THE EFFECTS OF USING AN EXPERIMENTAL STRATEGY TRAINING TOOL ON READING COMPREHENSION, ENGAGEMENT, AND METACOGNITIVE AWARENESS

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The Effects of Using an Experimental Strategy Training Tool on Reading Comprehension, Engagement, and Metacognitive Awareness

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DECLARATION OF ORIGINALITY

I, Gamze Uçak, certify that

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ABSTRACT

The Effects of Using an Experimental Strategy Training Tool on Reading Comprehension, Engagement, and Metacognitive Awareness

This study explores the effects of metacognitive strategy training, delivered online, or in-class, on reading comprehension, engagement, and metacognitive awareness of adult learners of English. The participants were 84 students in a preparatory school of a private university. The in-class group received metacognitive strategy training delivered by the teacher, the online tool group received the same training via an experimental tool, and the control group followed regular reading lessons based on the textbook. The online tool specifically designed for the study was based on the design principles of multimedia learning, and scaffolding design guidelines recommended for learning software. Pre and post-tests were conducted to compare the difference scores in reading comprehension. Metacognitive awareness and classroom engagement inventories were filled out before and after the study. Feedback from the participants in the online tool group was also collected. The findings showed that the online tool group significantly outscored the control group in terms of reading comprehension and metacognitive awareness. The in-class group outperformed the online-tool and the control group in terms of engagement. The feedback from the online tool group indicated that the implementation was considered useful. The findings of the study provide support for reading strategy training with carefully designed online scaffolding tools for adult learners of English, especially at lower proficiency levels. Recommendations and guidelines are offered for instructional design, as well as online scaffolding tool design for comprehensive metacognitive strategy training and reading strategy practice.

ÖZET

Deneysel Bir Okuma Stratejileri Aracı Kullanmanın Okuduğunu Anlama, Katılım ve Üstbilişsel Farkındalık Üzerindeki Etkileri

Bu çalışma, deneysel bir araçla çevrimiçi olarak ya da öğretmen tarafından sınıfta sunulan üstbilişsel strateji eğitiminin İngilizce öğrenenlerin okuduğunu anlama, katılım ve üstbilişsel farkındalıkları üzerindeki etkisini araştırmaktadır. Çalışmanın katılımcılarını özel bir üniversitenin hazırlık okulunda okuyan 84 öğrencidir. Sınıf içi grubu sınıfta öğretmenden üstbilişsel strateji eğitimi almış, çevrimiçi araç grubu aynı eğitimi deneysel bir araç ile almış, kontrol grubu ise ders kitabına dayanan normal okuma derslerini takip etmiştir. Bu çalışma için özel olarak tasarlanan çevrimiçi araç, çokluortam öğrenimi tasarım ilkelerine ve öğrenme yazılımları için önerilen destekleyici tasarım ilkelerine dayandırılmıştır. Okuduğunu anlamadaki fark skorlarını karşılaştırmak için ön ve son testler yapılmıştır. Eğitimden önce ve sonra üstbilişsel farkındalık ve derse katılım envanterlerini doldurulmuştur. Ayrıca çevrimiçi araç grubundaki katılımcılardan geri bildirimler toplanmıştır. Sonuçlar, çevrimiçi araç grubunun okuduğunu anlama ve üstbilişsel farkındalık açısından kontrol grubunu önemli ölçüde geride bıraktığını göstermiştir. Sınıf içi grubu çevrimiçi ve kontrol gruplarından katılım açısından daha yüksek başarım göstermiştir. Çevrimiçi araç grubundan toplanan geri bildirimler, uygulamanın faydalı bulunduğunu göstermiştir. Bu bulgular, özellikle daha düşük yeterlilik seviyelerinde İngilizce öğrenen yetişkinler için dikkatle tasarlanmış destekleyici çevrimiçi araçlar ile okuma stratejileri eğitimi verilmesini desteklemektedir. Öğretim tasarımı için öneriler ve kılavuzlar, ayrıca kapsamlı üstbilişsel strateji eğitimi ve okuma stratejisi uygulaması için çevrimiçi destek aracı tasarımı sunulmuştur.

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CHAPTER 1

INTRODUCTION

Using digital technologies for educational purposes has become common in different settings of learning and for a variety of learner needs. The potential for multiple interactions and increased learner autonomy make digital technologies indispensable in today's educational settings. Since 1950s foreign language teaching and learning has become one of the prominent fields in which current technology is used either as an aid or a medium.

