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Article abstract

The process of translation has been dramatically influenced by the latest developments in technology. Students' behaviours during the translation process have also changed as they try to seek information and use different resources. This study aims to investigate the translation behaviour of students in an English translation department. For this purpose, 11 students were recruited. The students were asked to translate a scientific text from English into Turkish. For the analysis of their translation behaviour, Think-Aloud Protocols (TAPs) and their translated texts were used. *Monologue Protocol* was used to see what goes on in a prospective translator's mind. The students were audio-recorded while translating. Then, the translations were scored and the transcriptions of the recordings were coded. The results were presented under three main themes: (i) Recruiting translation tools: when and how, (ii) Following a pattern of translation process, and (iii) Challenges: language(s), context and more. All in all, the present study highlights the importance of guiding students in the use of the appropriate tools for the translation of specialised texts, and also suggests that student translators should be more critical of Machine Translation outputs and should practice post-editing procedures in their courses.

Examining translation behaviour of Turkish student translators in scientific text translation with think-aloud protocols

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RÉSUMÉ

Le processus de traduction a été considérablement influencé par les derniers développements de la technologie. Les comportements des étudiants pendant le processus de traduction ont également changé lorsqu'ils recherchent des informations et utilisent différentes ressources. Cette étude vise à observer le comportement de certains étudiants issus d'un département d'études anglaises lorsqu'ils traduisent un texte. À cet effet, 11 étudiants ont été recrutés. Ces derniers ont été invités à traduire un texte scientifique en turc. Pour l'analyse de leur comportement en traduction, les protocoles Think-Aloud (TAP) et les textes traduits ont été utilisés. Le *protocole monologue* a été utilisé pour voir ce qui se passe dans l'esprit d'un futur traducteur. Les réflexions des étudiants ont été enregistrées pendant la traduction. Les traductions ont été notées et les transcriptions des enregistrements codées. Les résultats sont présentés selon trois thèmes principaux : (i) Trouver des outils de traduction : quand et comment, (ii) Respecter un modèle procédural de traduction, et (iii) Défis : langue(s), contexte, etc. Cette étude souligne l'importance de guider les étudiants dans l'utilisation des outils appropriés pour traduire des textes spécialisés, et suggère également que les étudiants traducteurs devraient être plus critiques à l'égard des résultats de traduction automatique et apprendre et mettre en pratique les procédures de post-édition.

ABSTRACT

The process of translation has been dramatically influenced by the latest developments in technology. Students' behaviours during the translation process have also changed as they try to seek information and use different resources. This study aims to investigate the translation behaviour of students in an English translation department. For this purpose, 11 students were recruited. The students were asked to translate a scientific text from English into Turkish. For the analysis of their translation behaviour, Think-Aloud Protocols (TAPs) and their translated texts were used. *Monologue Protocol* was used to see what goes on in a prospective translator's mind. The students were audio-recorded while translating. Then, the translations were scored and the transcriptions of the recordings were coded. The results were presented under three main themes: (i) Recruiting translation tools: when and how, (ii) Following a pattern of translation process, and (iii) Challenges: language(s), context and more. All in all, the present study highlights the importance of guiding students in the use of the appropriate tools for the translation of specialised texts, and also suggests that student translators should be more critical of Machine Translation outputs and should practice post-editing procedures in their courses.

RESUMEN

El proceso de traducción se ha visto muy influenciado por los últimos avances en tecnología. Los comportamientos de los estudiantes durante el proceso de traducción cambiaron cuando intentaron buscar información y utilizar diferentes recursos. Este estudio tiene como objetivo investigar el comportamiento de traducción de los estudiantes de un departamento de traducción al inglés. Para ello, se reclutaron 11 estudiantes. Se pidió a los estudiantes que tradujeran un texto científico al turco. Para el análisis se utilizaron los Protocolos Think-Aloud (TAP) y los textos traducidos. El protocolo de monólogos se utilizó para ver qué pasa en la mente de un futuro traductor. Los estudiantes fueron grabados en audio mientras traducían. Luego, se evaluaron las traducciones y se codificaron las transcripciones de las grabaciones. Los resultados se presentaron bajo tres temas principales: (i) Contratación de herramientas de traducción: cuándo y cómo, (ii) Siguiendo un patrón de proceso de traducción, y (iii) Desafíos: idioma (s), contexto y más. El estudio destaca la importancia de guiar a los estudiantes para que utilicen las herramientas adecuadas en la traducción de textos especializados y sugiere que los estudiantes deben ser más críticos con los resultados de la traducción automática y practicar procedimientos de posedición.

MOTS-CLÉS/KEYWORDS/PALABRAS CLAVE

think aloud protocols (TAP), comportement du traducteur, compétence de traduction, traduction basée sur les processus, cognition
think aloud protocols (TAPs), translation behaviour, translation competence, process-based translation, cognition
protocolos think aloud (TAP), comportamiento del traductor, competencia en traducción, traducción basada en procesos, cognición

1. Introduction

Interest in what goes on in the translator's mind while translating has increased over the last two decades. A manifold of methods have been used to reveal the mental processes. This interest has been more prominent given the acceptance of translation as a field of expertise and the accessibility of tools and methods for measuring neurocognitive aspects of translation. However, there is still a long path ahead before we can provide an accurate model of the brain when translating across different modalities.

Think-Aloud Protocols (TAPs) have been one of the frequently used behavioural methods in translation research. In translation, the final product has been often examined (Hatim and Munday 2004; Munday 2016), yet the focus on the process has only gained a particular interest in recent years. This is somehow due to the ambiguity in forming a valid construct to observe and evaluate the general process of translation (Garcia 2009). However, there has been an optimistic move towards performing experimental studies, thus a sharp increase has been reported in the number of such studies in recent years (Bernardini 2001; Lauffer 2002; Smith 2014; Sun 2011; Zhou and Lin 2012; Ferreiara and Schwieter 2015; García 2019).This expansion can be explained by the integration of the emerging methods adopted by the researchers, including key-stroke logging, screen recording and eye-tracking, into the introspective methods (Saldanha and O'Brien 2010; Alves and Jakobsen 2021). A systematic classification of the research methods used in the translation process was offered by Krings (2005), who defined two main titles including offline and online methods. As Dam-Jensen and Heine (2009) stated, this binary classification is based

on the time of data collection, for which offline methods correspond to those that are applied, after the translation process, to compile data while in online ones, the data are produced during the translation process. According to the classification drawn by Krings (2005), online methods are divided into two types, including observation of behaviour and online verbal-report data. As a subtitle of online verbal-report data, TAPs are frequently used to compile data while the subjects are performing a task, such as writing or translating. However, in recent years, these verbal-report data have been known to be supported through other online methods, including key-stroke logging, eye-tracking and brain pattern measurement, which are classified as online methods under the title of observation of behaviour.

As Gopferich (2008) indicated, TAPs have been used in experimental studies thanks to the fact that they offer a great amount of information which can be hard to obtain and display through other methods, though they have also been criticised for their limited scope and validity (as cited in Latorraca 2018). Investigating the reliability and validity of various research designs that use TAPs, Jääskeläinen (2011) highlighted the importance of supporting TAPs with other instruments. By the same token, as Li (2004) added, research designs can be trustworthy if the construct is formulated in such a way as not to leave a space for discrepancies. Thus, this study benefited from the quality evaluation of the participants' translated texts, the aim of which was to support TAPs with more quantitative data, and it paid attention to the considerations emphasised by Jääskeläinen (2011), such as subject selection, task type and methodological solutions (e.g. a multimethod approach), as well as transcribing and analysing procedures as Sun (2011) reported.

