arabic conjunction "و" (wa) is "very frequently used at the beginning of the sentences and paragraphs but not the first" (Fareh, 1998).
- The translators translated the texts in isolated segments on MemoQ and consequently, they forgot to make the final translations coherent and cohesive.

As a suggestion, the non-native translators need to revise their final translation as a whole, instead of revising it segment by segment. In addition, the non-native speakers of Arabic (Malay and English speakers in this case) should always be aware of the Arabic connectives, especially "و", when translating the equivalent terms into Arabic and when starting a sentence in Arabic if the nature of their language does not begin sentences with "and". Conversely, the Arab learners of English should also be aware when translating into English as findings of previous studies (Al-Khresheh, 2011; Al-Yaari et al., 2013; Tahaineh, 2014) show that the English discourse markers are one of the most problematic syntactic errors among Arab learners of English.

3. Word order

Another specific language-related error in the English-Arabic translations is the word order, which accounts for 14.5% of the syntactic errors. Word order

in Arabic differs from English and Malay. Even though word order in Arabic is flexible, there is two prominent word order in Arabic: verb-subject-object (VSO) and subject-verb-object (SVO), but in formal writing, the former is preferable.

According to the data, some translators used SVO word order instead of VSO. Even though SVO word order is permissible, but stylistically it is not preferable and in this study, it is considered as a minor error. Furthermore, since changing the word order may affect the grammatical rules, this may lead to grammatical errors for non-native speakers of Arabic if not carefully dealt with. English, however, only uses SVO, which can be more direct and easier for Malay speakers to correct as SVO is more common in Malay even though the nature of the word order in Malay is somewhat flexible.

4. Noun in a place of a verb and vice versa

In addition to the three top common errors, it may be worth noting that the MT systems tend to use a noun in a place of a verb and vice versa. For example:

Source text:

Immigration to Britain has not increased unemployment.

Arabic MT output:

الهجرة إلى بريطانيا لا تخفيض البطالة.

(Al-hijra ’ila briṭaniyā lā takfiḍ al-baṭāla)

Literal back translation:

Immigration to Britain no increase unemployment.

Several errors can be identified in the Arabic MT output above, but the focus of the discussion here is the noun "تخفيض" (takfiḍ), which is in a place of the verb "increased". In this case, the noun should be replaced with its verb form "تخفض" (tukaffiḍ). The literal back-translation may be comprehensible in English but in Arabic, it is grammatically incorrect. This information may be valuable to MT developers and should be included in the guidelines for PEMT, especially for the English-Arabic language pair.

- Incorrect term and lexis

  As previously mentioned, lexical errors are one of the most common errors found in both directions. A possible explanation for this is that the non-native trainee translators are unfamiliar with the specialised terminology and lack competence at the semantic level. Therefore, they accepted the terms suggested by the MT. Another possible explanation is that the MT mistranslated the terms as Arabic words may have different meanings, depending on the diacritics. In most Arabic texts, diacritics are omitted, except in religious texts, such as the Quran and Hadith, and language learning textbooks. The omission of diacritics creates ambiguity not just for non-native learners of Arabic but also for MT systems.

- Wrong and missing preposition

Grammatical errors such as number and wrong preposition, are both found in each direction. A possible explanation for this is some prepositions, such as "ب" (bi) could mean "with or in" depending on the context. Occasionally, the translators tend to provide literal translations of the texts suggested by the MT, and sometimes

they did not notice the prepositions missing from the sentences. The reason for the absence of the preposition here may be due to non-identification of Arabic prepositions especially when they are attached to nouns and pronouns, or the MT's lack of linguistic knowledge especially when it comes to intransitive verbs. For example:

Source text:

…in respect of the United Nations Interim Force…

MT output:

...فيما يتعلق قوة الأمم المتحدة المؤقتة...

(fīma yataʻallaqu quwwatul umam al-muttaḥida al-mu'aqqata)

In the MT output, there is a missing preposition "ب" which usually collocates with the verb "يتعلق". The sentence should read as "فيما يتعلق بقوة" (fīma yataʻallaqu biquwwa).

- Incorrect number

The number in verbs and nouns can also pose translation problems in the Arabic-English language pair because Arabic has singular, dual and plural forms of nouns, pronouns, verbs, and adjectives, for example: "migrant workers" would be rendered as "العمال المهاجرون" (al-ʻummālul al-muhajirūn). Both the adjective and noun in the example are plural but in the English translation, only the noun is plural. The difference in grammar here may pose a problem for MT.

It is also worth noting that number can constitute a problem for Malay speakers in the PE process. Plurality in Malay is typically emphasised by reduplication, such

as “anak-anak” which means “children”, and often, quantity comes before a singular noun. For example, “dua hari” means “two days” in English. The quantity “dua” (two) comes before the singular form of the noun “hari”. Similar to this case, the plural noun, “الانتخابات” (al-intiḵābāt) for instance, was translated into its singular form in English “the election” by the MT. For Malay speakers, this may sound correct to them, or they may not have noticed the error because there is only a singular form of its equivalence in Malay, “pilihan raya”. Therefore, L1 interference may be a possible reason for the error here.

- Gender

Gender, however, is only found in the EN-AR direction, which can be attributed to L1 interference. Most Arabic words must indicate the gender whereas Malay is gender-neutral. Therefore, Malay speakers tend to produce make grammatical gender mistakes when they are not cautious. Moreover, if MT incorrectly translates the gender, Malay speakers may not notice the errors at times. The L2 (English) may also have an influence on the L3 (Arabic) production because unlike Arabic, English lacks grammatical gender. Hence, gender errors are commonly found in the English-Arabic MT outputs. For example:

Source text:

The annex reflects the resources…

MT output:

وتعكس المرفق الموارد...

(wata‘kis al-marfaq al-mawārid)

In the example, the grammatical gender in the verb "تعكس" (ta'kisu) is incorrect as it indicates femininity. For some reason, the grammatical gender in the verb agrees with the gender of the object "الموارد" (al-mawārid), which poses distortion in meaning as if the subject of the sentence is "الموارد" instead of "المرفق" (al-marfaq). The Arabic verb is supposed to agree with the gender of the subject "المرفق", which is masculine. Therefore, the correct sentence should use the correct prefix "ي" (ya), which indicates masculinity. The correct sentence should read as:

"ويعكس المرفق الموارد"

(waya'kis al-marfaq al-mawārid)

- Omission

In the AR-EN direction, 2 out of 9 errors are content-related: omission and too literal, which are typically associated with MT output. Post editors, especially non-native speakers of the target language, may occasionally not notice missing words that MT failed to process. For example, in the legal text, the MT omitted the term "Logistics" which is rendered as "لوجستيات" (lūjistiyāt) in Arabic and often omitted the term "Base", which is equivalent to "قاعدة" (qā'ida) in this context. Some translators, particularly in this study, have overlooked these omissions, and some managed to correct them. Again, current available MTs can only assist the translators to a certain extent. Therefore, they should pay attention to both source and target text in the PE process because if they only focus more on the target text, for instance, they would not notice any missing word or information in the source text.

- Too literal

Too literal translations, however, can be problematic for the non-native trainee translators because they are less likely to notice unnaturalness in the target language as stated by Chesterman (2004, p.38) and even the successful L2 translations may still lack naturalness (Rogers, 2005, p.271). However, proficiency in the target language cannot be achieved in a short amount of time, especially for the trainee translators. With proper and adequate training and years of experience, they could be as good as the professional native translators.

- Distortion

As we can see from the results, distortion is one of the two errors commonly found in the post-editing EN-AR MT task only. A possible explanation for this is the English-Arabic MT output is poorer in comparison with the Arabic-English MT output, suggesting that MT developers, such as Google and Microsoft in this case, should pay more attention to improving the EN-AR MT because bad outputs could hinder translators from producing acceptable translations. In this study, some translators may have given up on editing the segments with a high number of errors, especially when dealing with complex sentences.

- Hygiene: punctuation and incorrect case

As we can see in Figure 2, punctuation and incorrect case are specific to the Arabic-English MT. The punctuation errors may be due to the source language as Arabic tends to have long complex sentences as opposed to English, which may seem wordy if the MT translates the sentence too literally. In this case, the trainee translators should have split the long sentence into two or more sentences.

Regarding the incorrect cases, Arabic does not have the concept of capitalisation. Therefore, MT tends to provide lower or upper cases in the English outputs. Even so, the trainee translators should have paid attention to the cases when translating proper nouns or names into English.

4.2.2.2 Error classification for the PETM+MT tasks

Figure 3 represents the type of errors that contributes the most errors in each translation direction. The overall total of errors in the PETM+MT task is low when compared to the number of errors in the PEMT task. Therefore, I only included the types of errors that have more than 10 errors in Figure 3.

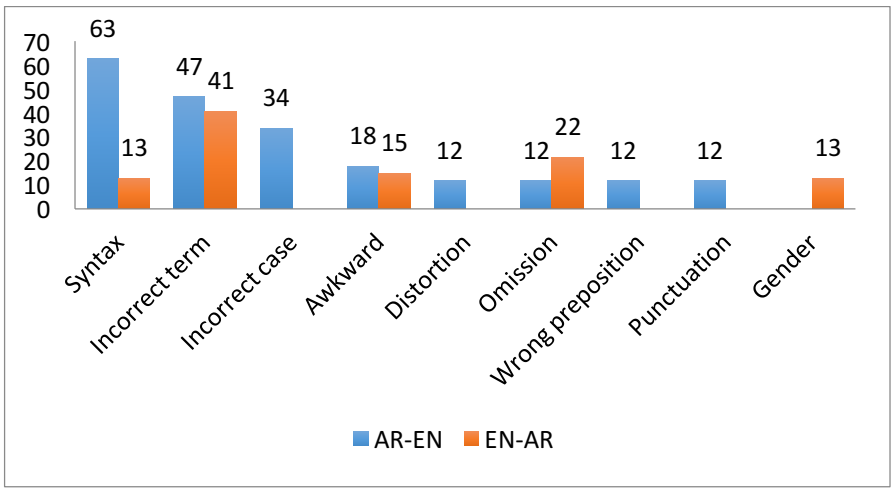

Figure 3: The type of errors that contributes the most errors in the PETM+MT task.

- Incorrect terms and lexis

Based on the error analysis, incorrect term and lexis contributed the most errors in both EN-AR and AR-EN translation with 41 and 47 errors respectively. A possible explanation for this is the translation memories were modified with different types of errors including incorrect terminologies, which the translators may or may not

have noticed. Alternatively, the trainee translators may have resorted to the MT outputs, which might also have provided incorrect equivalent terms.

- Awkward style

Awkward style is also commonly found in both directions. Certainly, this type of error does not originate from the TMs because the purpose of the modified TMs was to see if the trainee translators could notice the seeded errors in a natural-sounding target text.

Awkward style errors may have been caused by MT, which often does not provide stylistically natural target texts. It is also possible that the translators may have attempted to be overly creative in the PE process and consequently, they overcorrected the outputs.

- Distortion and omission

2 out of the 5 common errors in the Arabic-English translation are content-related: distortion and omission, whereas omission, is the only content-related error in the opposite direction. This may suggest that the translators may have found it difficult to comprehend the source text and mistranslated it, or they might have focused more on syntax and grammar and consequently forgot to check whether there is any missing information or change in the content of the source text. This may suggest that some translators may have performed monolingual PE in the process. Therefore, to avoid content-related and lexical errors, the non-native trainee translators should be advised to perform bilingual PE throughout the process.

- Syntactic errors

Syntactic errors are also commonly found in both directions. However, the trainee translators seemed to make considerably fewer errors in the EN-AR translations with only 13 errors when compared to a total of 63 errors in the AR-EN translations. In fact, syntactic errors are also the most common errors in the AR-EN translations. Several possible explanations for this are:

- the translators have a higher level of linguistic competence in Arabic than they do in English;
- they might have forgotten to pay more attention to syntactic errors in the AR-EN translation as the number of content-related errors is fairly low.

To understand the reasons for the difference in the number of syntactic errors in both directions, further investigation into the cognitive processes in translation is needed. However, to further examine the cognitive processes is beyond the scope of this research.

When compared to the translators' performance in the PEMT tasks, the number of syntactic errors in both Arabic-English and English-Arabic translations was decreased by 17.1% and 85.9%. It is undeniable that the number of errors in MT is still abundant when compared to the number of errors seeded in the TM. However, the translators did not choose to post-edit the TM outputs all the time as the number of occurrences of each source reference used in the PETM+MT tasks was almost 50-50 as shown in Table 25. This may suggest that having more than just one resource could help reduce the number of errors when one of which is a source reference of good quality. This could be an effective way to train the trainee translators to develop their resourcing skills by comparing the suggestions from both TM and MT in the post-editing process.

There are other similar errors commonly found in the PETM+MT tasks such as gender, preposition and punctuation. As previously mentioned in the PEMT tasks' results, the first two types of errors are more specific to English-Arabic translations and punctuation is more specific to Arabic-English translations. Incorrect cases, on the other hand, are more specific to Arabic-English MT errors as there were no case errors in the TMs.

4.2.2.3 Errors at segment level

In order to see whether the sentence length influences the quality of the translations, the number of errors by sentence length was normalised. To approximate the average number of errors by sentence length, the number of errors is divided by the number of words. In Table 16, the blue background indicates the sentence length with the lowest number of errors, the yellow background indicates the sentence length with the higher number of errors, and the red background indicates the sentence length with the highest number of errors.

The results in Table 16 show that there is no strong indication whether the sentence length affects the quality translations in the PEMT tasks. However, the data indicates that the non-native trainee translators are more likely to produce the fewest errors when translating short sentences and the most errors when translating long sentences. This may explain the lowest PE speed when translating short sentences and the highest speed when translating long sentences as mentioned in Table 8. The translators focused more on post-editing short segments. Hence, they spent more time when post-editing short segments. A possible explanation for this is that the short sentences tend to have incomplete sentences, which require the trainee translators to read the next segments before they could determine the meaning of the terms or phrases used in the

short segments. Hence, they post-edited the long segments faster than they did when post-editing short segments.

Sentence length	Source text				Target text			
	AREN		ENAR		AREN		ENAR	
	Major	Minor	Major	Minor	Major	Minor	Major	Minor
Short	0	1	1	2	0	1	1	3
Medium	-	-	2	6	1	3	0	1
Long	6	7	1	5	5	6	-	-

Table 16: Average number of errors by sentence length in the PEMT tasks.