Due to its complex nature, reading has been widely researched in traditional classroom settings as well as in digital learning environments. An earlier body of research focused on essential components necessary to comprehend texts. These studies reveal that vocabulary, background knowledge, and inference skills strongly predict reading comprehension. Therefore intervention studies focused on ways to increase the learners' knowledge and skills in these components through specially designed activities.

The second body of more recent research examines prior knowledge and using strategies to increase reading comprehension. The knowledge and use of reading strategies help learners increase their comprehension. Among these strategies, metacognitive strategies, which are prompted by metacognitive awareness, have been widely researched and found to have significant effects for predicting reading comprehension. By using metacognitive strategies, learners become active participants and aware of their own learning processes.

More recent studies focus on the identification of reading strategies to increase comprehension and aim to determine the strategies that are more helpful for individual components of reading. A less researched area of study is the effect of strategy training on increasing vocabulary knowledge and inference skills.

While reading may be difficult to master even in one's first language (L1), reading in a second or foreign language (L2) creates more challenges for learners. Mastering reading in L2 depends on similar sets of skills as in L1, but it is also closely related to the proficiency level in L2, motivation and comprehension skills of the learners, as well as cultural familiarity, and orthographical relationship with L1 (Grabe, 1991). In this sense, digital tools can provide several opportunities for meeting these requirements. Intervention studies carried on such tools indicated greater gains in terms of reading comprehension in L1 and L2 as well as individual components of reading.

As one commonly used medium, scaffolding tools enable learners to deal with complex content and comprehensive skills. These tools not only guide learners in content acquisition and planning, but also structure the process of learning, and therefore, they provide a great potential to shape the understanding and performance of the learners (Reiser, 2004). Despite their popularity and widespread use, the design of such tools is rarely based on a sound pedagogical and theoretical framework. There seems to be a need for consistently designed digital tools in foreign language education that combine current pedagogical approaches in language learning with sound instructional design principles. This study is an attempt to design, develop, implement, and evaluate an experimental scaffolding tool, called Meta-S, to address the specific learning needs of adult learners of English.

1.1 Statement of the problem

Research has shown that reading in a foreign language is a complex and problematic skill as it requires several sub-skills as well as an adequate proficiency level. When designed and used appropriately, digital/online tools can provide a good alternative to facilitate reading comprehension of language learners. Even though intervention studies provide promising results for increasing comprehension, they are not conclusive. Furthermore, despite the abundance of component-based interventions that focus on vocabulary, inference, background knowledge and other subcomponents of the reading process, there are not enough studies on the effects of strategy training delivered online by an experimental scaffolding tool on reading comprehension. In addition, there are no studies, to this researcher's knowledge, that also evaluate the effects of such training on metacognitive awareness and engagement.

The literature provides detailed benefits of strategy use, and the types of strategies used by students for reading comprehension. These findings were repeated in different classroom settings, grades, and languages. The literature also provides findings that show when learners are explicitly trained about reading comprehension strategies and how to use them, their reading comprehension and vocabulary scores, as well as their awareness on strategy use increase. Despite these benefits, teachers usually refrain from providing any additional strategy instruction and prefer to follow the textbook, because of large class sizes and lack of materials (Haznedar, 2010) as well as their reluctance of using technology because of either unfamiliarity or time concerns. Large class sizes are another limiting factor for learners who need individual attention due to variation in learning pace and styles. In this sense,

online/digital tools are helpful in enabling learners to follow their own pace, as well as providing individualized feedback.

Learners of English as a foreign language (EFL) in Turkey seem to experience problems especially in reading lessons, which may partly be caused by the lack of reading strategy training, in addition to proficiency levels and motivational reasons. A typical reading lesson in Turkey is likely to consist of answering comprehension and vocabulary questions without explicitly focusing on strategies that can help students to understand the texts under study. Comprehension is likely to be ensured with sentence by sentence translation into Turkish, which is also done by the teacher, which makes students passive listeners. Therefore, training students on strategy use, and designing an online scaffolding tool for this purpose is a promising and necessary area of study.

1.2 Significance of the study

Although there are a number of studies on the effects of strategy training on reading comprehension, there are not many studies that focus on proving such training with a scaffolding tool. There are even fewer studies on the effects of reading strategy training with a scaffolding tool for learning in a foreign language.