2. Literature review

Translation was seen as optimising the equivalence between source and target text up until the last three decades (Al-Smael 2000). However, it was criticised for being stuck in the purely theoretical discussions over the cultural or structural approaches for a very long period of time. As noted by Steiner (1975), the overwhelming majority of the approaches that consider translation solely from an equivalence-based theoretical perspective resulted in overlooking the process. Earlier attempts tried to make inferences from the final product. However, as Bernardini (2001) asserted, the translation product itself is not enough, by itself, to evaluate the whole process since the strategies employed and the problems encountered during the process can be overlooked. Hence, empirical models regarding the analysis of the translation process were proposed to cover the inadequacies of traditional theoretical approaches. By the same token, being among the pioneers of process oriented researchers, Krings (1986) and Lorscher (1992) levelled criticism against traditional approaches and favoured the study of the translator's mind to see the real background. Their criticism stems from the fact that psychological aspects of translating, that is the process that the mind undertakes during translation, has not been taken into consideration by previous approaches with any reliable methodology.

Similar criticism was voiced by other scholars who argued that purely theoretical approaches to translation were no longer sufficient for the growing needs of translator training (Jääskeläinen and Tirkkonen-Condit 1991). Al-Smael (2000) added that one of the most cited reasons for rejecting traditional approaches is that

they are mostly adjusted for the product of professional translators, thereby overlooking trainee translators. Similar to this reason, Lörscher (1992) suggested that tracking the translation process can be beneficial for teaching translation as certain strategies proven to be successful can be used in teaching settings. Kußmaul and Tirkkonen-Condit (1995) acknowledged that deductive and normative models of the translation process would be complemented by more empirical and inductive methods.

Think-Aloud Protocols (TAPs) became one of the earliest methods, followed by other methods; key-logging (Jakobsen 1999), eye-tracking (Sharmin, Špakov, *et al.* 2008) and screen recordings (Massey and Ehrensberger-Dow 2014). Originally derived from psychology and cognitive science, the foundations of TAPs were set out by Ericsson and Simon (1993). Their model envisages that the information stored in one's short-term memory (STM) can be accessed and reported while one's long-term memory is difficult to access and report. As for its use within Translation Studies, it is known as a method based on the idea that the "translator is asked to verbalise his thoughts and whatever comes to his mind during the process of translating" (Al-Smael 2000: 8). Jääskeläinen (2002) gave a concise definition of this technique, stating that it is a way of collecting data in which participants are given a task and asked to verbalise their thoughts while translating. Translation itself is a cognitive process that can be verbalised and the success of TAPs has been reported in many empirical studies. This attempt helped narrow the gap between theory and practice (Al-Smael 2000; Kußmaul 1995; Wilss 1996).

TAPs have often been used to reveal the problems and the translation strategies employed by non-professional, semi- professional and professional translators. It is important to highlight that practice and experience in translation may influence the amount of processing in STM (Bernardini 2001). This can be explained with the notion of "automation" in translation. Automatic processes are expected to be faster, although they do have their limits, such as being less flexible and less liable to modificiation if needed. Automaticity refers to performing a task with only a few cognitive resources and it is generally regarded as being opposed to controlled processing (Muñoz Martín 2016). This notion is generally addressed by comparing professionals with novice translators or trainee translators and language students. Since the professionals are known to carry out many translation processes automatically and have less to verbalise, it can be difficult to intervene in their mental process (Bernardini 2001; Hansen 2005).

A comprehensive bibliography of TAP research was initially compiled by Jääskeläinen (2002), and later Sun (2011) presented a detailed list of the literature with regard to methodological problems in translation process research. He put forward a classification system for the validity and comparison of methods. As the years have passed, and with new research having been published, it has been deemed necessary to take recent empirical studies performed with non-professionals, semi-professionals and professionals into consideration within the scope of this study.

One of the seminal studies was conducted by Gerloff (1986), who presented the text analysis and processing strategies adopted by university students studying French as a second language. Gerloff acknowledged that there was a strong need to develop and work on the techniques and she deemed this exploratory study a pilot study in this regard. In translating a short French text with sentences of varying difficulty, participants were asked to verbalise what they were doing. Upon analysis of

the subjects' transcriptions, the researcher attempted to define and elaborate the strategies adopted by the subjects. This was followed by a study by Krings (1986) who conducted a TAP study with 8 German learners of French to identify translation problems and strategies. Four participants were asked to do direct (L2-L1) and the other half were asked to do inverse translation (L1-L2).

Krings reported five main sets of strategies (i.e. comprehension, equivalent retrieval, equivalent monitoring, decision-making and reduction) and presented a tentative model of the translation process. One year after her previous study, Gerloff (1987) aimed to find a reliable methodology and analysed problem-solving strategies adopted by student translators. Jääskeläinen (1987) investigated the translation performance of non-professionals on the basis of internal and external processing, for which internal processing refers to the problem-solving strategies adopted by the subjects while external processing refers to the time spent and dictionaries used during the translation process. Analysing the TAPs of the subjects, the researcher attempted to draw some tentative conlusions regarding the behaviours of non-professional translators. Tirkkonen-Condit (1987) aimed to reveal the problem-solving strategies of two students, one of whom was a first-year student and the other was a fifth-year student of translation. The data showed that the fifth-year student identified more problems while needing less time. For the analysis of internal and external processing during translation, Gerloff (1988) used novices, competent bilinguals and professional translators as subjects. Based on the comparison of the final output of these three subjects, the results suggest that translation quality is determined by time and effort spent on a task.

Building upon the methodology of her previous study in 1987, (Jääskeläinen 1989a, 1989b, 1989c) not only tried to investigate the importance of reference materials for professional and non-professional students but also stressed the importance of a translation brief for the translation process in her consecutive three research studies. One year later, Jääskeläinen (1990) added new data to her previous work to determine process features accompanying translation performance. She showed that poor translation performance can stem from seeing the translation assignment as only a "mechanistic code-switching" operation (as cited by Jääskeläinen 2002: 118). Lörscher (1993) unveiled the results of a longitudinal study, in which he analysed the translation behaviours of 45 advanced level French students and 22 professional translators in terms of the length of translation units. The study showed that professionals tended to employ a sense-oriented approach and dealt with longer chunks of translation units compared to students. Focusing on the process of professional translators, Laukkanen (1993) compared routine and non-routine translation tasks, in which routine refers to the type of text that the translator is accustomed to while non-routine is a text that covers a lesser known subject matter. According to the result of the study, it was found that in routine tasks translators adopt a more positive attitude and display a higher self-image.

In their study on lexical search strategies, Mondahl and Jensen (1996) recruited adult learners of English. The study allowed them to unveil and categorise the most common strategies employed by their subjects. As a result, they separated translation production from evaluation strategies. Luukkainen (1996) sought to answer the question whether access to dictionaries during the translation process affected translation quality. The researcher concluded that students' access to dictionaries impeded their

processing, yet it did not affect the general strategies used by the students. Some researchers investigated the use of think-aloud as a methodology with professional translators in their working situation. For instance, Séguinot (1996) sought to find an answer to the problem of the non-linearity of the procession. The researcher recruited two professional translators for her study and discussed the limitations of TAPs to prove the non-linear nature of the translation process. However, previously accepted solutions regarding non-linear procession, parallel processing and the iterative nature of the process come into prominence again, suggesting that the translation is based on a self-generated meaning (as cited by Jääskeläinen 2002: 131). As part of this study, Séguinot (1996) identified four main strategies employed by these two professional translators: (i) interpersonal strategies, (ii) search strategies, (iii) inferencing strategies and (iv) monitoring strategies. As an example of complementing TAP with more quantitative data (e.g. Translog files), Jensen (2000) attempted to compare young non-professionals, young professionals and expert professionals in terms of time pressure. This study sought to shed light on the coping strategies adopted by non-professionals in a time restricted setting. Tirkkonen-Condit (2000) also investigated how translators manage the uncertainties that they are confronted with during the translation process and what solutions they employ to overcome the problems that arise from uncertainties. TAPs have also been investigated in terms of the effect on translation speed. To illustrate, Jakobsen and Alves (2003) recruited four semi-professional and five professional translators to identify the effect of TAPs on the process, in terms of speed, revision and text production. Inter-lingual translation was performed from Danish into English and vice versa under two conditions: including TAPs and excluding TAPs. The results showed that translation speed is significantly reduced by TAP intervention whereas the number of revisions does not change.