Similar results were also found in the PETM+MT tasks, suggesting that the non-native trainee translators tend to produce the fewest errors when translating short sentences and the most errors when translating long sentences. Nevertheless, the quality of the translations in the PETM+MT tasks increased when compared to the PEMT tasks. These results also support Hypothesis 1, which supposes that the increase in resources helps improve the quality of the translations.

Sentence length	Source text				Target text			
	AREN		ENAR		AREN		ENAR	
	Major	Minor	Major	Minor	Major	Minor	Major	Minor
Short	0	1	1	1	0	1	1	2
Medium	0	3	1	2	-	-	1	2
Long	1	7	1	2	1	6	2	3

Table 17: Average number of errors by sentence length in the PETM+MT tasks.

The results in Table 18 show the number of errors that the non-native trainee translators produced in the PETM+MT tasks based on fuzzy matches, indicating that they produced more errors in the English-Arabic translations. This may suggest that the translation memories are more beneficial for them in the Arabic-English translations. However, the quality of the Arabic-English translations (as shown in Table 14) in the PETM+MT tasks is slightly lower than that of the English-Arabic translations. This may suggest that most errors in the Arabic-English translations originate from the MT. Hence, further investigation on the number of the original, corrected and newly introduced errors is needed.

Fuzzy match	**AREN**		**ENAR**	
	Major	Minor	Major	Minor
101%	-	2	-	-
100%	1	3	-	-
95-99%	-	-	9	2
85-94%	4	2	-	-
75-84%	-	-	12	5
50-74%	4	7	7	16
TOTAL	9	14	28	23

Table 18: The number of errors in the PETM+MT tasks based on fuzzy match.

4.2.2.4 Corrected errors

Next, we shall look into the number of errors the non-native trainee translators successfully corrected and the number of new errors, as Koponen (2016, p.41) states that post-editors may introduce new errors in some cases. Based on the results in Table 19, the non-native trainee translators managed to correct 14.1% of the errors originally existed in the raw Arabic-English MT outputs and 13% of the errors in the English-

Arabic MT outputs. This may explain the similar quality of their translations even though the English-Arabic translations were of slightly higher quality than the Arabic-English translations (as shown in Table 13).

The trainee translators also introduced 22 new errors in the English-Arabic translations and 4 new errors in the Arabic-English translations. A possible explanation for the occurrences of the new errors is overcorrection. The translators attempted to be overly creative or careless when correcting the errors. Even though overcorrection is not desirable, the translators' tendency of overcorrection indicates that they were rather taking risks and showing potential growth in learning, which is reflected in the increased quality of their translations (as shown in Table 13).

As previously mentioned, it is also important to find out the types of errors the trainee translators tend to correct so that the present study could reveal their tendencies in the PE process. In the PEMT tasks, the results in Figure 4 show that the trainee translators tend to correct syntactic errors, incorrect cases and punctuations in the Arabic-English translations, implying that they paid more attention to language-related errors than they did to the content-related errors. In the English-Arabic translations, the translators also paid more attention to correcting language-related errors such as syntactic and punctuation errors. As a suggestion, post-editors should always pay attention to both content- and language-related errors to correct more errors.

Translator	AREN				ENAR			
	Original	Corrected	New	Left	Original	Corrected	New	Left
1	74	16 (21.6%)	3 (4.9%)	58	83	7 (8.4%)	9 (10.6%)	76
2	83	8 (9.6%)	-	75	87	6 (6.9%)	-	81
3	72	17 (23.6%)	1 (1.8%)	55	87	16 (18.4%)	2 (2.7%)	71
4	74	11 (14.9%)	-	63	77	27 (35.1%)	3 (5.7%)	50
5	76	7 (9.2%)	-	69	89	3 (3.4%)	-	86
6	75	5 (6.7%)	-	70	84	7 (8.3%)	8 (9.4%)	77
TOTAL	**454**	**64 (14.1%)**	**4 (1%)**	**390**	**507**	**66 (13%)**	**22 (4.8%)**	**441**

Table 19: The number of errors before and after post-editing in the PEMT tasks.

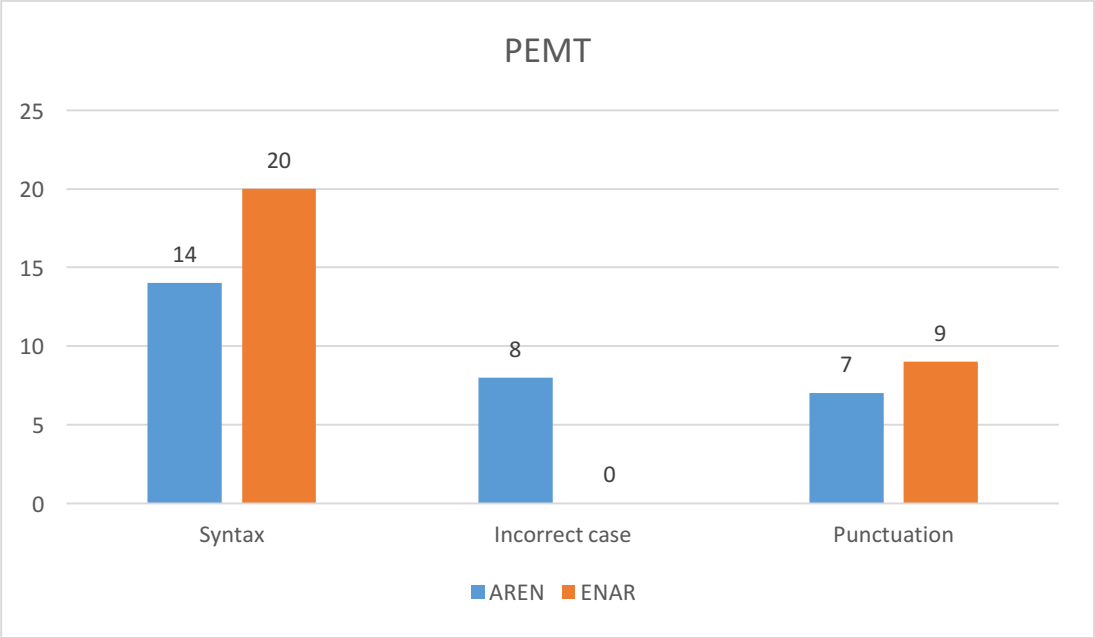

Figure 4: The most corrected types of errors in the PEMT tasks.

In the PETM+MT tasks, the non-native trainee translators also tend to correct more errors in the Arabic-English translations. The results in Table 20 show that they managed to correct 27.1% of the original errors in the Arabic-English translations and 22.5% of the original errors in the English-Arabic translations. When compared to their performance in the PEMT tasks, the translators corrected more errors in the PETM+MT tasks, indicating that they are showing potential growth in learning by noticing and correcting more errors. This is also reflected in the increase in the number of newly introduced errors and the quality of their translations.

It is also interesting to see that the trainee translators corrected fewer errors in the English-Arabic translations than they did in the Arabic-English translations and the quality of the former is higher than that of the latter. This supports the earlier claim that the Arabic outputs from both translation memories and machine translation were of good quality and did not require major changes.

Translator	AREN				ENAR			
	Original	Corrected	New	Left	Original	Corrected	New	Left
1	47	5 (10.6%)	3 (6.7%)	42	23	-	-	23
2	43	7 (16.3%)	-	36	23	4 (17.4%)	-	19
3	39	11 (28.2%)	8 (22.2%)	28	29	15 (51.7%)	3 (17.6%)	14
4	49	27 (55.1%)	7 (24.1%)	22	28	10 (35.7%)	3 (14.3%)	18
5	71	17 (23.9%)	3 (5.3%)	54	14	-	6 (30%)	14
6	54	15 (27.8%)	5 (11.4%)	39	21	2 (9.5%)	1 (5%)	19
TOTAL	**303**	**82 (27.1%)**	**26 (10.5%)**	**221**	**138**	**31 (22.5%)**	**13 (10.8)**	**107**

Table 20: The number of errors before and after post-editing in the PETM+MT tasks.

Similar to the PEMT tasks, the results in Figure 5 demonstrate that the trainee translators tend to focus more on correcting language-related errors, such as incorrect cases, syntactic and preposition errors in the Arabic-English translations. However, in the English-Arabic translations, the translators paid attention to both content- and language-related errors, which may also explain the increase in the quality of their English-Arabic translation.

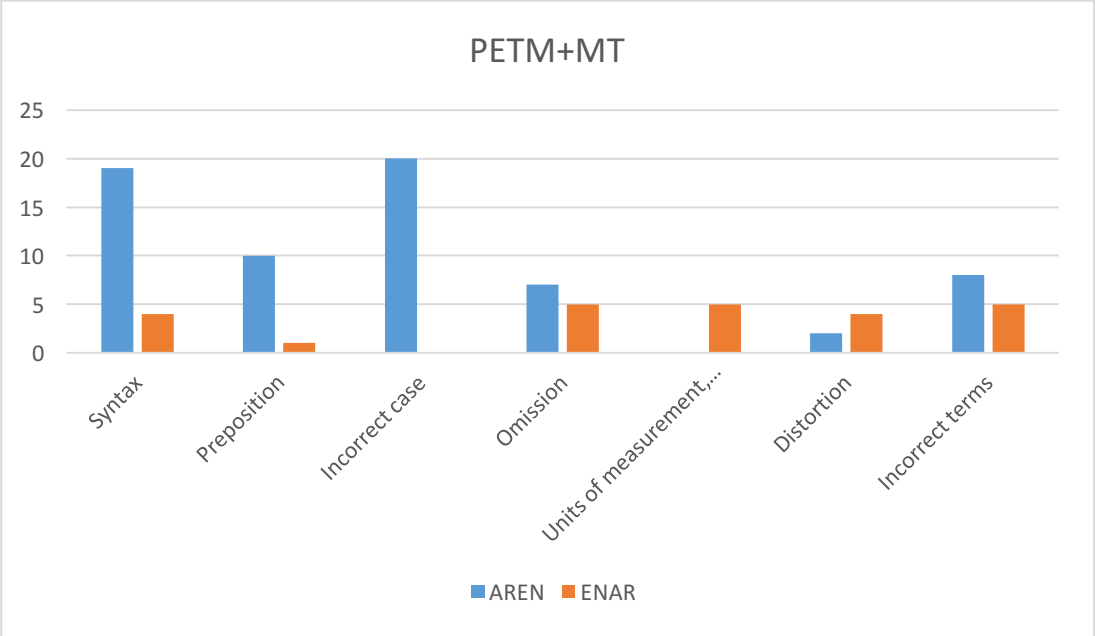

Figure 5: The most corrected types of errors in the PETM+MT tasks.

Next, we shall look into the number of errors that were corrected and left in both PEMT and PETM+MT tasks based on the sentence length. The reason for this analysis is to observe whether the sentence length affects the translation process by looking at the number of errors that the trainee translators managed to correct and failed to notice or correct in the given tasks. Hypothetically, the shorter the sentence is, the fewer errors the sentence are likely to have. Thus, it is easier to spot and correct them. The results in Table 21 indicate that the sentence length determines the number of errors the sentences have. However, the focus here is to investigate whether the sentence

length affects the difficulty level of correcting the errors. The results indicate that the trainee translators corrected the most errors in the long sentences, suggesting that the errors in the long sentences are the easiest to correct because the trainee translators corrected fewer errors in the shorter sentences. Hence, they translated the long sentences the fastest and spent longer time in post-editing short segments as previously mentioned in Section 4.1.1.3.

Sentence length	Original total of errors	Corrected	Left	New
Short	33	5	28	3
Medium	139	14	125	2
Long	790	111	679	20

Table 21: The number of errors corrected, left and newly introduced in the PEMT tasks based on sentence length.

Table 22 also shows similar results in the PETM+MT tasks. However, the translators corrected the fewest errors in the medium sentences. A possible explanation for this is that the medium sentences have the fewest errors when compared to the number of errors originally existed in the short and long sentences. Therefore, the trainee translators were more likely to have overlooked the errors due to the small number of errors.

Sentence length	Original total of errors	Corrected	Left	New
Short	106	42	64	10
Medium	42	5	37	4
Long	293	66	227	25

Table 22: The number of errors corrected, left and newly introduced in the PETM+MT tasks based on sentence length.

The results in Table 23 show that the trainee translators left 74 errors (including 15 new errors) in the PETM+MT tasks. Hypothetically, the higher fuzzy match value, the fewer errors the translators could make. The results show that the fuzzy match values correspond with the number of the original errors and the ones that left uncorrected in the translations. The translators also managed to correct 31.4% of the original errors in the PETM+MT tasks, suggesting that they noticed the errors in the translation memories. It is also clear that they noticed and corrected more errors in the 75-84% and 50-74% matches as lower percentage matches mean less stuff the segments have in common. Therefore, the translators knew that there are some errors in the translation memories. In other words, the fuzzy matches helped provide the information on the similarity between the source segments and TM outputs as well as offering an insight into the approximate level of editing that the translators should expect.

Fuzzy match	Original errors	Corrected	Left	New
101%	-	-	-	2
100%	6	4	2	2
95-99%	6	-	6	5
85-94%	7	1	6	-
75-84%	23	9	14	3
50-74%	44	13	31	3
TOTAL	86	27 (31.4%)	59	15

Table 23: The number of errors corrected, left and newly introduced in the PETM+MT tasks based on fuzzy match.

4.2.3 Centralising source references

In the previous sections, I have provided the number of errors that the translators produced in both PEMT and PETM+MT tasks. In this section, I attempt to find the source of errors through MemoQ. As the previously mentioned, the trainee translators were given options to post-edit raw output from two MT engines in the PEMT tasks: Google Translate and Bing. In the PETM+MT tasks, the translators were given options to post-edit raw output from modified TMs and the two integrated MT engines. However, for this type of task, they were advised to prioritise the TM outputs before referring to the MT outputs.

This analysis aims to provide a better understanding of the use of the source references, which could benefit various groups of people such as academics, developers, researchers and students. The error analysis approach here may be applicable when attempting to evaluate the quality of MT engines and TMs for different research purposes such as evaluating MT for certain text types or language pairs. The present study focuses on the influence of post-editing TM and MT on non-

native speakers of Arabic and English. In this section, the source references are ranked by taking the following factors into considerations:

- The number of occurrences of each source reference used in the tasks.
- The number of original and corrected errors in the source references.
- The average processing speed in post-editing the outputs.