None of the research reviewed focuses on the effects of comprehensive metacognitive strategy training using a scaffolding tool on metacognitive awareness and engagement. Therefore, this study will help bridge the gap in the literature by providing findings on metacognitive strategy training delivered online. To achieve this end, the effects of metacognitive strategy training on the reading comprehension of adult learners of English provided via Meta-S, and the effects of metacognitive strategy training provided by the teacher/researcher in the classroom are compared to

a control condition where no strategy training is provided, other than those addressed in the regular textbook. Secondly, the effect of such training on engagement and metacognitive awareness, which are considered as indispensable for foreign language learners will be examined. Such a study design has been reported neither in the Turkish context nor for other EFL contexts. It is also hoped that Meta-S, the scaffolding tool, will help increase the independence and activity of EFL learners whose native language is Turkish and that they will be trained about thinking on their own learning process.

An important contribution of this study lies in the instructional design it offers. The Meta-S online tool is designed based on the current approaches in teaching EFL, metacognitive reading strategies training, and the principles of multimedia design, and design guidelines for scaffolding software. This design may provide a model for online scaffolding tools that combine reading comprehension with metacognitive awareness, and engagement.

1.3 Statement of the purpose

The purpose of this study is to assess the effects of metacognitive strategy training provided by an experimental scaffolding tool on the reading comprehension, metacognitive awareness, and engagement of adult EFL learners whose native language is Turkish. Meta-S, designed by the researcher, consists of activities in vocabulary, inference, and background knowledge as essential components of reading comprehension to promote and help the practice of metacognitive strategies. The results from this strategy training will be compared to those from the same training provided by the teacher (who is also the researcher) in a regular classroom setting, and to a control group, which will not be provided with any additional

strategy training. The primary purpose of this research is to find out the effects of metacognitive strategy training provided online via Meta-S, and in the classroom by the teacher, on L2 reading comprehension, based on pre- and post-test scores. The second purpose is to find out whether this intervention has any influence on the learners' metacognitive awareness and engagement in the reading lesson. The participants' evaluation of the reading strategy training delivered online via Meta-S is also of interest in this study.

1.4 Research questions

1. How does metacognitive reading strategy training affect adult English learners' reading comprehension?

a. Does metacognitive strategy training with an experimental online scaffolding tool significantly affect adult English learners' reading comprehension scores, assessed through a standardized test and a researcher designed test?

b. Does metacognitive strategy training provided by the teacher in a regular classroom setting significantly affect adult English learners' reading comprehension scores assessed through a standardized test and researcher designed test?

c. Does metacognitive strategy training have different effects on the reading comprehension of adult English learners' with lower and higher levels of reading proficiency?

d. What are the participants' perceptions of the reading strategy training delivered online via the experimental tool, and its design?

2. To what extent does training in metacognitive reading strategy use affect adult English learners' metacognitive awareness, and engagement, regardless of the medium of delivery, when compared to a control group?

3. To what extent does the medium of delivery, online vs teacher-led, in metacognitive reading strategy use make a difference in adult English learners' metacognitive awareness, and engagement?

CHAPTER 2

LITERATURE REVIEW

2.1 Reading comprehension

Reading comprehension is a multidimensional skill and requires the integration of several components. It has been subjected to a great deal of research through decades, and several models and hypotheses have been put forward. Cain, Oakhill, and Bryant (2004) define reading comprehension as "[a] complex task that draws on many cognitive skills and processes" (p. 31).

Models and theories on reading comprehension of native speakers of English (L1 English) demonstrate that the nature of reading comprehension is rather complex and it is difficult to hypothesize a clear explanation for the ongoing process on a reader's mind during reading. Two different models of reading have been identified in the literature: those focusing on the identification of component skills, and those based on the identification of various processes (Kendeou, McMaster, & Chris, 2016, Urquhart & Weir, 1998). Whilst the former models dealt with linguistic and cognitive components such as language comprehension (Kendeou, van den Broek, White, & Lynch, 2009), vocabulary knowledge (Quinn, Wagner, Petscher, & Lopez, 2015), prior knowledge (Kintsch, 1988), and comprehension monitoring (Cain, Oakhill, Barnes, & Bryant, 2001); the latter models concerned primarily with the construction of mental representations during reading (Kendeou et al., 2016). These two lines of research have a common ground; both emphasize vocabulary, background knowledge, and inference either as components that predict reading ability or as separate or compound contributors in the reading process.

Process models are concerned with the mental processes readers experience during the act of reading. There are three approaches, bottom-up, top-down and interactive. The bottom-up approach examines the reading process as a continuum from the letter to sound, words, sentences, and finally meaning. The Simple View of Reading, which adheres to a bottom-up approach, focuses on decoding skills and the ability to distinguish individual words (Gough & Tunmer, 1986; Hoover & Gough, 1990). Gough and Tunmer (1986) argued that the reading process has two parts, recognizing the words on the page, and understanding those words once they have been recognized. They stated that even though comprehension and decoding are usually related, these two sets of skills should be handled separately, and formulated reading comprehension as Decoding (D) x Language Comprehension (LC) = Reading Comprehension (RC). A reader may be good at decoding but not at comprehension, or vice versa. The crucial role of decoding in Simple View of Reading is also supported with research results from children with dyslexia and hyperlexia (Gough, 1996), rendering phonemic awareness as a most important sub-skill.