The literature shows that researchers benefit from TAPs in giving feedback to trainee translators and helping them improve their translation skills. A good example is provided by Li (2011) who found that TAPs could be used as a pedagogical tool. Thus, with the aim of investigating whether TAPs could be used in tranlator training, the researcher attempted to discover what mental processes take place while students are translating and how the outputs of these mental processes can be incorporated into an interactive mode of teaching. With the arrival of the 2000s, the research on TAPs shifted from traditional types of translation to translation technology tools by which human intervention in translation is relatively reduced. In this regard, O'Brien (2005) measured the effort involved in Machine Translation Post-Editing. Think-Aloud Protocols were investigated for assessing the post-editing effort in combination with these tools. Similar to the research conducted by Tirkkonen-Condit (2000), as explained above, Angelone (2010) demonstrated the link between uncertainty management and the problem-solving strategies of translators by recruiting one professional and three student translators. The TAP data is supported with screen-recording and the results offer some significant differences between professionals and non-professionals in terms of coping with any uncertainties that emerge during the translation process.

Another outstanding study addresses the translation process according to Pavlovic's (2007) "direct" or "inverse" translation concepts, which refer to translation *from L2 into L1* or *from L1 into L2*, respectively (p.3). In order to understand the role

of typological differences, type of texts and the level of expertise on translators' decisions, Cifuentes-Férez and Rojo (2015) implemented a TAP study with ten Spanish translators (five professionals and five graduate students without professional experience) and asked them to transfer manner of motion verbs from English into Spanish. The results revealed that the translators' decisions were mainly influenced by the differences between the two languages although the text type and the level of expertise had some effect on their strategies. Being one of the recent studies that focus on process-oriented research, the study performed by Sycz-Opoń (2019) investigated the information searching strategies that translation students adopt during the translation process. Direct observation and Think-Aloud Protocols were used together to collect data. The result displayed the information seeking behaviour of students, indicating that students used bilingual sources without paying attention to the nature of the problem in the task.

To summarise this concise review of the literature, it is clearly seen that most of the earlier researchers (Lörscher 1993; Mondahl and Jensen 1996; Jensen 2000) used students in language teaching departments as their primary subjects. This can be attributed to the scarcity of translation departments around the world. With the foundation of translation departments in the following years, the comparison of professional translators with non-professionals, including novices or trainees, stood out as a popular research topic (Angelone 2010; Englund Dimitrova and Tiselius 2014; Cifuentes-Férez and Rojo 2015; Ferreira, Gottardo, *et al.* 2018; Sycz-Opón 2019). Process-oriented research was generally carried out to analyse the problem-solving strategies of professionals and non-professionals. More recently, directionality gained importance in process-oriented research.When it comes to recent research on process-oriented translation, it is seen that with the improvements in MT systems, especially after the year 2010, TAPs have been applied in the studies that try to investigate the link between cognitive effort and translation quality. For this purpose, researchers resort to emerging methods of data collection, such as eye-tracking and screen recording, in combination with TAPs and key-logging reports.

With Turkish speakers, there have been very few TAP studies (Unsalan 1996) and a majority of the studies using TAPS have been exclusively related to language learning, as an attempt to understand the reading and comprehension process of foreign language learners (Buckingham and Aktug-Ekinci 2017; Gurses and Bouvet 2017; Ustunbas 2019). It is expected that the present study will provide a better understanding of the translation process, the challenges that Turkish-English translators (of two typologically very different languages) have to cope with and the strategies that they use in the translation of a scientific text.

3. Materials and methods

The participants, setting, materials, procedure and data analysis process are explained below.

3.1. Participants

This study was conducted with 11 Turkish native speakers. Of those, 7 were female and 4 were male. Their mean age was around 23. Participants were senior under-

graduate students with upper-intermediate level English proficiency (i.e. B2 according to CEFR). All the participants were students enrolled in the English Translation and Interpreting Department. None had any language disorders or other psychological and neurological problems which might influence their comprehension and performance on the task. Furthermore, participants were unaware of the purpose of the study and took part in the study on a voluntary basis. The participants were asked to fill in an informed consent form and they were informed that no personal identification information was required for the study, that their data would be kept strictly confidential and evaluated only by the researchers and the obtained data would be used for scientific purposes.

3.2. Setting

English Translation and Interpreting is a 4-year BA level program which comprises both theoretical and applied training, in which students are also asked to do a summer internship either at public institutions, including government ministries, local administrative units affiliated with higher public institutions or in the private sector, including translation agencies, departments of foreign affairs in companies doing business on the internationa level. As English proficiency is a prerequisite condition for the program, an English preparation class is compulsory for those with lower proficiency levels. Thus, those who fail the English proficiency exam have to attend a one-year preparation class given by a team of lecturers at the School of Foreign Languages.

The courses in the first year of this program at a state university in central Turkey aim mostly to improve the students' language proficiency, specifically reading, writing and speaking skills. Subject matter courses and theoretical courses regarding Translation Studies are introduced in the second year. In the second year, they first take a course called "Introduction to Translation" and it is followed by "Text Translation," both of which are essential for the students to learn the classification of text types (Reiss 1976) and decide on the strategy to be used as per the type defined.

Furthermore, there are technology-based courses within the curriculum including Basic IT Skills in the first year and Computer-Aided Translation and Translation Technology courses in the second and third years, respectively. These courses offer students an opportunity to learn not only the basic tools used in the translation process but also emerging tools that are increasingly required on the translation market. In addition to these technology-based courses, students are to take subject matter courses in their third year. For example, there are courses including "Scientific and Technical Translation," "Medical Translation" and "Legal Translation" as explained in the previous sub-section of this study. However, students must take an introductory course before taking each of these subject-matter courses. The aim of these introductory courses is to give students background knowledge before they jump into actual translation assignments head first. Additionally, almost all the courses have pre-conditions, meaning that students cannot take higher level courses before taking the introductory courses (i.e.'Specialized Knowledge III" must be taken before 'Scientific and Technical Translation').

3.3. Materials

To collect information about the participants' background and potential factors that might have an effect on their performance, a demographic information form was presented, in which the participants reported their personal information and educational background, their native and foreign language(s), and experience with such behavioural studies.

In this study, the researchers were exclusively interested in the senior level translation students' abilities (knowledge, skills and strategies) to translate scientific texts. Hence, an abstract consisting of 6 sentences was chosen. The average length of the sentences was 26 words. The shortest sentence was the third sentence with 14 words. The length of the other sentences ranged from 25 to 32 words. The abstract was taken from the chapter 'Molecular Genetic Methods' by de Kovel and Fisher (2017) in the book entitled *Research Methods in Psycholinguistics and Neurobiology of Language: A Practical Guide*. As Sun (2011) warned, the difficulty of the task is a potential variable in terms of translation process research, the experimental text was determined based on the L2 proficiency of the subjects. This abstract was chosen not only because it consisted of more recent terminology, particularly in a growing field of molecular genetics and its relation to understanding human language processing, but also because it had a variety of syntactic structures such as active and passive, relative and noun clauses, participles, conditionals, conjunctions and different examples of tense, aspect and modality, which made it easier to observe the participants' struggles and distinct strategies to cope with each.

Given that the participants were unfamiliar with TAP tasks, three trial sentences were used as a warm-up task so as to familiarise them with the method before they started translating the text. The trial sentences were retrieved from scientific sources, such as research reports or articles. The participants' voices were audio-recorded while translating. They were allowed to use any digital or printed resources available that they regularly used in their assignments or translation jobs (e.g. dictionaries and CAT tools) so that the researchers could see the mental processes and challenges that the translation students experienced in their regular translation activities. Later, the recordings were transcribed verbatim and analysed.