4.2.3.1 Source of errors

In the PEMT tasks, Table 24 shows that the trainee translators preferred to edit raw outputs from Google Translate over Bing, with 60.2% and 38.1% of 294 occurrences respectively. This may suggest that the outputs from Google Translate are better than Bing. As we can see from the results, there are 5 occurrences when some translators decided to choose TM outputs. The reason for this is that they were translating segments that were identical to the previously translated ones.

Text	**Source reference**		
	TM	Google Translate	Bing
3	-	9	15
4	1	55	28
5	3	36	21
6	1	29	18
8	-	48	30
TOTAL	5	177 (60.2%)	112 (38.1%)

Table 24: The occurrences of each source reference used in the PEMT tasks.

In the PETM+MT tasks, the results in Table 25 shows that the translators prioritised and chose to edit the TM outputs, with 48.4% of 366 occurrences. This may indicate

their adherence to the instructions given to them. However, the remaining 51.6% of the occurrences (24% accounts for Google Translate and 27.6% for Bing Translator) may indicate that some of the raw MT outputs are more desirable among the translators. This suggests that they may have noticed that the TMs contained some errors and chose to edit the MT outputs that are presumably of better quality.

Text	**Source reference**		
	TM	Google Translate	Bing
7	44	29	29
9	49	22	25
10	32	15	19
11	52	22	28
TOTAL	177 (48.4%)	88 (24%)	101 (27.6%)

Table 25: The occurrences of each source reference used in the PETM+MT tasks.

4.2.3.2 Corrected errors

In this section, the source references are ranked based on the number of errors the trainee translators managed to correct. This analysis aims to find out which source reference is easier to post-edit. The results in Table 26 indicate that the translators managed to correct slightly more errors found in the raw output from Bing Translator, with 15.7% of the original total of errors. Indeed, the results from the PEMT tasks indicate that the number of the remaining errors are substantial, but the focus here is to rank which of the two engines is better. Even though the difference in the number of the corrected errors is marginal, based on the results, Bing Translator provides slightly better outputs or similar quality to that of Google Translator's outputs.

Source reference	Original total of errors	Corrected	Left
Google Translate	540	69 (12.8%)	471 (56.7%)
Bing	412	59 (14.3%)	353 (42.4%)
TM	10	2 (20%)	8 (1%)

Table 26: The number of errors corrected and left in the PEMT tasks based on source reference.

In the PETM+MT tasks, the trainee translators managed to correct most errors in the TMs, with 31.4% of the original total of errors, followed by Google Translate with 26.5% corrected errors and lastly, Bing Translator with 21.8% corrected errors. This may imply that good-quality TMs are better resources than MT engines even though the TMs were seeded with errors. However, MT outputs remained useful as the translators chose to post-edit more MT outputs than the TM outputs and corrected more MT errors collectively.

Source reference	Original total of errors	Corrected	Left
TM	86	27 (31.4%)	59
Google Translate	185	49 (26.5%)	136
Bing	170	37 (21.8%)	133

Table 27: The number of errors corrected and left in the PETM+MT tasks based on source reference.

4.2.3.3 Quality of the post-edited outputs

In this section, the source references are ranked based on the quality of the post-edited outputs. The quality was measured using the same method used to calculate the normalised score of the trainee translators' translations in Table 13. The results in Table 28 indicate that the average quality of the post-edited outputs from Google Translate are slightly higher than that of the post-edited outputs from Bing Translator in both PEMT and PETM+MT tasks. The post-edited TM outputs are of higher quality than the MT outputs because the number of the seeded errors was lower than the MT outputs and a large amount of the errors were corrected in the TM outputs as shown in Table 27.

Source reference	PEMT	PETM+MT
Google Translate	0.74	0.88
Bing Translator	0.73	0.87
TM	-	0.9

Table 28: The normalised score of the post-edited outputs based on source reference.

4.2.3.4 PE speed

In this section, the source references are ranked based on the trainee translators' average PE speed in both PE tasks. Although speed does not always indicate the quality of the translation, it is important to take PE speed into consideration as it may indicate the potential speed that a translator could achieve, mainly due to tight deadlines and increasing PE demands. In the PEMT tasks, there is only a marginal difference in the average PE speed when post-editing outputs from both Google

Translate and Bing Translator, with approximately 13 words per minute. (see Table 29)

Source reference	Processing speed (Word Per Minute)
Google Translate	12.8
Bing Translator	13.4

Table 29: The average processing speed in the PEMT tasks based on source reference.

In the PETM+MT tasks, the translators seemed to take their time when translating the TM outputs with an average PE speed of approximately 11 words per minute. However, they performed the best in post-editing MT outputs from Google Translate, with an average PE speed of approximately 15 words per minute, followed by Bing Translator, with an average PE speed of approximately 13 words per minute. (see Table 30)

Other than ranking the source references, it may also be beneficial for translators and researchers to know how fast they can post-edit the outputs from these source references because the analysis could provide an insight into what is best for their translation work. Having said that, it is advisable that the translators should always try any source references and see which one could optimise their daily productivity. As suggested by De Almeida and O'Brien (2010, no pagination), the average daily productivity of professional translators is at least 5,000 words per day. Based on the results in Table 30, the trainee translators successfully reached the average daily productivity when post-editing the outputs from all source references. Again, the results here were analysed based on the performance of non-native trainee translators, who are Malay learners of Arabic and English. Therefore, the results may be different for native speakers or different language pairs, as quality varies depending on the quality of the source reference, and source and target language proficiency.

Source reference	Processing speed	
	WPM	WPD
TM	11	5,280
Google Translate	15	7,200
Bing Translator	13	6,240

Table 30: The average processing speed in the PETM+MT tasks based on source reference.

In conclusion, based on the discussions on the occurrences of the source references, the number of corrected errors, and the average processing speed in both PE tasks, the TM outputs ranked first, followed by Google Translate and Bing Translator.

4.2.4 Conclusions on quality

I have tested my hypotheses and quantified the number of errors based on translation directionality, types of errors, sentence length, fuzzy match, and source reference. To answer RQ1 and 4 and validate Hypothesis 1, the quality of the translations in all three tasks was compared. In terms of directionality, the non-native translators produced better translations in the English-Arabic direction in all tasks, mainly due to their higher level of proficiency in Arabic. However, the present study revealed that even though the quality of their English-Arabic translations was better than that of the opposite direction, the non-native trainee translators showed more progress and benefited more from using the TMs and MTs in the Arabic-English Translations. This may imply that the TMs and MTs are more beneficial for novice translators and those who have intermediate language proficiency than for professional translators and those who have advanced language proficiency. This supports Garcia's (2011, p.229) findings, which suggest that post-editing is more beneficial for trainee translators and

non-native translators, especially when the translation is done into English or other major languages because the MT outputs are typically of good quality when translating into these languages.

The study hypothesised (Hypothesis 1) that the quality could increase through having more resources of good quality in one translation environment. The results revealed that the trainee translators could produce better translations with more resources in the Arabic-English translations. However, poor quality of the MT outputs in the English-Arabic direction did not help the non-native trainee translators and in fact, hindered them from producing acceptable translations. In the PETM+MT tasks, on the other hand, the translators managed to produce better translations, mainly due to the text type and the good quality of the outputs from the TMs and MTs when translating the United Nations legal documents as previously mentioned. Also, the trainee translators are competent in Arabic.

To answer RQ2 and 3, further investigations were made into the number of errors that the trainee translators left uncorrected and that of reduced, corrected and newly introduced. Based on the results, the non-native trainee translators tend to make more language-related errors in both PEMT and PETM+MT tasks, such as syntactic and lexical errors, except in the English-Arabic translations in the PETM+MT tasks, in which they made more omissions and lexical errors. Syntactic and lexical errors contributed the most errors in both PEMT and PETM+MT tasks. Based on the results, the trainee translators did not pay much attention to three types of syntactic errors: articles, the Arabic conjunction "و" (*wa*) and word order. Had they paid attention to correcting these errors, the number of errors could be reduced substantially. Also, the MTs tend to use a noun in a place of a verb and vice versa. Developers need to pay

more attention to this type of error as it could cause distortion in meaning and lexical errors, especially in the English-Arabic direction.

To further answer RQ2 and 3, the study looked further into the number of errors the non-native trainee translators managed to correct. The results show that the translators managed to correct more errors in the PETM+MT tasks than they did in the PEMT tasks. Even though the number of corrections is relatively small in both PE tasks, the trainee translators showed some progress throughout the study, implying that they could notice more errors and better understand the nature of PE by having more resources.

In terms of types of errors, the results showed that the non-native trainee translators tend to correct more language-related errors in both translation directions in the PEMT tasks, such as syntactic errors, incorrect cases and wrong punctuations. In the PETM+MT tasks, the non-native translators also tend to correct more language-related in the Arabic-English translations but in the opposite direction, the number of errors of both language- and content-related errors are balanced.

The results also showed that there are some newly introduced errors, which doubled in the PETM+MT tasks, indicating a tendency to overcorrect and become overly creative among the trainee translators. Even though overcorrection is undesirable in post-editing, the trainee translators showed they could potentially make more progress by taking risks.

Similar to the productivity analysis, the present study also analysed the number of errors the trainee translators managed to correct and that of left uncorrected in their translations to validate Hypothesis 4 and 5 based on sentence length and fuzzy match. The results showed that the non-native trainee translators corrected the most errors in the long sentences, suggesting that the errors in the long sentences are the easiest to

correct, followed by the errors in the short and medium sentences. Furthermore, based on the results of the translators' performance in terms of speed, they post-edited the long sentences the fastest, when compared to the time they spent in post-editing the short and medium sentences. Even though the findings could not validate Hypothesis 4, the overall results managed to answer RQ5, revealing that sentence length could have affected the quality of the post-edited output.

Regarding Hypothesis 5 and RQ6, the data showed that higher match value segments contain fewer errors. The translators also noticed and corrected more errors in the 50-74% and 75-84% segments, suggesting that the fuzzy matches could help increase the quality of the post-edited outputs because the match value provides the information on the similarity between the source segments and TM outputs as well as offering an insight into the approximate level of editing that the translators should expect. Hence, they became more aware of the seeded errors.

To answer RQ7, the source references were also ranked to inform developers and academics which source references are the best based on the occurrences of the source references used in the tasks, the source of errors, the number of corrected errors and the average PE speed. The results indicate that the TMs are the best source reference, followed by Google Translate and Bing Translator. This may suggest that source reference of good-quality and domain-specific could help increase the quality of the translations. In fact, it could also increase the PE speed.

The present study also attempted to find any correlation between PE speed and translation quality, which Hypothesis 3 supposes that the slow translators produce better translations than the fast ones. There are some indications that the slow translators are slightly more likely to produce better translations but the hypothesis could not be validated because the occurrences of the slow translators who produced

better translations are only slightly higher than the fast translators who produced better translations. However, the present study concluded that overall, the quality and speed greatly depend on the individual and resources used for the translation project, and both MT and TM outputs helped the non-native translation trainees improve their performance in terms of quality and speed.

Chapter 5: Post-editing guidelines for English-Arabic language pair

This chapter aims to design post-editing (PE) guidelines for the language pair of English and Arabic and non-native speakers of both languages. It is worth to bear in mind that the guidelines are not intended to be a complete guide for the language pair and non-native speakers. In fact, the scope of the guidelines is limited based on the results of the present study.

Many factors can contribute to the translation process and product, and the same goes to post-editing. Not only the guidelines may be language-dependent (see examples in National Institute of Standards and Technology and Linguistic Data Consortium, 2014; Rico Pérez et al., 2014), but they may also be specific for a machine translation (MT) system or users. For example, the present study uses statistical machine translation (SMT) engines: Google Translate and Bing, and the subjects of this study are the Malay trainee translators, who are non-native speakers of Arabic and English. Therefore, the findings of this study may only be beneficial for SMT users, some may be useful for non-native speakers, some may be specific for the Arabic-English language pair and some may be for Malay speakers only.

However, before discussing the guidelines, it is also important to provide information on the existing PE training courses and the post-editor profile.

5.1 Post-editor profile

This section aims to provide information on the prerequisites to train to become a post-editor and what makes a good post-editor:

- Positive attitude towards PE and smart in decision-making and problem-solving situations:

The first step is always the hardest. The crucial part of doing anything is a positive attitude towards it because nowadays many translators still have a negative attitude towards PE (Al-Mutawa and Izwaini, 2015; Moorkens and O'Brien, 2013, 2015) because they are afraid of changes and have little knowledge of PE. Most importantly, they are against MT as they assume that MT does not provide translations that could achieve the quality level they desire. This assumption may be true, but they should know that PE requires human intervention to improve the MT output or at least make it as comprehensible as possible. Again, it is also important to note that not everyone can be post-editors. It may be an advantage if the trainees are already professional translators but not all translators are qualified or skilled enough to become post-editors. They need to be critical in decision-making and problem-solving situations because the purpose of post-editing is to save more time as opposed to full human translations.

A survey was used for this study to get feedback from the participants. Even though the survey was not designed for analysis purposes, all participants responded to the questions in the survey. All of them gave positive feedbacks on MemoQ and the MT integration, showing positive attitudes towards the benefits of using the translation technologies, such as usability, enjoyment, and increase in speed and quality, which was reflected in their PE speed and translation quality.

- Linguistic skills and intercultural knowledge:

  Native speakers are usually desirable for PE tasks but nowadays it is a common practice to translate into the second language and some translation jobs even involve a third language as surveyed by IAPTI (2015, pp.19-20). Therefore, another crucial component to become a good post-editor is linguistic skills and intercultural knowledge. However, the present study revealed that MT and TM technology are more beneficial for novice translators and those who have intermediate language proficiency than they are for professional translators and those who have advanced language proficiency.

  Similar results were also reported by Garcia (2011, p.229), suggesting that post-editing are more valuable for trainee translators and translation into English and other major languages. Therefore, high linguistic skills and intercultural knowledge may define a good post-editor, but to become a trainee, it is required to at least have a good command of both source and target languages. The linguistic skills could be developed throughout the course, depending on the length of course because some people learn faster than others.