The top-down approach deals with the generation of expectations or guesses of readers about the text. Readers try to confirm or reject these generations with their background knowledge and contextual clues. Inference and background knowledge play important roles to confirm or reject generations. Deeper reading that requires discourse focus, presuppositions, and inferences are needed, and it is necessary to find common ground for understanding. At a more global level, understanding the genre, plot, perspectives, theme and even the writer's attitude may be important (Graesser, 2007). However, recent literature showed that top-down and bottom-up

approaches can lead to over-generalization or over-simplification (Grabe, 1991, 2009; Perfetti, 1985, 1994; Pressley, 2006).

In the interactive approach, instead of separate sequences of bottom-up and top-down approaches, the effective aspects of both processes are integrated. For example, Schema Theory (Anderson & Pearson, 1984) examines comprehension as the interaction of the old and new information. It focuses on schemata, the memory chunks as stored knowledge in the readers' memory. Therefore, it deals with how new information interacts with old information and becomes a part of stored knowledge. Reference making is a crucial part of the schemata building process. It can be a result of the decoding process of new text information while reading or while retrieving old information from the memory. In addition to reference-making, Anderson and Pearson (1984) underline that other types of inferences can be made under necessary conditions. Therefore, the reader is active during reading, and the reader's previous experience, world knowledge, and inference making ability of the reader constitute the underlying factors. In language learning, previous experiences in L1 reading can affect the reading practice of EFL learners.

Another well-known interactive approach, the Constructivist Theory (Graesser, Singer, & Trabasso, 1994), posits that readers make sense of reading by constructing self-explanations (McNamara, 2004) through the activation of world knowledge and personal experience. To do this they try to understand the causes of an event, the justification of claims, and the motives of characters with the help of contextual clues (Graesser et al., 1994). Similarly, the Construction-Integration Model (CI), views the readers as active seekers who try to create a coherent mental representation of a text (Graesser et al., 1994; Kintsch, & van Dijk, 1978). To have a coherent mental representation, readers go through three stages (a) a surface form,

(b) a textbase, and (c) a situation model (Kintsch, 1988, 1998). In the first stage, the surface form, readers are engaged in the linguistic structure, words, and phrases of the text which is an outcome of sufficient decoding, stored in the short-term memory. The second stage, textbase, is where a bottom-up construction (C) starts to occur as the textual information activates the background knowledge of readers. Compared to the first phase, the textbase stage is rather uncontrolled and automatic. In the third stage, the situation model, the integration of the information in the text-base and the activated background knowledge constitute a coherent mental representation of the text. The situation model, which is top-down, is the product of the integration (I) phase of the CI model (Pearson & Cervetti, 2015). In the integration (I) phase, the connections between ideas supported by background knowledge form the bases of relevant and irrelevant inferences. These inferences are kept or eliminated with the semantic relations in the text. (Kintsch & Welch, 1991). This posits that unlike earlier theories such as Schema theory, background knowledge does not have the sole, but rather has a contributory role for the semantic memory (Pearson & Cervetti, 2015).

Based on the Construction-Integration theory, Cromley and Azevedo (2007) hypothesized in their Direct and Inferential Mediation (DIME) model of comprehension that the predictors of background knowledge, inference, reading strategies, vocabulary, and word reading have a combined effect on comprehension, rather than a separate effect. The DIME model further suggests that inference mediates the effect of strategies on comprehension (Spörer, Brunstein, & Kieschke, 2009). Having accurate knowledge on a topic enables executing strategies such as using graphic organizers, and summarizing, and it helps draw inferences. The DIME model explains that background knowledge, reading strategies, and inferences can

each directly affect comprehension. Cromley & Azevedo (2007) also suggest that "accurately enacting strategies can then enable inferences, which then lead to comprehension" (p.312). In terms of vocabulary and word reading, which are hypothesized to affect reading comprehension directly, the DIME model hypothesizes that lack of comprehension may result from misreading a word. This misreading is intervened by vocabulary and inference and may cause an inactivation in readers' semantic knowledge and reading comprehension. A summary of reading comprehension processes in the literature can be seen in Figure 1.