3.4. Procedure

Participants were welcomed individually into a quiet room where there was a computer connected to the Internet and where they were less likely to be interrupted. For the warming-up phase, to help subjects become familiar with TAPs, they were given three trial sentences and they were asked to translate them into Turkish and, while translating, they had to describe their translation decision making process/reasoning. At this stage, all instructions were explained as clearly as possible. This briefing was deemed important as any ambiguity about the process would make the subjects take part in social interaction (e.g. asking the researchers about the instructions during the study), which would then distort the reports of their mental process (Bernardini 2001). Moreover, the students were asked to verbalise their thoughts while simultaneously considering the drawbacks of post hoc verbalisations including incomplete and uninterpretable verbal reports (Ericsson and Simon 1993). Afterwards, the students

continued with the translation of the abstract. As stated above, they were audio-recorded throughout the process and they were allowed to use any digital or printed resources since the researchers were ultimately interested in their typical translation behaviours. The mean duration of the think-aloud sessions for each participant is approximately 30 min.

3.5. Data analysis

3.5.1. Scoring translations

To score the translation quality of the student translators in the study, a 'Translation Quality Assessment' tool (Colina 2009) was used, given that the tool is practical and evaluates any specialised content and terminology used in addition to the basic language used and adequacy. The tool was originally developed in 2008 and tested with the raters of different languages in 2009 for inter-rater reliability. The tool has a cover sheet requiring information about the requester and three parts: Translation Brief, Quality Criteria and Assessment Summary, and Recommendation. The Quality Criteria assigns a specific weight to each of the four components in the Scoring Worksheet. The components are Target Language, Functional and Textual Adequacy, Non-Specialised Content, and Specialised Content and Terminology. In the tool, the maximum score possible is 100.

3.5.2. Transcription, coding and analysis

The audio-recordings were transcribed and coded. Following Sun's (2011) recommendations regarding how to transcribe, the parts which are not directly relevant to the research questions (i.e. the participants reading the sentences for comprehension or revision) were not completely transcribed. The recordings were transcribed verbatim apart from these specific parts.

For the analysis of the transcripts, Glaser and Strauss' (1967) constant comparative method was used. The method requires an inductive and systematic coding process for comparing and categorising qualitative data. It consists of four stages; "(1) comparing incidents applicable to each category, (2) integrating categories and their properties, (3) delimiting the theory, and (4) writing the theory" (Glaser and Strauss 1967: 105). In line with these explanations, the researchers first transcribed the recordings into *Word* documents. The translations and transcriptions were stored together in separate files for each participant. They read the transcriptions several times and compared the data coming from the source and translated texts to see if they supported each other. The documents were read in detail and labelled by codes. The codes were identified in meaningful chunks and categorised under the themes in relation to the research questions. After the process of coding ended, the emerging categories were reviewed and the final decisions were made.

4. Results

In this part, we present the scores that the student translators obtained for their translations and the results of the TAPs upon transcribing and analysing the transcripts.

4.1. Scoring translations

As mentioned before, there were 11 participants (4 male and 7 female) in this study. The participants translated three trial sentences. The actual text was an abstract of a chapter on using molecular genetic methods, namely a scientific text. The text consisted of 6 sentences. The sentences had a variety of language structures (e.g. active and passive, embedded clauses, etc.) and specialised terminology. Therefore, it was necessary for the student translators not only to be careful about the language used but also the specialised context. Before examining and reporting the results of the TAPs, the scores that the translators obtained for their translations might also be essential for a clearer picture of the process they had been through. Two raters scored the translations by using Colina's (2009) evaluation tool (see Table 1).

Table 1
Translation scores

Student Translator	Rater 1	Rater 2	Difference
M1	90	95	-5
M2	80	80	0
M3	90	90	0
M4	75	75	0
F1	75	70	5
F2	65	65	0
F3	70	70	0
F4	95	95	0
F5	70	65	5
F6	75	80	-5
F7	75	75	0

The agreement between the raters was 64%. Cohen's *K* was also run to determine whether there was an agreement between the two raters or not. Cohen's *K* was found: .564. According to the guidelines from Altman (1999), and adapted from Landis and Koch (1977), a kappa (*K*) of .564 shows a moderate agreement between the raters, *K*= .564 (95% CI, .234 to .893), $p < .01$ ($p = .000$). Given that the differences in the scores are not more than 5 points, this agreement is acceptable.

4.2. Temporal effort

The participants' temporal effort in translating the sentences under examination was also investigated for a better analysis and comparison of their translation behaviours. Table 2 below shows their production time per sentence and in total, as well as their initial reading, preparation and terminology extraction time (i.e. before translation) and their final reading (i.e. after translation), if participants followed any of these patterns, and eventually their average score given on their translation by the raters.

TABLE 2
Temporal effort

Student Translator	Before (sec.)	S1 (sec.)	S2 (sec.)	S3 (sec.)	S4 (sec.)	S5 (sec.)	S6 (sec.)	After (sec.)	Total (sec.)	Average Score
M1	72	98	75	64	98	252	118	0	777	92.5
M2	830	112	108	45	125	232	238	230	1920	80
M3	15	161	300	80	240	444	440	490	2170	90
M4	175	167	208	166	206	268	252	438	1880	75
F1	109	287	413	105	364	376	254	0	1908	72.5
F2	395	739	660	156	370	202	368	0	2890	65
F3	0	360	382	122	250	358	312	0	1784	70
F4	0	53	52	54	270	20	86	0	535	95
F5	72	302	289	154	574	314	260	171	2136	67.5
F6	81	334	676	144	586	406	490	162	2879	77.5
F7	124	55	115	81	114	180	218	166	1053	75

Accordingly, the average time the student translators spent on initial reading, preparation (e.g. uploading the file into *SmartCat* or *Memsourse*, opening dictionaries, etc.), underlining and looking up unknown words before they jumped into translating the sentences (if they preferred to do so, as can be seen in Table 2, there were 2 students who skipped this step) is approximately 170 seconds.

As for the average time they spent proofreading the translation, it is approximately 150 seconds, slightly less than the time spent on pre-translation tasks. On the other hand, there were more students who skipped this final stage of the translation cycle. In total, there were 5 student translators who did not do a final reading.

The average time the student translators spent on translating (and thinking aloud) each sentence is 226 seconds, ranging from 106 seconds to 298 seconds. Sentence 2 and 4 required the most time, with an average of 298 and 290 seconds respectively whereas Sentence 3 required the least time, with an average of 106 seconds. Sentence 2 and 4 are long and complex sentences; however, they are no more different than Sentence 1, 5 or 6 in terms of their length and structure (which took 246, 277 and 276 seconds to translate on average). When the recordings were meticulously examined, it was observed that the student translators mainly hesitated on the Turkish translation of words which might well have more than one equivalent, and thus felt the need to double check what might be the most appropriate usage in the given context. For instance, they had difficulty in finding the right Turkish translation for 'variability' and 'variants' in Sentence 2 and 'multigenerational families' in Sentence 4. Sentence 3 was the shortest and least complex sentence in the abstract. Therefore, as it might be expected, it took the least amount of time to translate (and to think aloud).

With regard to the total time, it was 1812 seconds on average, ranging from 535 seconds to 2890 seconds. More interestingly, the student translators who spent the least amount of time on the translation received the highest scores. For instance, it took only 535 seconds for F4 to complete the translation task given to her and she received a score of 95. Similarly, M1 completed the task within 777 seconds and he received a score of 92.5 on average. Furthermore, neither of these students carried out a final reading cycle. However, these students had fewer hesitations on language structure and word choice. To illustrate, M1 was able to capture how phrases and

different segments of the sentences were connected to each other. In this regard, he said:

1) Since the text has a scientific and academic language, I divided the sentences into their structures beforehand. Usually as Subject-Verb and Object. (M1)

As regards F4, she used the Machine Translation tools consistently and effectively. The only thing she did when she was not sure about the translation was to compare the outputs given by the MT engines and then she selected the better alternative, editing them if necessary, and completed the task without getting confused. Therefore, it might be more crucial to equip student translators with better language skills and an understanding of the context (e.g. scientific language and content) in the first place so that they can use translation tools and strategies more effectively and confidently.