- Computer literacy:

  The ability to use a computer efficiently is another crucial component to become good post-editors. Professional post-editors should possess the knowledge of MT, terminology management and the ability to use CAT tools effectively. However, to become a trainee, basic computer literacy is sufficient because, in the PE training course, trainee post-editors are introduced to MT and TM technology as well as hands-on sessions and assignments to help them develop their PE skills throughout the course.

5.2 PE training

This section provides a list of suggestions on the course duration and what should be included in the content of the course in order to design an effective way to train post-editors, particularly for the L2-L3 post-editors, based on the findings of the present study:

5.2.1 Course duration

The course duration typically depends on the training providers, the purpose of the course and most importantly, the prospective trainee translators for whom the course is designed. For the purpose of this study, I will only focus on designing the PE course based on the results of the present study. The present study took place over the duration of 6 weeks, which was a limited time to train non-professionals such as undergraduate students, who are non-native speakers of Arabic and English. The study suggests that the course should take place over one or two semester(s), especially if the training course is designed for non-native speaker because they need to be familiarised with the translation technologies and post-editing at first. Some may take more time to adapt to the working environment than the others. All these need to be considered when designing a post-editing course for non-native translators.

5.2.2 Course content

To design an effective PE training course, the content plays a major role in developing PE skills. The course should teach both theoretical and practical aspects of PE but extensively focus on the latter as most learning and training sessions should do. The final deliverables for the PE training will have four elements:

1. Familiarity with translation technologies.
2. Familiarity with the PE guidelines.
3. Familiarity with the MT errors different types of MT systems and working language pair.
4. Familiarity with the errors that are caused by cross-linguistic influence.

To achieve these objectives, the content of the course should cover:

- Introduction to translation technology

  Translation technology such as machine translation engines and translation memories are the main components of the PE process. Hence, the trainee translators should be introduced to MT and TM before they could proceed to perform the PE tasks. As previously mentioned, the present study provided the introductory sessions in 3 weeks to cover all the basic knowledge the Malay trainee translators needed to know to utilise the CAT tools and incorporate the MT engines to their workflow when working with the Arabic-English language pair. For beginners, the 3-week introductory sessions were not sufficient to familiarise the trainee translators with the tools as well as learning translation and developing PE skills. Therefore, the introductory should last more than 3 weeks to cover all the necessary basic knowledge as well as hands-on sessions and assignments.

  The introductory sessions should cover the types of Arabic-English MT systems, types of CAT tools, types of PE tasks, types of MT errors, and revision or proofreading. Therefore, they could experiment with these technologies and choose which tools are suitable for them. For non-native speakers, it should cover the errors the non-native speakers and MT systems

tend to make as this information could increase awareness of cross-linguistic interference and avoid making minor errors which will be discussed in detail in Section 5.3.3 and 5.3.4. The present study revealed that the non-native trainee translators tend to ignore or are not aware of minor errors which could be easily avoided and consequently, could improve the quality of the translations. The list of the types of common minor PE errors will also be discussed in Section 5.3.5.

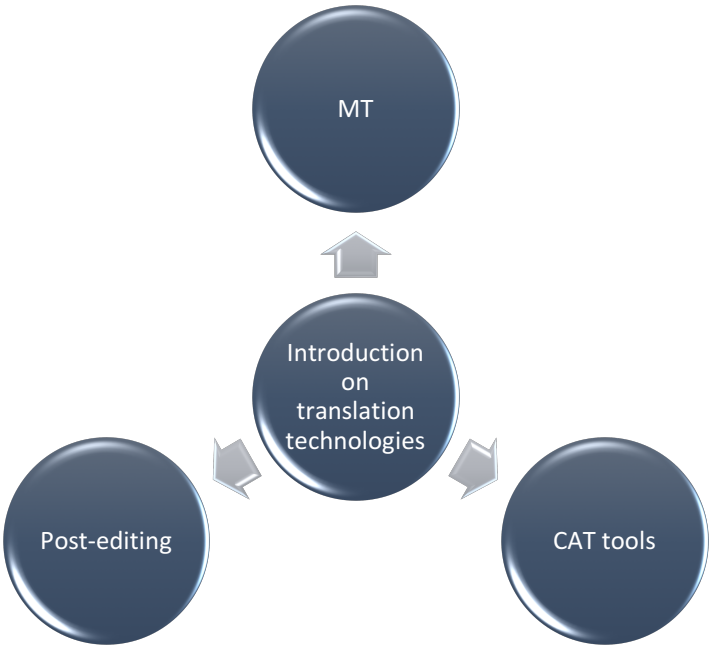

Figure 6: Introduction on translation technologies

- PE guidelines

  The present study adopted PE guidelines created by TAUS and in the PE tasks, the trainee translators were not specifically required to perform light or full PE tasks. Instead, they were required to post-edit as much as possible, which is not the norm of PE jobs. The purpose of this requirement is to test their understanding of the guidelines and the amount of edit they could make. The results of the present study showed that most participants performed light PE

tasks based on their PE speed and quality. However, the training only took place over 6 weeks, and the trainee translators already showed some progress within the limited period, making fewer errors and more corrections towards the end of the training course. In Section 5.3, the present study outlines the general PE rules and strategies for post-editors, along with specific guidelines to help non-native post-editors of Arabic and English, particularly Malay trainee post-editors, to make the right decisions when dealing with the common types of the SMT errors and the errors that were left unchanged or unnoticed due to cross-linguistic influence (See step-by-step PE guidelines in Figure 7).

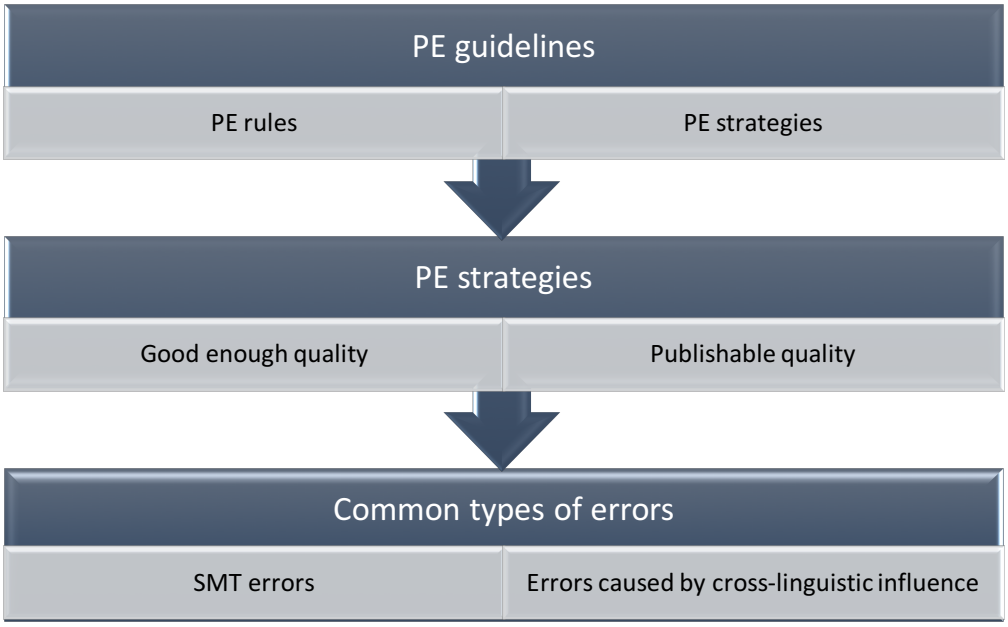

Figure 7: Step-by-step PE guidelines for post-editors.

- Revision skills

  Revision is compulsory to ensure the quality of the final translations. Based on the results of the present study, the non-native trainee translators' translations needed to be revised as most of them left many minor errors in their

translations. This may suggest that they were not aware of minor errors or perhaps, were not critical enough in performing their PE tasks. Based in the error analysis, the present study suggests a list of the common PE minor errors that the Malay trainee post-editors should be aware of when revising the translations.

The present study also suggests intensive training to develop their revision skills, such as exercises that involves revising certain types of errors that the non-native speakers tend to make, or quality evaluation using the error analysis approach and many others as listed in Figure 8. These types of exercises would help the non-native trainee translators become aware of their bad habits and consequently, avoid making recurring errors and improve the quality of their translations.

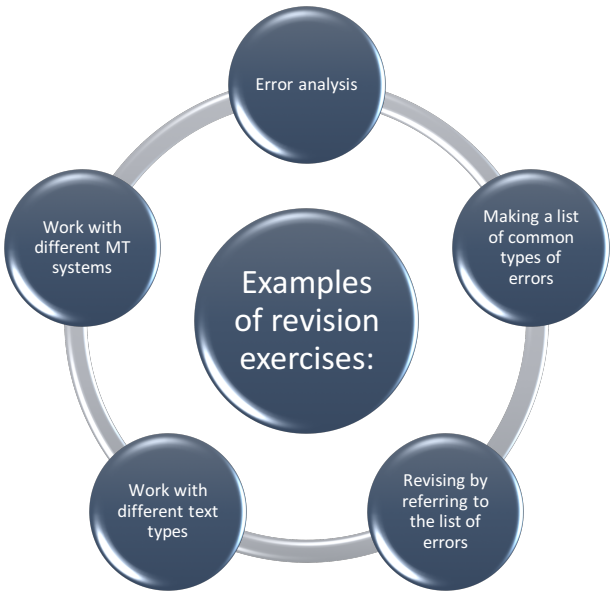

Figure 8: Examples of revision exercises that can be implemented in the PE training course.

5.3 PE guidelines for non-native post-editors of Arabic and English

Based on the results of the study, this section provides PE strategies and rules that could benefit post-editors, especially those who are working with Arabic and English language pairs. These guidelines are designed based on TAUS PE guidelines with some modifications to make them clear. Also, this section offers lists of Arabic and English MT errors, and a list of the errors the Malay speakers tend to make when post-editing Arabic and English MT outputs.

5.3.1 PE strategies

Like any other tasks, post-editors need to have strategies to maximise their daily productivity while still maintaining or improving the quality of their translations. The followings are step-by-step strategies that could help post-editors manage their PE tasks effectively:

1. Read both source and target text next to each other to ensure no overlooked errors, especially in terms of meaning.
2. Follow the editing rules.
3. Revise both source and target text again to ensure the product is of good enough or publishable quality.
4. For non-native speakers or those who are not translating into their mother tongue, make sure to prepare a list of common MT errors for the language pair and directionality, and a list of error tendencies which are typically caused by cross-linguistic influence. With this list, the post-editors could also figure out which types of errors they tend to make regardless the translation directionality and consequently, avoid making recurrent or minor errors that tend to be overlooked.

5. Ensure that the quality of the product meet the client's standards whether the quality is of good enough or publishable, including key terminology and file format, if available.

5.3.2 PE rules

The following PE rules are designed based on TAUS PE guidelines, with some modifications to make them as clear as possible to the post-editors. The PE rules are also grouped into two categories, depending on the desired quality of the translations.

5.3.2.1 Good enough quality

The post-editor should make sure that:

- The target text conveyed the same meaning as the source text, without any added or missing information.
- The target text is comprehensible, ignoring any stylistic issue. Only restructure sentences when the MT output causes distortion in meaning. Avoid overcorrection at all costs.
- Make as few edits as possible to avoid overcorrection.
- The target text is free from spelling, punctuation and capitalisation errors.

5.3.2.2 Publishable quality

The post-editor should make sure that:

- The target text conveyed the same meaning as the source text, without any added or missing information.
- The target text is comprehensible and stylistically fine.
- The sentences are grammatically and syntactically correct.
- To make as few edits as possible to avoid overcorrection.

- There is no spelling, punctuation or capitalisation mistake.
- Always use the key terminology that the clients provided, if available.
- The format of the file is correct.

5.3.3 SMT errors for the Arabic-English language pair

Arnold et al. (1994, p.33) state that it is important to know the pattern of errors found in certain types of MT. SMT systems, for instance, tend to make more grammatical and syntactical errors whereas RBMT systems tend to make more lexical errors. For the purpose of this study, it only focuses on the errors that SMT systems, such as Google Translate and Bing Translator, tend to make, particularly when working with Arabic and English language pair. Bear in mind that the list of errors here is only created based on the results of the initial analysis of the MT outputs used in this study:

1. Omission

   Both Google Translate and Bing Translator tend to make omissions based on the results of the study. The post-editors need to thoroughly check the MT outputs next to the source text, ensuring that there is no added or missing information in the target text. Schäfer (2003, p.3) gives similar suggestion "to identify "tricky" MT mistakes, especially those resulting from wrongly analysed syntactic structures or from defects in the input text".

2. Distortion

   The SMT systems also tend to cause distortion in meaning, which could be quickly noticed and corrected as this type of error usually does not make any sense to the readers.

3. Untranslated translatable

   When the system could not find any equivalent terms in the target language, they tend to omit or transliterate the words. For instance, in Text 7 regarding Morocco, the MT failed to find the equivalent term for "كرياضات" (kariyāḍāt) which means "such as sports". This type of error can be easily spotted and corrected, but it can also be easily neglected when the post-editors are careless and do not thoroughly check the MT outputs.

4. Too literal translations

   Although literal translations are permissible at times, too literal translations can change the meaning of the content if the post-editors are not careful as MT does not have native speakers' intuitions, which could convey a different meaning from the content of the source text.

5. Units of measurement, dates and numbers

   It is also important to ensure that any units of measurement, dates and numbers were correctly transferred in the MT output. Again, the post-editors should always thoroughly check the information in the target text is correct as this could ruin their reputations for making avoidable and sensitive mistakes.

6. Syntactic errors:

   As previously mentioned, SMT systems tend to make more language-related errors such as syntactic errors. Based on the results, the Arabic-English MT tends to make the following errors:

   - Articles:

     The MT systems tend to provide incorrect articles: a, an, the in English and "ال" (al) in Arabic. MT systems tend to translate them literally as can be seen in the following example:

Source text:

A major new study concluded…

Arabic MT:
خلصت دراسة جديدة الرئيسية...

(ḵalaṣat dirāsa jadīda ar-ra’isiyya)

The article “ال” in the adjective “الرئيسية” should have been omitted because, in Arabic, the adjective should agree with the noun “دراسة” (dirāsa) in definiteness apart from gender, number and case.