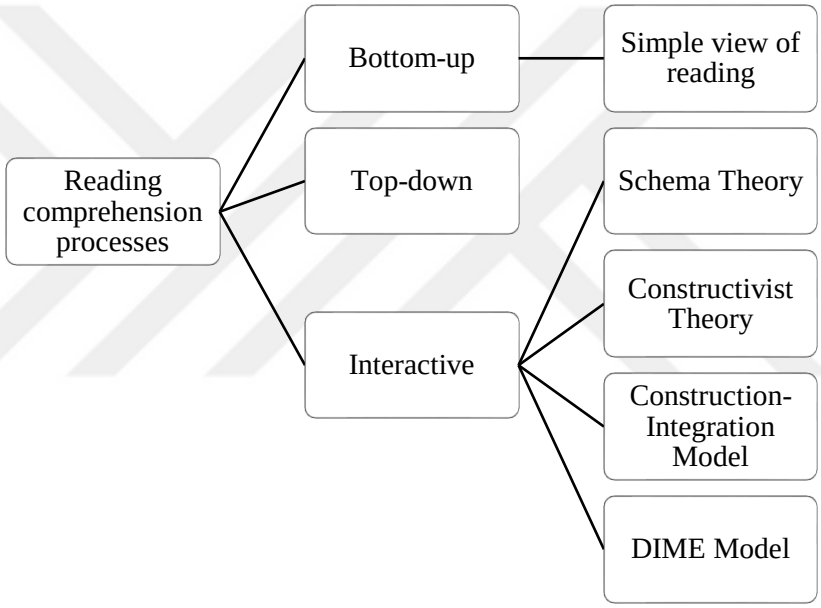

Figure 1. Summary of the reading comprehension processes in the literature

The processes of reading comprehension in English as a second language (ESL) or in EFL have also been researched extensively (Anderson & Freebody, 1983; Carrell, 1989; Grabe, 1991; Lynch & Hudson, 1991). The complexity of reading comprehension reveals itself even more with EFL learners since learner-related factors are augmented in the L2 context, such as age, proficiency, comprehension skills, motivation, the relationship with L1, level of orthographic similarity with L2, and text structure (Grabe, 1991). Among these factors, the following have been

repeatedly found both in L1 and L2 reading comprehension as predictive components: vocabulary, topic familiarity, and prior knowledge (Erçetin, 2010), inference, strategies, and interest (Leeser, 2007). The prominent difference in reading comprehension in L1 and L2 may result from the length and linguistic level of the text, which is most significant for struggling readers and readers with disabilities in their native language (McNamara, O'reilly, Best, & Ozuru, 2006; Proctor, Dalton, & Grisham, 2007), but can have impact across all proficiency levels in L2.

2.2 Essential components of reading comprehension

Unlike process models that examine the whole process of reading, componential models examined separate components or areas of skills involved in the reading process. Despite the abundance of taxonomies of different skills, based on the theories and studies in the literature, five variables have been found to be important predictors of reading comprehension: word reading/recognition (Cromley & Azevedo, 2007; Hood & Dubert, 1983; Grabe, 1991, 2009; Perfetti, 1999, 2007); vocabulary knowledge (Anderson & Freebody, 1983; Cromley & Azevedo, 2007; Koda, 2005); background knowledge (Anderson & Pearson, 1984; Cromley & Azevedo, 2007; Gersten, Fuchs, Williams, & Baker, 2001; Meyer et al, 2010; Kispal, 2008; Long, Seely, Oppy, & Golding, 1996; Rapp & Braasch, 2014; Stanovich, 2000; Zhang, 2017); inference (Barth, Barnes, Francis, Vaughn, & York, 2015; Cain & Oakhill, 1999; Graesser et al., 1994; Gygax, Garnham, & Oakhill, 2004; Pressley & Afflerbach, 1995; Kispal, 2008) , and reading strategies (Anderson, 1991, 2005; O'Malley & Chamot, 1990; Oxford, 1990, 2003; Proctor et al., 2007; Proctor et al., 2011). Before giving more detail on each of these components, it should be noted that three things, background knowledge, inference making, and

vocabulary constitute the essential points both in the process models and componential models.

Word reading or word recognition has the utmost importance in the native language and affects fluency (Grabe, 1991, 2009; Perfetti, 1999, 2007; Stanovich, 2000). As the readers become autonomous in reading or recognizing the words their fluency increases. This autonomy "activates lexical entries in the readers' lexicon that have well-represented information of four types: orthographic, phonological, semantic and syntactic" (Grabe, 2009, p. 23). However, word recognition will not be examined in this study; since the focus is not fluency and the target learners in this study are not native language readers.