4.3. Results of TAPs

The results that we obtained by transcribing and analysing TAPs can be considered under three categories: (i) the translation tools they consulted, (ii) the common strategies the student translators follow and (iii) the challenges they have. Below are the details of each, displaying the process of the Turkish student translators rendering of a short extract from a scientific text into Turkish.

4.3.1. Recruiting translation tools: When and how

The analysis of the students' TAPs reveals that students utilise some external resources during the translation process. These include bilingual dictionaries, CAT tools and Machine Translation engines, terminology databases and collections of theses (e.g. the one provided by the Council of Higher Education in Turkey). Most of the students consulted these resources throughout the whole translation process as seen in the following quotations (translated into English from the TAPs in Turkish):

2) […] before I begin to translate, I open my favourite dictionary *Tureng* and machine translation engine *Google Translate* in a new tab on my browser. (M4)

3) […] before I begin to translate, I open *Google Translate* and *Yandex Translate* in a new tab. (F4)

However, when their pattern of referring to external resources is examined more closely, it is seen that the students mostly use bilingual dictionaries and they do not opt for monolingual ones. This may be attributed to the fact that the direction of the translation is from their L2 into their L1.

Additionally,the students prefer to use comparable texts or sources such as collections of theses when they feel unsure of the right Turkish translation of a term. One of the students explained why he referred to the collection of theses from the Council of Higher Education in Turkey as follows:

4) I have selected 'variation.' The reason is that I cannot decide if I should use 'varyasyon' or 'çeşitlilik.' I need to see what people have used in this kind of text. (M2)

As for the use of CAT tools, one student made it clear that she used a CAT tool based on the volume of the translation assignment as follows:

5) Generally, I use *Memsource* for most of my translation assignments if the text type is from a technical domain. However, it depends on the volume of the assignment. I use *Memsource* for translation assignments that would take a few days to complete. (F5)

Furthermore, most of the students mentioned the facilitating role that translation tools play in the translation process. For instance, one student stressed the indispensable role that translation technology tools play for her as follows:

6) […] *Memsource* is everything for me during the translation. It is my saver. I can translate easily in this way. (F6)

Another student also added that these tools, at least, could give suggestions and they facilitated the process.

7) Now I am uploading my text into *Smartcat*. The terminology list is ready. I will also upload the terminology list. Now *Smartcat* gives me Machine Translation. Usually it is not enough, but at least it gives an idea. (M2)

The students used other tools if they were not sure or satisfied with the translation given by a tool.

8) After I read a sentence, I will put it into the translation tools and whichever I find more correct, I will do revisions on it. I am also putting the second sentence into *Google Translate* and *Yandex Translate*. *Yandex Translate* is better this time. I will do revisions on it now. (F4)

All these remarks clearly show that the students were aware of the external resources they could exploit during the translation process and nearly all of them used these resources to some extent. Furthermore, the selection of a dictionary or a CAT tool generally depended on individual preferences. The students did not seem to be aware of how they could use these tools to their full advantage. To illustrate, as given above, F6 states that *Memsource* was vital to her, yet she used *Memsource* as an alignment tool only. She copied each sentence onto a *Word* document one by one and, after translating, she pasted it back into *Memsourse*. M2 used *SmartCat* effectively. He even prepared a terminology list and, after that, he started translating on the tool. Nevertheless, he was not be sure about the Turkish equivalents for the terms in this extract from a scientific paper so he consulted several resources. In a nutshell, even though the student translators were aware of the external resources thanks to their previous experiences in the relevant courses, they might have been confused, especially when they had their own insecurities about their language knowledge and skills, and thus they should be provided with a better understanding of how they can ultimately benefit from these developing tools, resources or strategies in the given contexts. Otherwise, they might well be lost, perform below expectations and receive lower scores even if they seem to follow a regular pattern of translation cycle.

4.3.2. Following a pattern of translation process

The analysis of the students' TAPs also shows some important considerations for the students' general translation process. In this regard, the whole translation process can be split into three parts including pre-translation, translation and post-translation processes (Gouadec 2007). A pre-translation process refers to the preparation stage, at which the text is read, key terms are defined and parallel texts are found if

any. Of the 11 students in this study, 6 preferred to read the text before they started translating it. Furthermore, they also identified the unknown words and found their Turkish equivalents, or at least underlined these words.

9) […] Now I have read the text, the first thing I will do is to look up the words that I do not know. (M4)

For one student, the fact that the text was short also led her to read it quickly before she started translating it, although this was not her typical behaviour when the text is long. However, the recordings indicate that other students (5 students) skiped this stage and started translating the first sentence immediately, as seen in the following quotations:

10) […] Now I upload the translation in *Memsource* and begin to translate the first sentence. (M4)

11) […] Let's start with the first sentence. I am looking at the subject of the first sentence. It is a fairly long sentence. (F3)

When it comes to using dictionaries during the translation process, it was observed that they looked up nearly all the words in the dictionary even though they already knew some of them. There was one student that always went back and checked the cohesion between the sentences in the context of the text. The reason he gave for doing this was:

12) After I translate each sentence, I go back to the initial sentences and read the text again. Is there a lack of coherence in the context? This enables me to correct the part or the structure that I have mistranslated. (M3)

The recordings also show that the students rely on Machine Translation outputs excessively. They mostly accept the translation outputs given that they did only a little post-editing. In some cases, they only changed the terminology offered, as seen in the following quotation:

13) […] I copy the sentences from the *Word* document one by one and past it into *Google Translate*, *Yandex Translate*. As with the trial sentence, this offer of *Google Translate* is more apt to be post-edited. It gave a better translation. I will look up the word "figure out" in the *Tureng* dictionary as I don't like the suggestion from *Google Translate*. (F4)

As for forming target sentences, their recordings reveal that they tried to translate and merge the parts of speech one by one instead of reading the whole sentence. In other words, they did not focus on the whole structure but only chunks and phrases in a sentence. There were also students who preferred not to rely on a MT tool and worked on a *Word* document separately. For instance, as mentioned above, F6 first uploaded the entire text into *Memsource*; however, she preferred to work on each sentence individually by copying and pasting them into a *Word* document. She translated the sentences by dividing them into smaller units, and then combined everything altogether, and put her translation of individual sentences back into *Memsource*. She explained that she does not use Machine Translation on *Memsource*.

14) I have put the file into *Memsource*… I think this is the easiest way of translating. I do the translation by putting it in *Word*, dividing each sentence into parts and

> then I do the translation and combine everything, but if I don't have much time, I use Translate… This is how I use *Memsource*…Well I do not use Machine Translation on *Memsource*, I do the translation myself. (F6)

As for the post-translation stage, the recordings show that some students applied a superficial proofreading, only for spell-check purposes, after finishing the translation while others opted for reading the target text once more:

15) […] Ok. The translation is finished. I can submit it.(F3)

16) […] After finishing the translation, I will read it from start to end and control if there is any ambiguity or incomprehensible parts in the Turkish version. (F4)

The average score the student translators received in this study was 78, ranging from 65 to 95. All in all, the reasons why the student translators mostly received lower or average scores on the given task might be related to how effectively they completed the pattern of translation cycle. To this end, some recommendations are: (i) the students should have a better understanding of the context, a superfical reading or looking up some unknown words without knowing the context may not be effective, (ii) the students should feel more confident about their vocabulary knowledge and be aware of the resources they should consult, (iii) they should know how to use the MT outputs effectively, but they should not rely on them excessively, and (iv) proofreading should be more than a quick spell-check.

4.3.3. Challenges: Language(s), context and more

In this study, the challenges that the student translators have are mainly related to the selection of the most appropriate Turkish translation for the words in that specific context and the structural differences between English and Turkish.