- Word order:

  Word order is also a problem in MT as the system tend to literally translate word by word, which do not always work in both languages as can be seen in the following example:

  Source text:

  The study also looked at…

  Arabic MT:

  الدراسة أيضا نظرت إلى...

  (ad-dirāsatu ’aiḍan naḍarat ’iIā)

  Syntactically and grammatically the sentence is correct. However, the word order here is SVO as opposed to VSO which is preferable in formal Arabic writing. For light PE, this output is acceptable and does not require further changes. However, for full PE tasks, the sentence should be

arranged to make the target text sound more natural as VSO is more preferable in written standard modern Arabic.

- Conjunction "و" (wa)

  The SMT systems tend to dismiss conjunctions, such as "و" (wa) and "ف" (fa), at the beginning of every Arabic sentence, to make the text coherent and cohesive, except titles and the first sentence of the first paragraph.

- Noun in a place of verb

  The SMT systems also tend to use a noun in a place of a verb, which could be correct in meaning but not grammatically. Based on the results of the study, this type of error commonly occurs in the Arabic MT output as shown in the following example:

  Source text:

  Immigration has not increased unemployment.

  Arabic MT output:

  الهجرة لا تخفيض البطالة.

  (Al-hijra 'ila briṭaniyā lā takfiḍ al-baṭāla)

  Literal back translation:

  Immigration to Britain no increase unemployment.

  In the example, the noun "تخفيض" (takfiḍ) here is in the place of the verb "increased". In this case, the noun should be replaced with its verb form "تخفض" (tukaffiḍ). The literal back-translation may sound comprehensible in English but in Arabic, it is grammatically incorrect.

7. Grammatical errors:

   There are three types of grammatical errors commonly found in the Arabic and English MT outputs:

   - Gender

     The SMT systems tend to be confused with gender in Arabic, especially in long, complex sentences.

     Source text:

     Both currencies are allowed to be legally interchangeable in both countries.

     Arabic MT:

     يسمح كلا العملتين لتكون قابلة للتبادل بشكل قانوني في البلدين.

     (yusmaḥ kilā al-'umlatayn litakūna qabila littabādul bišaklin qanūni fil baladayn)

     In the example, the word "كلا" (kilā which means both) here is masculine. The SMT systems should have used its feminine word "كلتا" (kiltā), following the feminine noun "العملتين" (al-'umlatayn), or "كلتي" (kiltay) because grammatically it is the object for the verb "يسمح" (yusmah) and it should use the accusative case for dual nouns "ي" instead of nominative case "ا".

   - Number

     The SMT systems also tend to make grammatical number errors. In the previous example, both verb "تكون" (takūna) and noun "قابلة" (qābila) here are singular. Instead, they should be in the form of dual verb "تكونا" (takūnā) and noun "قابلتين" (qābilatayn).

- Preposition

  The SMT systems also tend to provide literal translation of prepositions. The dissimilarity in some Arabic and English prepositions, cause stylistically awkward sentences and sometimes distortion in meaning. For example:

  Source text:

  ويتجلى هذا التنوع الطبيعي في الاستعراضات المذهلة كالجبال المغطاة بالثلوج وغابات الأرز الخلابة

  (wa yatajallā hāḏat tanawwu' aṭ-ṭabī'i fil 'isti'rāḍāt al-muzahhala kaljibālil muḡaṭṭā bittulūj wa ḡābātil 'aruz al-ḵalāba)

  English MT:

  This natural diversity is reflected in the stunning panoramas as the snow-capped mountains and Cedar forests, and Plains along the Atlantic coast.

  In the example, there are several errors in the English MT output but the focus here is the preposition "ك" (ka) means "as" in English but the sentence sounds incomplete. Therefore, it should be translated as "of" instead, to make the sentence more comprehensible in English.

8. Incorrect terms and lexis

   In the present study, the SMT systems do not always give the correct equivalent terms in the output, depending on the content of the database. The word and the equivalent term may be in the database but the equivalent term may not be preferred as it sounds strange in the target language. For example:

Source text:

وانتقلت الصين من المركز العاشر إلى المركز السابع...

(wantaqalatiṣ ṣīn minal markaz al'āšir 'ilal markaz as-sābi')

English output:

China moved from tenth centre to seventh centre…

In the example, the word "المركز" (al-markaz) means centre but in this context, the correct term should be used is "place" as it sounds more natural in English.

9. Spelling

   There is no major spelling mistake in the MT output but the post-editors should be aware of the varieties of English. Based on the results of the present study, the SMT systems use American English spelling system, such as "traveler" and "mobilization". Because the trainee translators were instructed to write in British English, any word spelt using American English spelling system counts as a minor error. However, the correct spelling of the words depends on the clients' requirements and the target readers.

10. Incorrect cases

    Cases here means capitalisation which is only specific to English as there is no capitalisation in Arabic. The data of the present study reported that the SMT systems occasionally use capital letters for common nouns and small letters for proper nouns. Therefore, post-editors should be aware of the types of nouns.

11. Punctuation

    Punctuation is another problem in the SMT output, especially when translating from Arabic into English because Arabic sentences tend to be very long when

compared to English sentences. Sometimes it could make the sentence stylistically awkward and wordy. Moreover, the data of the present study reported that English MT outputs tend to be longer than the Arabic source texts. Therefore, it is advisable to split the English MT outputs into a few sentences.

12. Awkward style

Awkward style is inevitable in most MT outputs. Therefore, the post-editors should know when to change the style of the sentence and when to leave it as it is. If the clients want a publishable-quality translation, the post-editors should improve the style of the sentence. However, if the clients only want a good-enough-quality translation, it is advisable to leave the output as it is unless the structure of the sentence causes distortion in meaning. For example:

Source text:

وقد حافظت الأسواق الخمسة التي تصدرت قائمة زوار الولايات المتحدة في العام ٢٠١٠ على مكانتها في العام ٢٠١١.

(Waqad ḥāfaḍat al-’aswāqul ḵamsa ’allatī taṣaddarat qā’imatu zuwwāril wilayāt almuttaḥida fil ‘ām 2010 ‘alā makānatiha fil ‘ām 2011)

English MT:

The five markets that topped the list of visitors to the United States in 2010 on its position in the year 2011 has been maintained.

In the example, the MT output is stylistically awkward and does not make sense in English. Therefore, it is advisable to restructure the sentence to make it comprehensible.

Table 31 shows the summary of PE guidelines for the common types of SMT errors when working with the Arabic-English language pair. These guidelines are designed based on the findings of the error analysis and each type of error has its own instruction to help post-editors make the correct decision, depending on the desired quality of the translation. These rules may not be applicable if the clients provided different instructions in the translation brief.

Types of MT errors	Good enough quality	Publishable quality
Omission	Add the omitted information	Add the omitted information
Distortion	Rephrase or restructure the sentence if needed	Rephrase or restructure the sentence
Untranslated translatable	Translate the term	Translate the term
Too literal	Only edit if the translation conveys different meaning	Only edit if the translation conveys different meaning
Units of measurement, dates and numbers	Correct the units	Correct the units
Articles	Choose the correct articles	Choose the correct articles
Word order	No need to reorder if it does not cause distortion in meaning	Restructure the sentence using the correct word order

Conjunction *wa*	Edit where necessary	Edit where necessary
Noun in a place of verb	Change the noun to its verb form	Change the noun to its verb form
Gender	Assign the correct gender to the noun or verb	Assign the correct gender to the noun or verb
Number	Assign the correct grammatical number to the verb and the correct plural for the noun	Assign the correct grammatical number to the verb and the correct plural for the noun
Preposition	Choose the correct preposition	Choose the correct preposition
Incorrect terms	Only correct the term if it conveys different meaning or the key terminology is provided by the client	Choose the correct term, particularly when the key terminology is provided by the client
Spelling	Correct the spelling	Correct the spelling
Incorrect cases	Use the correct case	Use the correct case
Punctuation	Use the correct punctuation	Use the correct punctuation
Awkward style	No need to edit the style if the text is comprehensible.	The text should be comprehensible and stylistically fine.

Table 31: PE guidelines for the common types of Arabic-English-Arabic MT errors.

5.3.4 Cross-linguistic influence among Malay learners of Arabic and English

This section provides a list of errors that the Malay learners of Arabic (L3) and English (L2) tend to make in the present study. Therefore, more types of errors could be identified beyond the scope of this study by experimenting with different texts, MT systems or CAT tools. Since the focus here is cross-linguistic influence that may have hindered the Malay trainee post-editors from correcting the MT and TM outputs, I have grouped the common errors into two categories:

1. Syntactic errors: articles, word order, agreement, conjunction "و" (wa)

   Based on the results of the present study, there are four common syntactic errors that could be identified to be caused by cross-linguistic influence:

   - Articles:

     As previously mentioned, the absence of article in Malay may hinder native Malay speakers from using the correct articles in Arabic and English. Furthermore, MT systems cannot translate the articles properly sometimes. Thus, Malay post-editors may not notice the article errors if they do not meticulously check the MT output.

   - Word order:

     Word order is also a problem for Malay translators because as previously mentioned, word order is flexible in Malay and Arabic. The non-native trainee translators who participated in this study tend to use SVO word order. This is mainly because the MT systems tend to provide literal Arabic translation of the English source texts, which typically use SVO sentences. Even though SVO sentences are grammatically correct in Arabic, most modern standard Arabic texts use VSO sentences in formal writing.

- Conjunction "و":

  The conjunction "و" could also be a recurring type of error because Arabic sentences typically start with conjunctions, such as "و" and "ف", whereas English and Malay sentences do not start with "and" or the Malay equivalent term "dan". Therefore, Malay post-editors should always be aware of this dissimilarity when working with both translation directions. Adding and deleting conjunctions could be tedious but it could reduce a large amount of errors as reported in the present study.

2. Grammatical errors: gender and number.

   There are two common grammatical errors the Malay speakers tend to make when working with the Arabic-English language pair and both types of errors are related to agreement. Unlike English and Arabic, there is no agreement in Malay. Arabic particularly has many agreement rules which involve person, gender, number and case, depending on the context. The two grammatical errors are as follows:

   - Gender

     As previously explained, Malay is a gender-neutral language. If the MT system does not translate the gender correctly, Malay speakers could not notice this type of errors at times. Based on the results of the present study, the abundance of gender-related errors in Arabic proved that it could be problematic if the post-editors do not carefully check the MT outputs.

   - Number

     Due to the dissimilarity of grammatical numbers in both Arabic and English, it is sometimes difficult for Malay speakers to avoid grammatical number errors if not carefully translated. Unlike Arabic, Malay does not

have grammatical numbers in verbs and nouns. As previously explained, plurality in Malay is typically expressed with quantity or reduplication instead of using plural nouns, such as in Arabic and English, to indicate plurality.

5.3.5 Common PE minor errors among Malay learners of Arabic and English

This section provides a list of the common PE minor errors that the Malay trainee translators tended to leave in their translations in both PE tasks. Based on the results in the PEMT tasks, the minor errors account for 84% in the Arabic-English translations and 71.6% in the English-Arabic translations, whereas in the PETM+MT tasks, the minor errors account for 77.2% in the Arabic-English translations and 61.7% in the opposite direction. Some errors can be easily avoided and some may be inevitable if not careful. The followings are the most common PE minor errors that remained in the trainee translators' translations:

1. Syntactic errors

   The most common PE minor errors in both PEMT and PETM+MT tasks are syntactic errors. In the PEMT tasks, the results show 76 minor errors in the Arabic-English translations and 138 minor errors in the English-Arabic translations. In the PETM+MT tasks, the results show 52 minor errors in the Arabic-English translations and 13 minor errors in the opposite direction. Compared to the PEMT tasks, the number of minor syntactic errors in the PETM+MT tasks is relatively small, suggesting that some minor syntactic errors can be avoided when the translators check their translation carefully.

   Three types of common minor syntactic errors were found in the PEMT tasks: articles, which account for 56.6% of the minor errors in the Arabic-English

translation, whereas in the English-Arabic translation, the conjunction *wa* and word order account for 46.4% and 14.5% of the minor errors respectively.

The followings are examples of minor syntactic errors that can be avoided:

Article:

Source text:

وقال وفقا لبيان للخارجية...

(wa qāla wifqan libayān lil ḵārijiyya)

MT output:

According to a Foreign Ministry statement

In the example, several errors can be noticed but the focus here is the indefinite article 'a', which should be replaced by the definite article 'the', because the word 'ministry' is a governmental organisation and the definite article 'the' is often applied to the types of organisation when they are part of the names such as ministry, association, office and many others.

The conjunction *wa* and word order:

Source text:

It has remained stable with an average inflation rate of 1.5% over the past twenty years. The people of Brunei Darussalam enjoy a high quality of life.

MT output:

وقد ظلت مستقرة حيث بلغ متوسط معدل التضخم 1.5٪ على مدى عشرين سنة الماضية. شعب بروناي دار السلام يتمتع بنوعية الحياة العالية.

(waqad ẓallat mustaqirra ḥayṯu balaġa mutawassiṭu maʻdalit taḍakk̲um 1.5% ʻalā madā ʻišrīna sana al-māḍiya. šaʻbu Brunei Darussalam yatamattaʻu bi nawʻiyyatil hayā al-ʻāliya)

In the example, two types of minor syntactic errors can be noticed in the second sentence. Firstly, the conjunction *wa* is missing from the beginning of the second sentence. Hence, there is no cohesion between the two sentences. Secondly, the word order should be VSO instead of SVO, because, in written Standard Modern Arabic, SVO is preferable. The subject here is "شعب" (šaʻbu, which means the people) and the verb is "يتمتع" (yatamattaʻu, which means enjoy). Therefore, the correct sentence should be:

"ويتمتع شعب بروناي دار السلام بنوعية الحياة العالية"

(wa yatamattaʻu šaʻbu Brunei Darussalam bi nawʻiyyatil hayā al-ʻāliya)

As we can see here, these types of errors are minor and can be easily spotted and edited if the translators thoroughly check the translations as these syntactic rules are parts of the basic knowledge of the Arabic language taught to beginners and intermediate learners of Arabic.

2. Incorrect cases

In the Arabic-English translation, the Malay trainee translators did not check if the cases of the words are correct. Even though these errors are minor, sometimes they may raise some eyebrows among readers because these minor errors could have been avoided if the text was revised thoroughly. For example, "the Federal laws" is the equivalent terms for "القانون الاتحادي" (al-qānūn al-ittiḥādiy) in Arabic. However, the term "law" should be capitalised as the Federal Laws are proper nouns. Incorrect cases account for 11.5% and 17.4% of the minor errors in the PEMT and PETM+MT tasks respectively.