2.2.1 Vocabulary knowledge

Vocabulary acquisition has crucial importance for reading comprehension (Anderson & Freebody, 1983), and vocabulary and reading comprehension have an intertwined relationship (Schmitt, 2010; Stanovich, 2000). While knowing the meaning of vocabulary and the number of words known affect comprehension positively (Cromley & Azevedo, 2007), being a strong reader which means being good at comprehending a text coherently due to proficiency and successful use of reading strategies, leads to a greater vocabulary knowledge in English, whether studied as L1 or L2 (Koda, 2005). For example, when strong readers face an unknown vocabulary, they can infer its meaning either with comprehension of the text or with reading strategies.

For monolingual and bilingual readers, academic vocabulary knowledge is essential for mastering text comprehension. Comprehension also increases the number of vocabulary learned in a foreign language. The proportion of vocabulary

knowledge necessary to understand written text varies, but an approximate rate of 95 % known vocabulary is suggested (Hsueh-Chao & Nation, 2000). However, the importance attributed to vocabulary by the students may hinder reading comprehension, as especially elementary language learners may approach each word as vital (Nagy, 1988) and struggle to comprehend every word in a text they read.

2.2.2 Prior knowledge on text structure

In the literature, prior knowledge or background knowledge are used interchangeably and may indicate two different funds of knowledge. Many researchers have referred to prior knowledge as the previous experiences of learners or world knowledge, and have found that prior knowledge has significant importance in facilitating reading comprehension (Chen, 2008; Ozuru, Dempsey, & McNamara 2009; Pressley, 2000). Sufficient, accurate background knowledge directly affects comprehension. It has been hypothesized that when knowledge is not accurate, it may hinder comprehension (Long et al., 1996; Rapp & Braasch, 2014) since it is likely to result in inaccurate inferences. Good readers consult prior knowledge only when deemed necessary to understand the ideas in a text. Weak readers, on the other hand, may consult prior knowledge even though it is not directly related to the key ideas, which will result in unnecessary inferences (Pressley, 2000). In a similar pattern, Cromley and Azevedo (2007) hypothesized that background knowledge also enables strategy use (such as summarizing, self-questioning, using graphic organizers, and using story structure) and drawing inferences. Similar to L1 reading comprehension studies, topic familiarity or background knowledge helps L2 readers to simplify the text by compensating for unknown vocabulary or structures, through the retrieval of contextual information from memory (Schmitt, Jiang, & Grabe, 2011).

The second connotation of background knowledge, which will be the focus of this study, examines not just a sum of "reader's life experience, world or prior knowledge, and all previous reading; it also denotes previous representations of earlier parts of the current text" (Kispal, 2008, p.18). Text structure or previously read paragraphs within a text can also form background knowledge (Meyer, Wijekumar, Lin, 2011). Learners can be taught about text structures, such as comparison-contrast, and cause-and-effect texts (Meyer et al., 2010) to promote the knowledge of text-structure. The structure of the text reveals the logical connections among the ideas in a text (Meyer & Poon, 2001). It has links to background knowledge as it has a rhetoric structure of events, and is an important part of strategy instruction. Signal words in a text such as *reason, as a result, similarly* prompt students to understand the structure of a text (Williams, 2007). Gersten, Fuchs, Williams, and Baker (2001) conducted a literature review on narrative and expository text structures and the effects of structure strategy training on students with learning disabilities. They found that instructions designed to teach the structure of a text increase recall and comprehension.

Similarly, it has been documented that learning about the structure of a text helps readers understand the text better and recall the information in the text (Meyer et al., 2011). L1 studies on text structure strategy instruction with children and adults resulted in increased text comprehension and remembering (Williams, 2007; Williams, Stafford, Lauer, Hall, & Pollini, 2009). In a study on modeling comprehension with vocabulary, text structure and text features for older readers with L1 English, Fisher, Frey, and Lapp (2008) observed grade 3 to 8 teachers and their implementation of shared reading lessons. After the observations, teachers were interviewed for the components of their shared reading. From these interviews,

researchers identified four major areas of instruction as comprehension, vocabulary, text structures, and text features. It was found that the expert teachers usually commented on the importance of text structure and explained it as a way the authors organize the information within the text. The teachers also emphasized the use of signal words for understanding the text structure.

Several studies on reading comprehension within multimedia environments further showed that the lack of background knowledge either as world knowledge or as text-structure knowledge could be compensated in multimedia reading environments through multiple representations, animations, and external links. This compensation will be explained in detail in strategy identification and intervention studies conducted with online tools.