To start, how a single term or word sounds to the ear of the Turkish native speakers is one of the important criteria when it comes to the selection of the Turkish translation for words and, most of the time, students feel insecure about their decisions, particularly when the text requires specialised terminology. The extracts taken from their transcriptions show their concerns:

17) Even if I know the meanings of some words, I look them up in a dictionary to be sure (about their meanings) in the context. (F6)

18) Even if they are the words I know, I look them up in the dictionary because I think I might be in doubt of myself while translating. I have so much anxiety, for instance, is this OK or should I use something else? Am I translating it incorrectly? (F5)

Even if some students preferred to use Machine Translation tools, such as *Smartcat* or *Memsourse*, they also often changed what the tool offered if it did not sound 'good' or natural to them.

19) What has it given me? I did not like mimarisine [genetic architecture]. I'll say genetik yapısına [genetic architecture]. Genetik mimarisine does not sound good. (M2)

Similar to the way the student translators are influenced by how the Turkish translation for a word sounds to them, they also decided the sentence structure based on the most likely and natural way to express it in Turkish. For example, in the sen-

tences below, the translator explains that he prefers to use the passive in his translation although the English sentence is active.

20) […] *This chapter describes the principles behind*… Bu bölümde… actually, it is not passive, but I will transform it into the passive… Bu bölümde… tanımlanmaktadır. In fact, I transformed an active sentence into the passive. (M4)

The students often use *Google Translate* or what they call 'post-editing' when they have difficulty understanding the English sentence structure.

21) […] due to the inadequacy in my (English) grammar, I have some problems, that's why I will try post-editing here… Yes, I can use the post-editing (the translation that *Google Translate* gives them) with some minor changes. (M4)
22) Well, because this sentence is a little challenging for me, I will put it into Translate. (F6)

English and Turkish are typologically different languages. The word order is different in both languages. English is a Subject-Verb-Object language while Turkish has a more flexible sentence structure (Goksel and Kerslake 2011). However, typically verbs come at the end of the sentence. This also affects the translation strategies such that translators often start from the end of the sentence.

23) […] I have started translating from the end. When I look into the sentence, I see that the word order in Turkish is from the end to the beginning. That's why, I have started translating like that. (F1)

24) *It is optimal to carry out*… Well, I'll start translating this sentence from the end. (F3)

5. Discussion

Translation process-research has garnered interest with the emergence of data collection tools. In this study, Think-Aloud Protocol (TAP) was used to draw inferences about the translation behaviour of Turkish translation students. To this end, the student translators were asked to verbalise their thoughts while translating an extract from a scientific text. As stated in the previous section, the themes obtained from the analysis of the students' audio recordings were grouped into three main categories including (i) the translation tools that students consulted, (ii) translation strategies adopted by the students, (iii) the challenges experienced by the students regarding the language and specialised terminology.

The analysis showed that the students mostly are aware of the translation tools available, including bilingual dictionaries, CAT tools and Machine Translation engines, and consulted them even though they could have used them more effectively. As for their preference for dictionaries, it was shown that they used bilingual ones to a great extent. This may be explained by the fact that the translation assignment is from English to their L1. However, Sin-wai (2004) warned that only looking up an unknown word in a bilingual dictionary would not help students understand the context to which that unknown word belongs. Furthermore, "bilingual dictionaries give only a limited range of equivalents and not a comprehensive list of possible translations" (Sin-Wai 2004: 8). By the same token, Tarp (2004) added that bilingual dictionaries should be used together with monolingual ones to find solutions to the

problems encountered during the translation process. Additionally, as stated by Cetiner (2021), even though there are technology-related courses in the curricula of translator education programs in Turkey, there is not a standard position in terms of the courses that should be offered to prospective translators and, what's more, course content is not usually designed to answer the needs of those who plan to take their part in the professional translation industry. The present study also shows that even though these courses raise awareness of the available translation tools, student translators might be in need of more careful guidance so that they can benefit from them to the utmost extent without getting lost or confused.

The analysis also showed that the students were aware of the benefits of consulting databases during the translation process as is the case with referring to the theses collection provided by the Council of Higher Education in Turkey, which might be a useful resource for them to find comparable texts and relevant terminology used by scholars. Their statements show that their primary aim in using this theses collection is to find what other people have used for the terms that they encounter in the translation assignments. Though this theses collection may give an insight into the terms in the translation assignments, it may also create confusion as the terms are not written in a standardised manner within this theses collection. Regarding the use of term banks during the translation process, Cabré (1999) highlights that standardised term banks are the most important resources to use during the translation process. To this end, students should be made more aware of the term banks or glossaries where they can find standardised equivalents for the terms in their translation assignment.

As for the pattern of translation process and the strategies that students adopt, it was observed that some students skip the pre-translation process and start translating the first sentence immediately. However, this may cause cohesion problems as they start translating without having a full comprehension of the source text. Moreover, their pattern of forming a target text shows that they merge parts of sentences (e.g. subject, verb, object) one by one instead of focusing on the whole structure. This may again cause cohesion and coherence problems in the target text. Hence, the conclusion can be drawn that the importance of the pre-translation stage, for obtaining a better understanding of the material, should be stressed more in translation classes. A similar problem occurs in the post-translation process. Some students do only superficial proofreading or skip the proofreading stage completely. Given the importance of the post-translation process for the quality of the final translation product, proof-reading, revising, self-revision or reading the whole target text from scratch are very important steps to create an appropriate and adequate target text. In this regard, Mossop (2014: 164) classified self-revision as "an integral part of the translation process." Thus, their failure to apply revision steps during the post-translation process shows that students should be reminded of the importance of self-revision. The differences in the translation scores of the students might be also explained by how effectively they followed the pattern of translation cycle.The students who carry doubts due to a lack of understanding of what each sentence aims to convey within the given context also have difficulty forming their Turkish translations. Even though this study does not aim to present a linguistic analysis of the translations, the places where the students lose points can be exemplified as using the wrong words/terms, grammatical mistakes and a lack of coreferences, etc, which

might be minimised to a large extent if further attention was given to the pre- and post- translation processes.

When it comes to taking advantage of MT systems, the statements reveal that they rely on MT outputs excessively. They rarely change or post-edit these outputs. Building upon the relevant literature, O'Brien (2012) reminds us that novices or student translators may benefit from MT more than professional translators. However, as in the case of matches and suggestions proposed by Translation Memory, a condition of "blind-faith" may occur for students towards the raw MT outputs (Bowker 2005: 19). Thus, the importance of being critical about the MT outputs and procedures for post-editing should be stressed in translation courses.

Lastly, the students' statements make it clear that they encounter linguistic, contextual, and some other kinds of challenges during the translation process. As for language-related problems, they are concerned about their selection of Turkish equivalents for the specialised terminology in the source text. It was observed that they found interim solutions for the terms based on their intuitions, but they were hesitant about their final decisions. They made their decisions based on the criteria that the Turkish equivalents of the terms sounded better to their ears. Thus, students can be informed about collocation dictionaries, which may help them find better equivalents to form a solid background for finding appropriate solutions for the specialised terminology. In addition, students can be guided to search for parallel or comparable texts to gain better terminology results as their importance in Translation Studies has been reported in previous research (Baker 1995; Zanettin 2000).

6. Conclusion

The mental processes in the translators' mind have been of great interest to many scholars over the last few decades. Several methods have been used. TAPs have been one of the most frequently used behavioural methods in translation research. With the advancements in translation technology, however, the pattern that translators follow during the translation process has also changed. On the one hand, a greater variety of tools and resources help translators to a large extent, yet on the other hand overreliance on these tools may result in word to word translation, and thus lead to a lack of a natural sounding text or the loss of coherence and cohesion in the translated text. Hence, it is important not only to introduce these tools to the prospective translators but also to identify their needs and to train them appropriately so that they can actually benefit from them.

In this study, the researchers aimed to better understand the typical strategies that student translators tend to use and the challenges they face while translating a scientific text. The participants were familiar with certain translation tools and strategies required for scientific translation. However, the results unveiled how effectively they carried out the patterns of translation cycle, which influenced the quality of their translation. It was observed that the importance of translation stages should be further highlighted in translator education. The student translators had challenges regarding specialised terminology in particular. Furthermore, the results also suggest that no matter how easier the tools make life, it is not these tools that make translation more successful, it is the language competency that translators have and the extent to which they comprehend the text in a particular field or topic. In this regard,

parallel or comparable corpus studies might also be included in the curriculum of the relevant courses in order to raise the students' awareness and to encourage them to take advantage of these sources.