The percentage of the errors is still somewhat high as these types of errors could have been spotted and corrected easily.

3. Punctuation

Another type of minor errors that the Malay trainee translators could have avoided to improve their translations was punctuation, particularly in the Arabic-English translation. For example:

Source text:

احتفظت المملكة السعودية بمكانها في صدارة القائمة تليها الهند والمملكة المتحدة والولايات المتحدة وإيران...

(iḥtafaẓat al-mamlakah as-sa‘ūdiyya bimakānihā fī ṣadāratil qa’ima talīhā al-hindu walmamlaka al-muttahida walwilāyāt al-muttahida wa ‘īrān)

MT output:

Saudi Arabia has maintained its place at the top of the list, followed by India, the United Kingdom and the United States and Iran.

As we can see, the conjunction ‘and’ or *wa* in Arabic posed some minor problems as the MT literally translated the Arabic sentence into English. However, the focus here is the punctuation. In the MT output, commas are missing from the sentence. This is because English uses commas to separate words when there are more than two items in a list whereas Arabic uses the conjunction *wa* instead, to separate the items in the list. Therefore, the correct sentence should read as follows:

Saudi Arabia has maintained its place at the top of the list, followed by India, the United Kingdom, the United States, and Iran.

Based on the results of the present study, punctuation errors account for 10% and 5.8% of the minor errors in the PEMT and PETM+MT tasks respectively

4. Incorrect terms

   Unlike the other types of minor errors mentioned previously, incorrect terms can be somewhat difficult for non-native speakers to identify, depending on the translators' vocabulary and semantic knowledge because non-native speakers may not be familiar with the specialised terms and lack competence at the semantic level. The results of the present study show that in the PEMT tasks, incorrect terms account for 10% of the minor errors in the Arabic-English translations and 21.8% in the English-Arabic translations. In the PETM+MT tasks, on the other hand, incorrect terms account for 17.4% of the minor errors in the Arabic-English translations and 20.3% in the English-Arabic translation.

When compared to the findings from the existing studies mentioned in Section 2.2.6 regarding the MT errors, the present study has a different list of common types of errors, either before or after PE as Izwaini (2006) reports that addition and deletion are the major problems for Google Translate. In addition to the two errors, Al-Samawi (2014) states that Google Translate also tends to violate the phrase structure. The variation in the common types of MT errors before and after PE suggests that the findings may vary for different MT systems, text types, and post-editors. The quality of the MT systems, like Google Translate, may also have changed over time. Hence, the variation in the common types of errors.

5.4 Conclusions

This chapter aims to provide information on the prerequisites to become a post-editor and a list of suggestions on designing a PE training course, which includes the guidelines for post-editing. To answer RQ8, firstly, this chapter provides information

on the prerequisites to become a post-editor. Positive attitude and being smart in decision-making and problem-solving situations are keys to succeed in any type of tasks. The study revealed that the Malay trainee translators showed a positive attitude towards the use of the translation technologies and this was reflected in their PE speed and translation quality, which improved throughout the study. In terms of linguistic skills, the present study revealed that MT and TM technologies are beneficial for novice translators and those who have intermediate language proficiency as similar results were reported by Garcia (2011, p.229). Another crucial component to become a good post-editor is computer literacy as this skill would help the post-editor to work efficiently.

Based on the findings of the present study, this chapter suggests that the course duration should take place at least over one or two semester(s), because training non-native speakers may require more time. The course content, on the other hand, needs to be intensive, covering an introduction to translation technologies and hands-on sessions and assignment. The PE guidelines should also be included in the training as they are the crucial part in understanding and meeting the requirements of the PE tasks. Therefore, the present study suggests a list of PE strategies and rules as guidelines for non-native speakers of Arabic and English, particularly the Malay trainee translators/post-editors. To make the post-editing tasks easier and ensure the quality of the post-edited outputs, the present study suggested a list of common types of errors commonly found in the raw MT output for the Arabic-English language pair, along with examples from the MT output and guidelines to help the trainee post-editors make the right decisions.

In addition to the MT errors, this chapter also provides a list of errors that may have been affected by cross-linguistic influence. This influence could hinder the Malay

trainee post-editors from correcting the errors of the MT and TM outputs, such as articles, word order, the conjunction *wa*, gender and number. To ensure the good quality of the post-edited outputs, the presents study also provides a list of the common minor errors that the Malay trainee post-editors tend to leave in both PE tasks. In addition to the minor syntactic errors, such as articles, word order and the conjunction *wa*, the present study suggests post-editors to check if there are any minor errors, such as punctuation errors and incorrect cases, particularly in the Arabic-English translation. Incorrect terms, however, can be difficult to identify because non-native speakers lack competence at the semantic level and may not be familiar with the specialised terms. Nevertheless, it is important to note that these lists are created based on the findings of the study and were more likely to be associated with Malay trainee post-editors. Therefore, to investigate the common types of errors for specific language pair, a similar error analysis approach can be adopted as some errors may be more commonly found in some language pairs than in the others, depending on the text type, the translators or post-editors, the MT engines and the types of MT systems, and many other factors that could lead to different findings.

Chapter 6: Conclusions

This chapter provides the conclusions from the results of the analyses, the contribution to knowledge, the limitations of the study, as well as a list of suggestions for future research.

6.1 Conclusions

In this section, the present study attempts to investigate the validation of the hypotheses regarding productivity and quality. In order to do so, each research question is answered accordingly, and ultimately, the validation of each hypothesis is made based on the findings of the results:

RQ1: What are the differences of post-editing machine translation and post-editing the outputs from both translation memories and machine translation in terms of productivity and quality?

The results of the study revealed that there is certainly an increase in the average processing speed when post-editing the outputs from both translation memories and machine translation (PETM+MT) when compared to that of post-editing machine translation only (PEMT). This suggests that having more resources could increase the non-native trainee translators' productivity and translation quality. Even though initially the quality of their translations was not as good as that of professional native translators, the translators could improve the quality of their translations throughout the study. In fact, most of them managed to reach the pass mark threshold set by the European Commission and Temizöz (2013). Nevertheless, the increase in the non-native

trainee translators' PE speed and quality supports the validity of Hypothesis 1, which suggests that the non-native trainee translators' productivity and quality increase with more resources in one translation environment.

In terms of productivity, the study revealed that the non-native trainee translators could be as productive as the professional native translators because most of them could reach the average daily productivity for professional native translators, which is at least 5,000 words per day. This means the data validated Hypothesis 2.

RQ2: What are the types of errors commonly found before and after PE in the English-Arabic combination? How many of them could be corrected by the non-native trainee translators? How many of them are classified as major and minor errors? Do the errors exist before or after PE?

The results of the present study revealed that the MT outputs tend to contain more syntactic and lexical errors than content-related errors before and after PE. The data also revealed that some of the syntactic and grammatical errors may have been influenced by language transfer, such as articles, word order, the conjunction "و" (wa), grammatical gender and number.

The study also found that the number of corrected errors is minimal when compared to the number of errors left in the translations. This has led to a question whether the translators were critical enough in carrying out the PE tasks. Initially, it was assumed that this was the case, but the increase in the number of corrections throughout the study shows that the translators were still trying to get used to the post-editing process at the beginning of the study and

constantly, made more corrections and improved the quality of their translations towards the end of the research project.

The study also revealed that the non-native trainee translators tend to focus more on correcting the major errors than correcting the minor ones. The abundance of minor errors left in the translation showed that the trainee translators did not revise their translations as thoroughly as possible. Had they revised their translations, the quality of their translations could have greatly increased.

The study also revealed that most of the errors existed before PE and there is a small amount of newly introduced errors after PE. Based on the observation of the translations, the new errors were caused by the translators' carelessness and their tendency to overcorrect in post-editing.

RQ3: Does the translation directionality affect the PE speed and the translation quality?

The results revealed that the difference in the PE speed between the L2-L3 translations (English-Arabic) and the L3-L2 translations (Arabic-English) is marginal. However, in the PETM+MT tasks, the translators performed faster in the English-Arabic translations than in the opposite direction. In terms of quality, the non-native trainee translators produced better translations in the English-Arabic translations in both PEMT and PETM+MT tasks. The results revealed that the quality of the English MT outputs was better than that of the Arabic MT outputs, suggesting that more research is needed to improve the English-Arabic MT outputs. The study also revealed that the translators' proficiency in Arabic and the decent quality of the Arabic MT and TM outputs

for the source texts in the PETM+MT tasks particularly helped the translators produce better translations. Also, both Google Translate and Bing Translator could provide decent translations of the United Nations legal documents as they used the UN legal documents to train their MT systems.

RQ4: Does the sentence length affect the PE speed and the translation quality?

The study revealed that the sentence length affected both PE speed and the translation quality. The non-native trainee translators were more likely to perform the fastest when translating long sentences and the slowest when translating short sentences. The reason for this was the translators tend to focus and spend more time on post-editing short segments because short segments tend to contain incomplete sentences, which require the trainee translators to read the next segments before they could understand the meaning of the terms or phrases used in the short segments.

The present study hypothesised that longer sentences tend to cause many errors, which slow down the PE speed. However, the data could not validate this hypothesis (Hypothesis 4) as the data revealed that the trainee translators performed the fastest when translating long sentences.

In terms of quality, the translators left the most errors in the long sentences. This may not be surprising because long sentences tend to be complex and cause more errors when literally translated by MT, particularly when translating between two languages that belong to different families. However, despite the abundance of errors, the translators managed to correct the most errors in the long sentences. This may suggest that the errors in the long sentences are the easiest to correct because as previously mentioned, short

segments tend to contain incomplete sentences, which require the trainee translators to read the next segments before they could provide the correct translations. Even though long sentences are the easiest to correct, some minor errors may be overlooked if not careful due to the abundance of errors.

RQ5: Does the fuzzy match value affect the PE speed and the translation quality?

The study revealed that the fuzzy match value affected both PE speed and translation quality. However, higher fuzzy match value does not guarantee faster speed. The results showed that post-editing 'no match' outputs are faster than post-editing the outputs of 50-74%, 100% and 101% match values. The slower speed in post-editing the 100% and 101% match segments suggests that the translators did not blindly accept the TM outputs and even though they were not informed about the seeded errors, the fuzzy match value helped them become aware of the errors because lower percentage match means less stuff the source text and TM output have in common. Hence, they noticed more errors in the 50-74% and 75-84% match segments. Overall, the findings could not validate Hypothesis 5 because there is no strong indication to support it but the fuzzy match value could help increase both PE speed and the translation quality.

RQ6: Which source reference is better: TM, Google Translate or Bing Translator?

The study revealed that the TM outputs are the most preferable in the PETM+MT tasks, followed by Bing Translator and Google Translate. However, the TM outputs made the fewest errors, mainly due to the good quality and fewer errors in the TMs when compared to the MT outputs. The

study also revealed that the outputs from the two MT systems were of similar quality. However, the number of corrections made in the PETM+MT tasks suggests that the outputs from Google Translate were easier to spot and correct than those of Bing Translator.

The study also revealed that the translators performed the fastest when translating outputs from Google Translate, followed by Bing Translator and TMs. Nevertheless, the overall results show that the TM outputs were the best source reference, followed by Google Translate and Bing Translator, implying that source reference of good quality and domain-specific could improve both PE speed and translation quality.

RQ7: If non-native trainee translators should be taught differently as suggested by Campbell (1998, p.12), what learning model or guidelines can be offered to them in translator training, especially concerning post-editing?

The present study learned that the existing guidelines such as TAUS PE guidelines are somewhat applicable to train non-native trainee translators and any language pair. However, the PE training course should be designed based on:

- Level of translation/post-editing experience:

  The course designer needs to consider whether the course is designed for beginners who do not have anything but linguistic knowledge and competence; intermediates who have background knowledge of translation but have not worked as translators or post-editors; or advanced trainees who work as professional translators but have no experience in post-editing.

- Language pair:

  The course designer also needs to consider which language pair the course is suitable for because it will give an opportunity for the trainee translators to work with the same group who work with the same language pair. Therefore, this opportunity could encourage collaborative student-centered learning. Specifying language pair could also determine the MT errors that are commonly found for particular types of MT. This pattern of errors could help the trainee translators avoid making recurring errors, which sometimes could be left unnoticed if not careful. The present study also suggests that the course should focus on training the trainee post-editors to correct certain MT error(s) in each class, so that they know when to change and when to leave the errors as they are, depending on the PE level. Through these exercises, the trainee translators could familiarise themselves with the pattern of MT errors for their language pair as well as the MT systems that best suit their needs.

- Translation directionality:

  Similar to the language pair, it is also important to specify the translation directionality for the course, so that the trainee translators could focus on working with particular translation direction in the same group. The present study revealed that the non-native trainee translators should be familiarised with cross-linguistic influence that could occur when working with their language pair and translation direction. Similar to the language pair, intensive exercises such as correcting errors caused by cross-linguistic influence could help them

become more aware of the errors and consequently, avoid making recurring mistakes.

6.2 Contribution to knowledge

The present study provides several contributions to the following fields:

- English-Arabic translation

  The study highlighted the pattern of MT errors when working with the Arabic and English language pair, which would make an informative topic in training post-editors for this particular language pair.

- Translation directionality

  The study also observed the nature of the L2-L3 translations among Malay trainee translators who are non-native speakers of Arabic and English. The pattern of errors caused by the cross-linguistic influence could also be useful for non-native speakers of Arabic and English, especially for Malay trainee translators in PE training sessions.

  The study also highlighted the PE work by non-native trainee translators who could be as productive as professional native translators. This valuable information could hopefully encourage more translation service providers (TSPs) to hire non-native speakers to perform post-editing tasks in order to meet the increasing demands and tight deadlines.

- SMT system

  The study also sought to investigate the types of errors that could be useful for developers and researchers to improve the MT systems and in this case, the SMT systems for the Arabic-English language pair.

This study also highlighted the need for improving the Arabic MT outputs for Google Translate and Bing Translator as the study revealed that the SMT systems provide better English MT outputs.