2.2.3 Inference

Inference, which is the generation of not-present information in the text being read, or the retrieval of text-related information from memory, is a keystone in reading research (Barth et al., 2015). Researchers have examined inference from different points of view and analyzed types and categories of inference using various criteria, and there is not a consensus on inference types in the literature. In their different descriptions on inference types, researchers mostly focused on the distinction between two or three types of inferences. Mostly cited inference distinctions included automatic or strategic inferences, on-line or off-line, text-connecting or knowledge-based, coherence or elaborative, text-connecting or gap-filling, and local or global inferences (Kispal, 2008). The terms local and global inferences will be used in this study because they are more comprehensible for the students and have the clearest distinction.

Cain and Oakhill (1999) grouped three types of inferences as text connecting, inter-sentence and gap-filling inferences. While the first two are required to establish cohesion between the sentences and integrate textual information, gap-filling inferences deal with the information outside the text, which is basically readers' background knowledge. Alternatively, the terms coherence and elaborative inference were used to describe types of inference necessary for reading comprehension (Barnes, Dennis, & Haefele-Kalvaitis, 1996; Calvo, 2004; Bowyer-Crane & Snowling, 2005). The coherence inference corresponds to text connecting and the elaborative inference refers to gap filling, while both are knowledge-based inferences. Cromley and Azevedo (2007) used the terms text-to-text and background-to-text inferences to differentiate the types of inferences. While the text-to-text inference equates to the coherence or text-connecting inferences; background-to-text equates to elaborative or gap-filling distinctions (Kispal, 2008).

Local inference, as the name implies, generates coherent representations of sentences and paragraphs at the local levels. Global inference covers the whole act of reading. The main difference is whether an inference is made "on-line", or local, i.e. automatically formed during reading, or "off-line", global, i.e. formed only when prompted. Local inferences provide a coherent representation at the level of sentences and paragraphs and include coherence or text-connecting inferences explained above (Graesser et al., 1994). Global inferences, on the other hand, are coherent representations of the whole text and include the main point, theme, aim or the moral point of a text (Graesser et al., 1994).

Unlike many researchers, Graesser, Singer, and Trabasso (1994) and Pressley and Afflerbach (1995) cataloged as many inferences as they can find, instead of making distinctions. Training and assessment of all these types of inferences are

beyond the scope of this study. The inference types that will be addressed in this study are local and global inferences (Graesser et al., 1994; Beishuizen, Le Grand, & van der Schalk, 1999; Gygax et al., 2004), because they are more comprehensive compared to other classifications of inferences, and better suited to the proficiency level of participants of this study. Table 1 summarizes the different terminologies used by researchers on two types of inference and their main distinction.

Table 1. Different Terms for Inference Types in the Literature

	Inference based on information between sentences, integrating textual information	Inference made with information outside the text, based on prior knowledge
Cain, and Oakhill (1999)	Text connecting inference Inter-sentence inference	Gap filling inference
Barnes, Dennis and Haefele-Kalvaitis (1996) Calvo (2004) Bowyer-Crane, and Snowling (2005)	Coherence inference	Elaborative inference
Cromley, and Azevedo (2007)	Text-to-text inference	Background-to-text inference
Graesser, Singer, and Trabasso (1994) Beishuizen, Le Grand, and van der Scholk (1999) Gygax, Garnham, and Oakhill (2004)	Local inference	Global inference

2.3 Reading comprehension strategies in L1 and L2

Reading strategies were defined as the components of the reading process (Zhang, 2017). Their effective use, and the knowledge of when, where and how to use them

can compensate for difficulties that learners may have in other aspects of reading comprehension, such as vocabulary, background knowledge, and inference. However, their ineffective or incorrect use through overgeneralization or oversimplification may hinder the comprehension to severe extents.

The strategies that affect reading comprehension in one's native language are similar to those in a second or a foreign language (Bernhardt & Kamil, 1995; Carrell, 1991). In addition, effective use of similar strategies is indispensable both for readers reading in their native language and those reading in L2 English (Nassaji, 2011; Cesur & Fer, 2011). As strategies are conscious actions, learners involve actively in selecting and using them to improve language learning. Some strategies are observable, such as taking notes; others are unobservable mental processes such as reflecting on one's background knowledge or guessing the intention of the writer. There are several strategies, however, none of which are used in isolation, but rather considered as part of the same process (Anderson, 2003).

Many studies have been carried out on reading comprehension of language learners at various levels of proficiency and schooling. One set of research focused on identifying what type of strategies are used by learners during reading, and which ones better predict comprehension. In another set, strategy interventions were carried out to help learners with reading comprehension, and their effectiveness was measured. Text-based strategies for vocabulary (Proctor et al., 2007; Proctor et al., 2011), and inference and learner related strategies such as background were explicitly taught in these studies.