The present study also has limitations. It did not aim to compare groups of student translators, or to include a comparison with professional translators. The ultimate goal was to provide a picture of typical behaviours of prospective translators who were familiar with today's technology and to see how they used them in their translation of scientific texts. However, this study did reveal important questions regarding how the use of Machine Translation might affect the translation process and it showed that student translators might show overreliance on these tools. Thus, it should be questioned whether working on these tools at the sentence level might lead translators to lose the coherence and cohesion in the text or not. Furthermore, now post-editing is becoming ever more popular, so future research might use TAPs to investigate translators' mental processes during post-editing.

REFERENCES

Al-Smael, Fahad (2000): *A think-aloud protocols investigation of lexico-semantic problems and problem-solving strategies among trainee English-Arabic translators*. Ph.D. thesis, unpublished. Durham: Durham University.

Altman, Douglas G. (1999): *Practical statistics for medical research*. New York: Chapman & Hall/CRC Press.

Alves, Fabio and Jakobsen, Arnt Lykke (2021): Grounding Cognitive Translation Studies: Goals, commitments and challenges. *In*: Fabio Alves and Arnt Lykke Jakobsen, eds. *The Routledge handbook of translation and cognition*. London & New York: Routledge, 545-555.

Angelone, Erik (2010): Uncertainty, uncertainty management and metacognitive problem solving in the translation task. *In*: Gregory M. Shreve and Erik Angelone, eds. *Translation and cognition*. Amsterdam: John Benjamins Publishing Company, 17-40.

Baker, Mona (1995): Corpora in translation studies: An overview and some suggestions for future research. *Target. International Journal of Translation Studies*. 7(2):223-243.

Bernardini, Silvia (2001): Think-aloud protocols in translation research: achievements, limits, future prospects. *Target. International Journal of Translation Studies*. 13(2):241-263.

Bowker, Lynne (2005): Productivity vs quality? A pilot study on the impact of translation memory systems. *Localization Focus*. 4(1):13-20.

Buckingham, Louisa and Aktug-Ekinci, Duygu (2017): Interpreting coded feedback on writing: Turkish EFL students' approaches to revision. *Journal of English for Academic Purposes*. Elsevier. 26:1-16.

Cabré, Maria Teresa (1999): *Terminology: Theory, methods, and applications*. Amsterdam & Philadelphia: John Benjamins Publishing.

Cifuentes-Férez, Paula and Rojo, Ana (2015): Thinking for translating: A think-aloud protocol on the translation of manner-of-motion verbs. *Target. International Journal of Translation Studies*. 27(2):273-300.

Colina, Sonia (2009): Further evidence for a functionalist approach to translation quality evaluation. *Target. International Journal of Translation Studies*. 21(2):235-264.

Cetiner, Caner (2021): Designing a syllabus for the translation technology course: with theoretical considerations and hands-on assignments. *International Journal of Language Academy*. 9(2):250-272.

Dam-Jensen, Helle and Heine, Carmen (2009): Process research methods and their application in the didactics of text production and translation. *Trans-kom*. 2(1):1-25.

De Kovel, Carolien G. F. and Fisher, Simon (2017): Molecular genetic methods. *In*: Annette M.B. De Groot and Peter Hagoort, eds. *Research methods in psycholinguistics and neurobiology of language: A practical guide*. Oxford: Wiley-Blackwell, 330-353.

Englund Dimitrova, Birgitta and Tiselius, Elisabet (2014): Retrospection in interpreting and translation: Explaining the process? *MonTi Monografías de Traducción e Interpretación*, 1 (5): 177-200.

Ericsson, Karl Anders and Simon, Herbert Alexander (1993): *Protocol analysis: Verbal reports as data*. Cambridge: The MIT Press.

Ferreira, Aline and Schwieter, John W. (2015): *Psycholinguistic and cognitive inquiries into translation and interpreting*. Amsterdam & Philadelphia: Benjamins.

Ferreira, Aline, Gottardo, Alexandra and Schwieter, John W. (2018): *Decision-making processes in direct and inverse translation through retrospective protocols. Translation, Cognition & Behavior*, 1(1):98-118.

Garcia, Adolfe M. (2019). T*he neurocognition of translation and interpreting*. Amsterdam: John Benjamins Publishing Company.

Garcia, Ignacio (2009): Research on translation tools. *In*: Anthony Pym and Alexander Perekrestenko, eds. *Translation Research Projects*. Tarragona: Intercultural Studies Group, 18-27.

Gerloff, Pamela (1986): Second Language Learners' Reports on the Interpretive Process. Interlingual and Intercultural Communications. *Discourse and Cognition in Translation and Second Language Acquisition Studies*. Tübingen: Narr. 243-262.

Gerloff, Pamela (1987): Identifying the unit of analysis in translation: Some uses of think-aloud protocol data. *Introspection in second language research*. 135-158.

Gerloff, Pamela (1988): *From French to English: A look at the translation process in students, bilinguals, and professional translators*. Ph.D. thesis, unpublished. Harvard: Harvard University.

Glaser, Barney and Strauss, Anselm (1967): *The Discovery of Grounded Theory Strategies for Qualitative Research*. Mill Valley: CA Sociology Press.

Gouadec, Daniel (2007): *Translation as a Profession*. Amsterdam & Philadelphia: John Benjamins Publishing Company.

Goksel, Aslı and Kerslake, Celia. (2011): *Turkish: An essential grammar*. New York: Routledge.

Gopferich, Susanne (2008): *Translationsprozessforschung: Stand, methoden, perspektiven*. Tübingen: Narr.

Gurses, Meral Ozkan and Bouvet, Eric (2017): Turkish Students' Comprehension Monitoring and Strategic Behaviors While Reading in French: A think-aloud study. *The Journal of Language Learning and Teaching*. 7(2):90-112.

Hansen, Gyde (2005): Experience and emotion in empirical translation research with think-aloud and retrospection. *Meta: journal des traducteurs*. Les Presses de l'Université de Montréal. 50(2):511-521.

Hatim, Basil and Munday, Jeremy (2004): *Translation: An advanced resource book*. New York: Routledge.

Jääskeläinen, Riitta (1987): *What happens in a Translation Process: think-aloud protocols of translation*. Master thesis, unpublished. Joensuu: University of Joensuu.

Jääskeläinen, Riitta (1989a): Teaching How to Use Reference Material in Translator Training: A Think-aloud Protocol Study. *In*: Anita Nuopponen and Rolf Palmberg, eds. *Special Languages and Second Languages: Methodology and Research*. Vaasa: AFinLA, 69-78.

Jääskeläinen, Riitta (1989b): The Role of Reference Material in Professional vs. Non-professional Translation: A Think-aloud Protocol Study. *In*: Sonja Tirkkonen Condit and Stephen Condit, eds. *Empirical Studies in Translation and Linguistics*. Joensuu: University of Joensuu Press, 175-200.

Jääskeläinen, Riitta (1989c): Translation Assignment in Professional vs. Non-professional Translation: A Think-aloud Protocol Study. *In*: Candace Séguinot, ed. *The Translation Process*. Toronto: H.G. Publications, 87-98.

Jääskeläinen, Riitta (1990): *Features of successful translation processes: A think-aloud protocol study*. Licentiate thesis, unpublished. University of Joensuu, Savonlinna School of Translation Studies.

Jääskeläinen, Riitta (2002): Think-aloud protocol studies into translation: an annotated bibliography. *Target. International Journal of Translation Studies*. 14(01):107-136.

Jääskeläinen, Riitta (2011): Back to basics: Designing a study to determine the validity and reliability of verbal report data on translation processes. *In*: Sharon O'Brien, ed. *Cognitive explorations of translation*. London: Bloomsbury Publishing, 15-29.