- CAT tools

  The study highlighted the usefulness of using translation memories of good quality and domain-specific MT in post-editing. The MT integration in CAT tools proved to be helpful when translation memories could not provide convincing translation suggestions. The MT suggestions also proved to be useful for finding equivalent terms as the study showed that the non-native trainee translators made fewer errors in the PEMT tasks than they did in the PETM+MT tasks.

  The study also highlighted the usefulness of MemoQ features such as the linguistic quality assurance (LQA) feature for assessing the translations, the Editing Time feature for measuring PE speed, and the Edit Distance feature for measuring the number of edits in the PE process. Also, MemoQ records the source of the outputs after the segments are confirmed. This feature proved to be useful for investigating the source of the errors; whether they originate from particular TM or MT. The track changes also helped the author in investigating the number of corrected and newly introduced errors, which could be useful for giving feedbacks in PE training.

- PE training

  The study also reported the difference between translation from scratch, post-editing MT (PEMT) and post-editing outputs from TM and MT (PETM+MT), suggesting that the balanced use of TM and MT

could improve both productivity and quality. This strategy should be taught in the PE training sessions as it will encourage the trainee post-editors to improve their resourcing skills. Also, the usefulness of the translation technology highlighted in the study hopefully could encourage more translators to have a positive attitude towards PE specifically and translation technology in general.

The study also emphasised the usefulness of good-quality MT outputs in training beginners or intermediate trainee post-editors as they seem to benefit more from the MT outputs than professional translators and those who have high language proficiency. Furthermore, this could encourage PE training providers and even language teachers to include MT in PE training sessions and language classes to encourage the trainee post-editors and language students to use MT effectively.

The study also provided PE strategies and editing rules that could be used as guidelines, especially for the Arabic-English language pair and non-native speakers. Additionally, the study suggested what should be included in designing an effective PE training content based on the results of the study.

6.3 Limitations and implications for future research

6.3.1 Language pair

The present study only focuses on the Arabic and English language pair. Therefore, the results may vary when working with other language pairs. The results of the

present study suggest that there is a difference in the quality of the MT outputs, indicating that the English MT outputs are better than the Arabic MT outputs.

6.3.2 Participants

The results of the present study were only derived from observing the PE work by Malay speakers who are non-native speakers of Arabic and English. Therefore, the study could only observe the cross-linguistic influence among the Malay trainee translators. Had the study been extended to different non-native speakers of Arabic and English, the results could be different. Furthermore, the size of the group participated in this study was relatively small. Therefore, experimenting similar study on a bigger group would show significant results. However, it would require a substantial amount of effort and time dedicated to such bigger scale research, and it is beyond the limit of the study. In addition, the translations in the present study were only reviewed by the researcher alone. It would be interesting to see when similar study employs at least two reviewers: one is a native speaker, and the other is a non-native speaker. This could provide different results, especially in the number and types of errors that each reviewer manages to spot and correct.

6.3.3 Duration of the study

The research project took place over the course of six weeks only because the researcher had limited time to conduct the study in Brunei. Furthermore, the participants would find it difficult to find the suitable times to participate in the project as they were undergraduate students who were already burdened with many assignments and other extra-curricular activities. Therefore, the duration of the project could not be extended as they could easily lose interest in the project if it is too long.

Even so, the study managed to collect sufficient data to answer the research questions and support some of the research hypotheses.

6.3.4 MT systems

The MT systems used in this study were Google Translate and Bing Translator, which are both statistical machine translation systems. Therefore, the findings of this study are limited to SMT systems. A similar study on other types of MT systems, such as rule-based, hybrid and most recently neural MT systems, could produce different results in terms of productivity and quality as well as a different pattern of errors. The results of the study indicated that domain-specific MT systems could improve the translation quality. Therefore, it would be interesting to explore the use of the same methodology on trained domain-specific MT systems. However, training MT engine is not simple as it requires a large amount of time and effort.

6.3.5 CAT tool

The present study only used MemoQ 2014 at the time of the project. Therefore, different results could be obtained when conducting similar studies on other CAT tools, such as SDL Trados Studio and Wordfast, as different translation environment may affect the results of the study. Using cloud- or web-based CAT tools, such as Memsource, SmartCAT and MateCat, could also affect the results of the study as the speed of the internet and the stability of the tools may affect the PE speed, especially in the countries that do not have fast internet connections.

6.3.6 Methodology

The results of the present study were derived only from the error analysis and observation of the pattern of errors and PE speed based on the sentence length and fuzzy match value. It would also be interesting to explore the use of the cognitive approach to measuring the time effort in correcting certain types of errors, using keystroke logging and eye-tracking techniques. The cognitive approach would also help investigate the non-native speakers' attitude towards processing certain types of errors or sentence length.

In addition, it would also be interesting to see the effect of training the trainee translators through correcting certain types of errors on their performance as suggested in the present study. If this method is proved to be effective, it could be beneficial for PE training.

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Appendix A: Project information sheet

Project title: **Using translation technology in Arabic-English-Arabic translation.**

You are being invited to take part in a research project. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask me if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Brief introduction

This project is aimed to investigate the effectiveness of translation technology in teaching translation into second language. The language pair for this project is English and Arabic. In this project, you will be asked to use MemoQ 2014. You will need to do all three different translation activities. I will only take two or three hours of your time every week and this research will go on only for 2 months or most probably less than that. However, the timetable can be changed and will depend on everyone's availability. More details will be given to you in the introduction class.

Benefits

By participating in this project, hopefully you will be able to use these tools efficiently and effectively and you will be able to be a better translator. Hopefully this project can inspire you to be a freelance translator in the future. In addition, your participation will definitely make a contribution to the field of translation pedagogy.

Finally, it is up to you to decide whether or not to take part. If you do decide to take

part, you will be given this information sheet to keep (and be asked to sign a consent form) and you can still withdraw at any time without it affecting any benefits that you are entitled to in any way. You do not have to give a reason.

All the information that we collect about you during the course of the research will be kept strictly confidential. You will not be able to be identified in any reports or publications.

Appendix B: Consent form

School of Modern Languages and Cultures

UNIVERSITY OF LEEDS

Consent to take part in [Using translation technology in teaching Arabic-English-Arabic translation]

	Add your initials next to the statements you agree with
I confirm that I have read and understand the information sheet/ letter dated [4th March 2013] explaining the above research project and I have had the opportunity to ask questions about the project.	
I agree for the data collected from me to be used in relevant future research.	
I agree to take part in the above research project and will inform the lead researcher should my contact details change.	

Name of participant	
Participant's signature	
Date	
Name of lead researcher	
Signature	
Date*	

*To be signed and dated in the presence of the participant.

Once this has been signed by all parties the participant should receive a copy of the signed and dated participant consent form, the letter/ pre-written script/ information sheet and any other written information provided to the participants. A copy of the signed and dated consent form should be kept with the project's main documents, which must be kept in a secure location.

Project title	*Document type*	*Version #*	*Date*
Using translation technology in teaching Arabic-English-Arabic translation.	Consent form for research project	1	4th March 2013

Appendix C: Questionnaire

"Using translation technology in Arabic-English-Arabic translation"

The aim of this survey is to find out to what extent the application of CAT tools can help in learning Arabic-English translation. This survey is not a test so there are no "right" or "wrong" answers and you do not even have to write your name on it. Please give your answers sincerely as only this will guarantee the success of the investigation. Thank you very much for your help.

Personal Details	
Gender	
Age	
Educational level	
First language	
Second language	
Translation from and into	
*Number of years of learning English	
*Number of years of learning Arabic	
Have you studied translation before?	
Have you worked as a translator?	

* Fill in if applicable

a. Questions on method

	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
Using CAT tools in classroom makes learning translation more impressive.					
Using CAT tools in classroom is a facilitative learning strategy.					

This method makes learning translation faster and easier.					
Through having used the integrated resources, do you feel more confident as a translator and reviewer/proofreader?					
Using CAT tools makes you feel less pressure in learning Arabic-English translation.					
Using CAT tools helps you develop your resourcing and decision-making skills.					
Using CAT tools allows helps you develop your linguistic and translation competence.					

b. Questions on tasks and MemoQ features

	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
MemoQ is easy to use.					
Using MemoQ in translation classroom save time.					
The termbase/glossary feature is helpful.					
The 'AutoSuggest' enhanced the translation process.					

The terminology task is an effective way to acquire vocabulary (i.e. learning new words and information on them while looking up for the equivalent terms in dictionaries and internet).					
Like a corpus, the concordance feature helps you search for equivalences and collocations of certain terms in the Translation Memory.					
Having both original text and translation next to each other increases awareness about similarities and differences between the two languages.					
Having both original text and translation next to each other assists your comprehension of the text.					
The Translation Memory feature increases TT accuracy.					
The Translation Memory is useful for providing grammatical solutions.					
The machine translation assists your comprehension of the text.					
The machine translation increases TT accuracy.					
The machine translation is useful for providing grammatical solutions.					

Post-editing increases awareness about similarities and differences between the two languages.					
Post-editing increases awareness about translation strategies.					
Post-editing allows you to put your linguistic and translation knowledge into practical use.					
Post-editing helps you develop your resourcing and decision-making skills in spotting and solving problems made by the machine translation (i.e. mistranslations, incorrect terms, grammatical errors).					

c. Open response questions

Q. How was your learning experience with MemoQ? What did you benefit from it? Any suggestions of what should be done next?

A.

Q. Which feature/s of the tool significantly help(s) you the most? Machine translation alone is enough or a combination of machine translation and translation memory? Why?

A.

Q. Which machine translation engine did you use the most? Google Translate or Microsoft Translator?

A.

Q. Which dictionary/dictionaries do use most often in finding equivalent terms?

A.

Q. What do you usually do if you cannot found the terms you are looking for in a dictionary?

A.

Q. Which feature do you refer most often and why? (Glossary/TM/MT)

A.

Thank you for your time. ☺

Appendix D: Sample texts

Text 1:

“The political system in the country is governed by the constitution and the national tradition of the Malay Islamic Monarchy, the concept of *Melayu Islam Beraja* (MIB). The three components of MIB cover Malay culture, Islamic religion, and the political framework under the monarchy. It has a legal system based on English common law, although Islamic Shariah Law supersedes this in some cases.

Under Brunei's 1959 constitution, His Majesty Paduka Seri Baginda Sultan Haji Hassanal Bolkiah Mu’izzaddin Waddaulah is the head of state with full executive authority. Since 1962, this authority has included emergency powers, which are renewed every two years. The country has been under hypothetical martial law since the Brunei Revolt of 1962. Hassanal Bolkiah also serves as the state's Prime Minister, Finance Minister and Defence Minister”.

Source from: Wikipedia, 2016. *Brunei*. [Online]. [Accessed 12 May 2016]. Available from: https://en.wikipedia.org/wiki/Brunei

Text 2:

الإبداع العربي في علم الفلك

الأسباب التي دعت المسلمين للاهتمام بعلم الفلك

كانت متطلبات الدين الإسلامي ذات ضرورة لرصد دائم لقبة السماء الزرقاء، لأن رسول (ص) وضع قوانين ثابتة بفروض العبادة، كما أن نزول عدد من الآيات في سور عديدة تحدثت عن السماء والأفلاك والبروج والنجوم والأجرام السماوية والشمس والقمر، جعلت المسلم المؤمن يفكر بشأنها، ويحترم هذه القوانين ويحاول تطبيقها.

فكان يتطلب من المسلم الذي يريد إقامة الصلاة الاتجاه إلى القبلة في الكعبة بمدينة مكة المكرمة، وذلك يقتضي معرفة سمت القبلة، لأن زمن الصلاة يختلف حسب الموقع الجغرافي وحركة سير الشمس في دائرة البروج، وكذلك معرفة أحوال الشفق والتماس هلال شهر رمضان كل ذلك تطلب حل مسألة من مسائل علم الهيئة الكروي المبني على حساب المثلثات.

Text 3:

"مصر تؤكد التزامها بدعم عمليات الأمم المتحدة لحفظ السلام

أكد السفير عمرو أبو العطا، مندوب مصر الدائم لدى الأمم المتحدة التزام مصر بدعم عمليات الأمم المتحدة لحفظ السلام، كونها ضمن أكبر عشر دول مساهمة بقوات وشرطة، وهو ما يعضد من ترشيحها للعضوية غير الدائمة لمجلس الأمن، في الانتخابات التي ستجريها الجمعية العامة في أكتوبر القادم.

ورحب ابو العطا بانعقاد اجتماع "شركاء "المنتدى الدولي حول تحديات عمليات السلام" بمقر بعثة مصر في نيويورك، وقال وفقا لبيان للخارجية، اليوم الأحد، إن "أهمية أعمال المنتدى تكمن في دوره النشط في التعرف على الاتجاهات البازغة في طبيعة بعثات الأمم المتحدة في الميدان، وطرح البدائل لمواجهة التحديات التي تواجهها عمليات حفظ السلام".

وأكد أبو العطا، أن مصر تحرص على المشاركة بفعالية في منتدى تحديات حفظ السلام، كونه يجمع بين دول الشمال والجنوب، بما يساهم في تعبئة الموارد المالية والبشرية ويعزز من الشراكة بين دول العالم بما يعزز من قدرة الأمم المتحدة على معالجة التحديات الجديدة".

Source from: A.S.A, 2015. Misr, Tuakkidy iltizamaha bida'mi 'amaliyyat al-umam al-muttahida lihifzi as-salam, *Shorouk News*. [Online]. [Accessed 12 May 2016]. Available from: http://www.shorouknews.com

Text 4:

“Sixty-first session

Fifth Committee

Agenda item 132

Administrative and budgetary aspects of the financing of the United Nations peacekeeping operations

Financing of the support account for peacekeeping operations and the United Nations Logistics Base at Brindisi, Italy

Note by the Secretary-General

The present note is issued in accordance with the prorating procedures approved by the General Assembly in its resolution 50/221 B.

The annex reflects the resources to be approved by the General Assembly in respect of each peacekeeping mission, including the prorated shares of the support account and of the United Nations Logistics Base at Brindisi.

A note will be issued later on the approved level of resources for all peacekeeping operations once the General Assembly has taken action.

The Fifth Committee is requested to take note of these amounts.

* Reissued for technical reasons.