Jääskeläinen, Riitta and Tirkkonen-Condit, Sonja (1991): Automatised processes in professional vs. non-professional translation: A think-aloud protocol study. *In*: Sonja Tirkkonen-Condit, ed. *Empirical research in translation and intercultural studies*. Berlin: G.Narr, 89-109.

Jakobsen, Arnt Lykke (1999): Logging target text production with Translog. *In*: Gyde Hansen, ed. *Probing the process in translation: Methods and results*. Frederiksberg: Samfundslitteratur, 9-20.

Jakobsen, Arnt Lykke and Alves, Fábio (2003): Effects of think aloud on translation speed, revision, and segmentation. *In*: Célia Magalhães and Adriana Pagano, eds. *Triangulating Translation: Perspectives in process oriented research*. Amsterdam & Philadelphia: John Benjamins Publishing Company.

Jensen, Astrid (2000): *The Effects of Time on Cognitive Processes and Strategies in Translation* Ph.D. thesis, unpublished. Copenhagen: Copenhagen Business School.

Krings, Hans P. (1986): *Was in den Köpfen von Übersetzern vorgeht. Eine empirische Untersuchung zur Struktur des Übersetzungsprozesses an fortgeschrittenen Französischlehrern*. Tübingen: Narr.

Krings, Hans P. (2005). Wege ins Labyrinth–Fragestellungen und Methoden der Übersetzungsprozessforschung im Überblick. *Meta: Journal Des Traducteurs*, 50(2), 342-358.

Kussmaul, Paul (1995): *Training the Translator*. Amsterdam & Philadelphia: John Benjamins Publishing.

Kussmaul, Paul and Tirkkonen-Condit, Sonja (1995): Think-aloud protocol analysis in translation studies. *TTR: traduction, terminologie, rédaction*. 8(1):177-199.

Landis, Richard and Koch, Gary (1977): The Measurement of Observer Agreement for Categorical Data. *Biometrics*. 33(1):159-174.

Latorraca, Rossella (2018): Think aloud as a tool for implementing observational learning in the translation class. *Perspectives*. 26(5):708-724.

Lauffer, Sabine (2002): The Translation Process: an analysis of observational methodology. *Cadernos de traduçao*. 2(10):59-74.

Laukkanen, Johanna (1993): *Routine vs Non-routine Processes in Translation: A Think-aloud Protocol Study*. Master thesis, unpublished. Joensuu: University of Joensuu.

Li, Dechao (2011): Think-aloud teaching in translation class: Implications from TAPs translation research. *Perspectives*. 19(2):109-122.

Li, Defeng (2004): Trustworthiness of think-aloud protocols in the study of translation processes. *International Journal of Applied Linguistics*. 14(3):301-313.

Lorscher, Wolfgang (1992): Investigating the translation process. *Meta: Journal des traducteurs*. 37(3):426-439.

Lorscher, Wofgang (1993): Translation Process Analysis. *In*: Yves Gambier and Jorma Tommola, eds. *Translation and Knowledge*. Turku: University of Turku, 195-212.

Luukkainen, Tiina (1996): *Comparisons of Translations Made with and without Reference Material: A Think-Aloud Protocol Study*. Master thesis, unpublished. Joensuu: University of Joensuu.

Massey, Gary and Ehrensberger-Dow, Maureen (2014): Looking beyond the text: The usefulness of translation process data. *In*: Dagmar Knorr, Carmen Heine, and Jan Engberg, eds. *Methods in writing process research*. Berlin: Peter Lang, 81-98.

Mondahl, Margrethe and Jensen, Knud (1996): Lexical search strategies in translation. *Meta: Translators' Journal*. 41(1):97-113.

Mossop, Brian (2014): *Revising and editing for translators*. London: Routledge.

Munday, Jeremy (2016): *Introducing translation studies: theories and applications*. New York: Routledge.

Muñoz Martín, Ricardo (2016): Reembedding translation process research: An introduction. *In*: Ricardo Muñoz Martín, ed. *Reembedding Translation Process Research*. Amsterdam & Philadelphia: John Benjamins Publishing Company, 1-20.

O'Brien, Sharon (2005): Methodologies for measuring the correlations between post-editing effort and machine translatability. *Machine translation*. 19(1):37-58.

O'Brien, Sharon (2012): Translation as human-computer interaction. *Translation Spaces*. 1(1):101-122.

Pavlovic, Natasa (2007): *Directionality in collaborative translation processes*. Ph.D. thesis, unpublished. Spain: Universitat Rovira i Virgili.

Reiss, Katharina (1976): *Texttyp und Übersetzungsmethode: der operative Text*. Heidelberg: Scriptor Verlag.

Saldanha, Gabriela and O'Brien, Sharon (2010): *Research methodologies in translation studies*. London; New York: Routledge.

Séguinot, Candace (1996): Some thoughts about think-aloud protocols. *Target. International Journal of Translation Studies*. 8(1):75-95.

Sharmin, Selina, Špakov, Oleg, Räihä, Kari-Jouko et. al. (2008): Effects of time pressure and text complexity on translators' fixations. *In*: Stephen Spencer, ed. *Proceedings of the 2008 symposium on Eye tracking research & applications*. (Eye tracking research and applications symposium, Savannah, 26-28 March 2008). New York: ACM Inc., 123-126.

Sin-wai, Chan (2004): Dictionaries and Translators. *In*: Chan Sin-wai, ed. *Translation and Bilingual Dictionaries*. Tübingen: Max Niemeyer Verlag, 1-7.

Smith, Amanda (2014): Think aloud protocols: Viable for teaching, learning, and professional development in interpreting. *Translation & Interpreting*. 6(1):128-143.

Steiner, George (1975): *After Babel: Aspects of Language and Translation*. London: Oxford University Press.

Sun, Sanjun (2011): Think-aloud-based translation process research: Some methodological considerations. *Meta: Journal des traducteurs*. 56(4):928-951.

Sycz-Opoń, Joanna (2019): Information-seeking behaviour of translation students at the University of Silesia during legal translation–an empirical investigation. *The Interpreter and Translator Trainer*. 13(2):152-176.

Tarp, Sven (2004): Dictionaries and Translators. *In*: Chan Sin-wai, ed. *Translation and Bilingual Dictionaries*. Tübingen: Max Niemeyer Verlag, 23-37.

Tirkkonen-Condit, Sonja (1987): Think-aloud Protocols in the Study of the Translation Process. *In*: Heikki Nyyssönen, Riitta Kataja, and Vesa Komulainen, eds. Oulu: University of Oulu, 39-49.

Tirkkonen-Condit, Sonja (2000): Uncertainty in Translation Processes. *In*: Sonja Tirkkonen-Condit and Riitta Jääskeläinen, eds. *Tapping and Mapping the Processes of Translation and Interpreting: Outlooks on Empirical Research*. Amsterdam & Philadelphia: John Benjamins Publishing, 123-142.

Unsalan, Gonca, (1996). *A case study of translation strategies among three Turkish students using think-aloud protocols*. Master thesis, unpublished. Ankara: Bilkent University.

Ustunbas, Umran (2019): Use of Cognitive Strategies in Reading: A Descriptive Study on EFL Learners' Metacognition. *Eğitimde Kuram ve Uygulama*. 15(2):1-11.

Wilss, Wolfram (1996): *Knowledge and Skills in Translator Behavior*. Amsterdam & Philadelphia: John Benjamins Publishing Company.

Zanettin, Federico (2000): Parallel Corpora in Translation Studies Issues in Corpus Design and Analysis. *In*: Maeve Olohan, ed. *Intercultural Faultlines Research Models in Translation Studies: v. 1: Textual and Cognitive Aspects*. London & New York: Routledge, 105-119.

Zhou, Yali and Lin, Yan (2012): Probe into Translation Process Based on Think-aloud Protocols. *Theory & Practice in Language Studies*. 2(7).