Annex

Appropriation to be approved by the General Assembly for peacekeeping operations for the period from 1 July 2007 to 30 June 2008

(United States dollars)”

Source from: Eisele, A. and Chen, Y. 2010. MultiUN: A Multilingual Corpus from United Nation Documents., In: *Proceedings of the Seventh conference on International Language Resources and Evaluation*. [Online]. pp.2868-2872. [Accessed 2 June 2016]. Available from: http://www.euromatrixplus.net/multi-un/

Text 5:

“Immigration to Britain has not increased unemployment or reduced wages, study finds

Immigration to Britain has not increased unemployment or reduced wages, a major new study has concluded. Researchers at the London School of Economics looked at the levels of immigration to each of Britain’s counties, and compared it to the unemployment rate in the same area across the same period. They found that there was no connection between how much immigration a county had seen between 2004 and 2012 and the area’s level of unemployment.

The study also looked at whether migrants coming to an area had led to a fall in wage levels and found no evidence that this was the case. Many areas that saw huge increases in immigration had seen wages rise and unemployment fall, while many areas, which had seen no immigration had suffered from falling wages and rises in employment. On average, immigration had a neutral effect on the employment and wage rates – neither increasing nor decreasing them.

The economists also specifically whether lower-skilled workers had seen their wages impacted, and whether migration a rise in young people out of work or training. These areas were examined because popular perception is that migrant workers compete with the young for low wage jobs. They said they found "no evidence" that the young or low skilled had been impacted, and called for further researcher in why anti-immigrant perceptions were still prevalent despite the evidence."

Source from: Stone, J. 2015. *Immigration to Britain has not increased unemployment or reduced wages, study finds*. The Independent. [Online]. [Accessed 12 May 2016]. Available from: http://www.independent.co.uk/news/uk/politics/immigration-to-britain-has-not-increased-unemployment-or-reduced-wages-study-finds-10075047.html

Text 6:

"فنادق دبي استضافت أكثر من 11.6 مليون زائر في العام 2014

أعلنت دائرة السياحة والتسويق التجاري في دبي اليوم أن فنادق الإمارة استقبلت 11629578 ضيفاً (١١ مليون و629 ألف و578 ضيفا) في عام 2014 مسجلةً بذلك زيادة قدرها 5.6% مقارنة بالعام 2013، مما يشير إلى نمو وارتفاع كبير في مختلف المؤشرات الرئيسية بما في ذلك عائدات الفنادق وعدد ليالي النزلاء.

وقد حافظت الأسواق العشرة التي تصدرت قائمة زوار دبي في العام 2013 على مكانتها في العام 2014، مع تغير طفيف في الترتيب .وخلال الفترة من يناير إلى ديسمبر 2014، احتفظت المملكة العربية السعودية بمكانها في صدارة القائمة تليها الهند والمملكة المتحدة والولايات المتحدة الأمريكية وإيران وسلطنة عمان والصين والكويت وروسيا وألمانيا.

وانتقلت الصين من المركز العاشر إلى المركز السابع بنسبة نمو بلغت % 24.9 خلال الاثني عشر شهر الأخيرة، حيث استقبلت دبي 344329 ضيفا (344 ألف و329 ضيفا) مقارنة مع 275675 ضيفاً (275 ألف و675 ضيفاً في العام 2013. ويعود هذا الارتفاع إلى نمو عدد المسافرين الصينيين وإلى الجهود الحثيثة التي تبذلها دائرة السياحة والتسويق التجاري في دبي مع شركائها في قطاعي الطيران والضيافة بهدف تعزيز مكانة دبي كوجهة مفضلة لتلك الشريحة من المسافرين .كما حلت الهند في المرتبة الثانية والمملكة المتحدة في المرتبة الثالثة، حيث شهد عدد الضيوف من كلتا السوقين نمواً كبيراً بنسبة 12.2٪ و11.3٪ على التوالي.

وقد ساهم القانون الاتحادي الذي صدر في مارس 2014 في زيادة عدد ضيوف الفنادق القادمين من الدول الأوروبية، حيث نص على إعفاء مواطني 13 دولة من أعضاء الاتحاد الأوروبي من الحصول على تأشيرة دخول مسبقًا للسفر إلى دولة الإمارات العربية المتحدة لتنضم بذلك إلى 15 دولة أوروبية أخرى كانت معفية من التأشيرة في السابق".

Source from: Emaratalyoum. 2015. Fanadiq Dubai istadafat aktar min milyun za’ir fil ‘am 2014. *Emaratalyoum*. [Online]. [Accessed 12 May 2016]. Available from: http://www.emaratalyoum.com/business/local/2015-03-03-1.762063

Text 7:

"الجولات السياحية

المغرب هو أحد أهم الدول السياحية على خريطة السياحة الدولية، أرض مبارك بالمكون الطبيعي المتنوع، والعمق التاريخي والثقافي، وتقدم المغرب مجموعة واسعة من الأنشطة كالرياضات المائية وزيارة المدن الترفيهية جعلت المغرب الوجهة السياحية المفضلة لكل العائلة بمختلف الأعمار.

مياه البحيرات النقية المحاطة بالجبال والغابات تعطي لوحة متقنة. ولا تزال الطبيعة في المغرب طبيعة بكر لم يمسسها يد الحضارة بكل سلبياتها. زرها واستمتع بوقتك فيها.

جولات للعائلة والأطفال

علما منا بأن المرأة عامة والعربية خاصة مثقفة سياحيا، وهي تدقق في التفاصيل عند تخطيطها لرحلة سياحية عائلة، لذا نسعى إلى توفير أجواء من الخصوصية للعائلة العربية في المرافق السياحية، كما أولينا اهتماما خاصا بتوفر مراكز التسوق العالمية، وتوفر مدن الألعاب والملاهي الترفيهية للأطفال، وأيضا تقديم امتيازات خاضة.

لذلك نقدم سعرا مخفضا للسفر إلى المغرب يشمل الإقامة المجانية لليلتين في أحد الفنادق بالمغرب، وللعائلات سعر مخفض حيث تستفيد الزوجة والأولاد بخصم ٥٠ في المائة من سعر تذكرة الزوج أو الأب.

أهم المدن السياحية بالمغرب الحبيب

توجد بالمغرب العديد من مواقع التراث العالمي: الموقع الأثري لوليلي، قصر آيت بن حدو، مازاكان (الجديدة)، المدينة العتيقة للصويرة، المدينة القديمة في فاس، المدينة العتيقة لمراكش، المدينة العتيقة لتطوان، المدينة التاريخية لمكناس، الفضاء الثقافي لساحة جامع الفنا، مدينة طنجة ومدينة طانطان.. لا ندري أيها نختار، بل علينا بزيارتها كلها، عابرين المغرب وتاريخه، قاطعين مسافة (٣٥٠٠ كم) من الشمال إلى الجنوب عبر شواطئ البحر الأبيض المتوسط والمحيط الأطلسي الذي يربط بينها. رحلة لا تنسى لاكتشاف هذه المدن الجذابة، حيث يمتزج الحاضر بالماضي ليعطينا بجملة من التجارب المثيرة، لا نكاد نغادرها حتى نحلم بالعودة إليها.

ويتمتع المغرب المناخات المتنوعة، متوسطي في الشمال وجبلي في الوسط وصحراوي في الجنوب. وهناك سلسلتان جبليتان هما الريف والأطلس اللتان أعلى جبل بالمغرب 4165 مترا بجبل توبقال بالأطلس الكبير. ويتجلى هذا التنوع الطبيعي في الاستعراضات المذهلة كالجبال المغطاة بالثلوج وغابات الأرز الخلابة، والسهول

طول ساحل المحيط الأطلسي. وفي الربيع، يمكن الزوار أن يختاروا بين الاستمتاع بالسباحة والتزحلق على الجليد وهدوء الواحات".

Source from: Hamza, A. 2012. As-siyaha fil-Maghribi. July 2012. *Mudawwana al-baramij al-'arabiyya*. [Online]. [Accessed 12 May 2016]. Available from: https://proall-ar.blogspot.com/2012/07/blog-post.html

Text 9:

"مأرب

اقترنت محافظة مارب باسم مدينتها التاريخية مارب، وعاصمة دولة سبأ القديمة وهي موطن السبئيين. وتمتلك مأرب اهم رموز التاريخ اليمني والحضارة اليمنية القديمة التي ازدهرت في الألف الأول قبل الميلاد.

جبل البلق الشمالي: (بانوراما وادي سبأ)

عبر الطريق القريب من البوابة الشمالية لسد مأرب العظيم، تصل نقطة معينة في جبل البلق الشمالي لتشاهد حول المكان والصدفين (المصرفين) والقنوات التي روت ارض الجنتين متمنين لك رحلة سعيدة على ضفاف وادي سبأ.

مدينة مارب القديمة

هي عاصمة دولة سبأ المذكورة في الكتب السماوية العهد القديم والقرآن الكريم التي تحدثت فيها عن زيارة بلقيس ملكة سبأ لسليمان عليه السلام حوالي 950 ق.م. واقترنت مارب باسم سبأ أهم الممالك اليمنية القديمة وأقدمها وأعظم رموز تاريخها وحضارتها وهي أشهر المدن القديمة وأكبرها.

صرواح

تقع بين صنعاء ومارب على بعد 120 كم شرق صنعاء وعلى بعد 37 كم غرب مارب وهي من أقدم المواقع الأثرية اليمنية القديمة، وتبدو صرواح أحسن حالا من كثير من المواقع الأثرية الأخرى وتأتي أطلالها على رأس قائمة أهم المواقع الأثرية اليمنية بعد مارب.

أهم المواقع الأثرية في صرواح

معبد الإله المقة الذي يرجع تاريخه الى العصر السبئي الأول بداية الألف الأول ق.م، وقد بني فوق تل طبيعي يرتفع 10 أمتار تقريبا من قاع سفح الوادي ولا يزال الجزء الشرقي من المعبد قائما بشكل نصف دائري يصل ارتفاعه إلى 7 أمتار مبني بالأحجار المهذبة المصقولة ويتصل جداره الغربي مرتبط بأربعة أعمدة تسمى (قدس الاقداس)، وبجانب الجدار من الداخل توجد مائدة حجرية مستطيلة الشكل تحيط بها مقاعد حجرية، وبجانبها يوجد النقش الحجري المشهور (نقش النصر) أهم النقوش اليمنية القديمة المكون من قطعتين طول الواحدة 3 أمتار وسمكها 80×60سم والتي تعود للقرن السابع ق.م.. والى الشمال من المعبد بمسافة 30 متراً تقع البئر المقدسة التي لا تزال تعمل حتى اليوم وهناك برج علوه 10 أمتار وأجزاء من معبد آخر.

وما بقي من آثار صرواح يمثل نموذجا جيدا للفنون المعمارية السبئية. وقد قامت بعثة أثرية المانية بالتنقيب في المواقع بين عامي 1993م-1994م".

Source from: Farook. [No date]. Mamlaka Saba'. [No date]. *As-siyaha Al-arabiyya*. [Online]. [Accessed 12 May 2016]. Available from: http://www.startimes.com/?t=927974

Text 10:

"Sixty-third session

Fifth Committee

Agenda item 132

Administrative and budgetary aspects of the financing of the United Nations peacekeeping operations

Proposed budgetary levels for peacekeeping operations for the period from 1 July 2009 to 30 June 2010

Note by the Secretary-General

The budgetary information contained in the annex to the present note is submitted pursuant to General Assembly resolution 49/233 A, section I, paragraph 8, in which the Secretary-General was requested to submit twice a year to the Assembly for information purposes a table summarizing the proposed budgetary requirements of each peacekeeping operation for the period from 1 July to 30 June, by category and with the aggregate total resource requirement.

The annex to the present note reflects the proposed budget levels for peacekeeping operations, the United Nations Logistics Base at Brindisi, Italy, and the support account for peacekeeping operations for the period from 1 July 2009 to 30 June 2010.

Annex

Proposed budgets for peacekeeping operations, the United Nations Logistics Base at Brindisi, Italy, and the support account for peacekeeping operations for the period from 1 July 2009 to 30 June 2010a

a) Does not include resource requirements for a United Nations peacekeeping operation in Somalia, pending a decision by the Security Council on the establishment of the operation (see Security Council resolution 1863 (2009))".

Source from: Eisele, A. and Chen, Y. 2010. MultiUN: A Multilingual Corpus from United Nation Documents., In: *Proceedings of the Seventh conference on International Language Resources and Evaluation*. [Online]. pp.2868-2872. [Accessed 2 June 2016]. Available from: http://www.euromatrixplus.net/multi-un/

Text 11:

"Sixty-first session

Fifth Committee

Agenda item 132

Administrative and budgetary aspects of the financing of the United Nations peacekeeping operations

Approved resources for peacekeeping operations for the period from 1 July 2006 to 30 June 2007 and proposed budgetary levels for the period from 1 July 2007 to 30 June 2008

Note by the Secretary-General

Information on the approved resources for peacekeeping operations, the United Nations Logistics Base at Brindisi, Italy, and the support account for peacekeeping operations for the period from 1 July 2006 to 30 June 2007 was last updated in my note of 15 January 2007 (A/C.5/61/18).

In accordance with established practice, further financing actions taken by the General Assembly at the first part of its resumed sixty-first session in respect of the United Nations Interim Force in Lebanon and the United Nations Integrated Mission in Timor-Leste are reflected in annex I below.

In section I, paragraph 8 of General Assembly resolution 49/233 A, the Assembly requested the Secretary-General to submit to it for information purposes a table summarizing the proposed budgetary requirements of each peacekeeping operation for the period from 1 July to 30 June, by category and with the aggregate total resource requirements.

Accordingly, the proposed budget levels for peacekeeping operations, the Logistics Base and the support account for the period from 1 July 2007 to 30 June 2008 are set out in annex II below.

Annex I

Approved budgets for peacekeeping operations for the period from 1 July 2006 to 30 June 2007

(United States dollars)

a) Information provided in the annex to A/C.5/61/18 is superseded owing to technical adjustments in the distribution of approved resources among expenditure categories.

Annex II

Proposed budgetary levels for peacekeeping operations for the period from 1 July 2007 to 30 June 2008

(United States dollars)”

Source from: Eisele, A. and Chen, Y. 2010. MultiUN: A Multilingual Corpus from United Nation Documents., In: *Proceedings of the Seventh conference on International Language Resources and Evaluation*. [Online]. pp.2868-2872. [Accessed 2 June 2016]. Available from: http://www.euromatrixplus.net/multi-un/