Within strategy identification studies, several different types of language learning strategies and seven major categories have been classified in L1 English: cognitive strategies, metacognitive strategies, mnemonic or memory-related

strategies, compensatory strategies, affective strategies, social strategies, and self-motivating strategies (Anderson, 2003). While many researchers focused on fewer of them (O'Malley & Chamot, 1990; Meyer, Brandt, & Bluth, 1980); Hsiao and Oxford (2002) compared and tested classification theories to provide an empirical data to classify language learning strategies. Out of fifteen classifications developed, the results showed that six categories; cognitive strategies, metacognitive strategies, memory strategies, compensatory strategies, affective strategies, and social strategies are the most effective classifications. Oxford (1990, 2003) focused on the first six categories for language learners and developed Strategy Inventory for Language Learning (SILL).

SILL (Oxford, 1990, 2003) provided detailed and comprehensive explanations for the strategies used by EFL and ESL students. It introduced two types of strategies; direct and indirect reading strategies. Memory, cognitive and compensation strategies constitute direct strategies, while metacognitive, affective and social strategies are indirect strategies. Within these strategy categories, metacognitive strategies will be explained in detail because it constitutes the theoretical framework of this study.

Metacognitive strategies, which received considerable attention from several researchers (Anderson, 2003; Mokhtari & Sheorey, 2002; Mokhtari & Reichard, 2004), enable students to coordinate their own learning process. Oxford (1990) grouped metacognitive strategies into three: centering, arranging and planning, and evaluating the learning. When students center their learning, they overview and link what they already know into the new topics with why the activities are being done, reviewing the necessary vocabulary and making associations. They also pay selective attention by ignoring the distractions such as uncritical vocabulary. In the arranging

and planning phase, learners organize, set goals, identify a purpose, and plan for possible language tasks. During evaluating, students monitor their own learning of task at hand by identifying errors or problematic areas, and monitor their language proficiency process.

Similarly, Anderson (2003) hypothesized that metacognitive strategies play a more significant role in reading comprehension when compared to other strategies. He argued that when learners understand how to regulate their learning with the help of metacognitive strategies, their acquisition of language proceeds faster. Similarly, Vandergrift (2002) underlined the importance of metacognitive strategies as they "oversee, regulate, or direct the language learning task, and involve thinking about the learning process" (p. 559).

2.4 Metacognitive awareness and metacognitive strategy training

As metacognitive awareness is a crucial part of skilled reading, there is a lot of emphasis in the literature on the role of metacognitive awareness for predicting reading comprehension (Pressley, 2000; Pressley & Afflerbach, 1995). Metacognition is "the knowledge of the readers' cognition about reading and the self-control mechanisms they exercise when monitoring and regulating text comprehension" (Mokhtari & Reichard, 2002, p.1). Skilled readers who are good comprehenders engage in conscious activities of careful thinking, using strategies flexibly, and monitoring themselves regularly by thinking about the topic, and checking their understanding (Paris, & Jacobs, 1984). Metacognitive awareness as a predictor of reading comprehension has been widely studied in the literature. Students with this awareness use world knowledge for comprehension, and make inferences from the text (Snow, Burns, & Griffin, 1998). Similarly, they know the

reason of why they read; employ and manipulate strategies when they encounter problems of comprehension. However, less skilled or novice readers are not aware of these strategies and the necessity to use them. They may not realize that they do not understand the text (Mokhtari & Reichard, 2002).

Similarly, in their review of reading instruction literature and treatments of reading problems, Palinscar and Brown (1984) defined six functions of strategies that help learners increase their comprehension:

> (1) understanding the purposes of reading, both explicit and implicit; (2) activating relevant background knowledge; (3) allocating attention so that concentration can be focused on the major content at the expense of trivia; (4) critical evaluation of content for internal consistency, and compatibility with prior knowledge and common sense; (5) monitoring ongoing activities to see if comprehension is occurring, by engaging in such activities as periodic review and self- interrogation; and (6) drawing and testing inferences of many kinds, including interpretations, predictions, and conclusions. (p.120)

Strategy training in traditional environments and its effectiveness has been studied quite widely. Even though some researchers questioned its efficiency (Rees-Miller, 1993), most researchers agreed that strategy training has positive results in reading comprehension. It is further suggested that effective strategy instruction should be metacognitive (Carrell, 1998; Cotterall, 1993). Therefore, a promising way to promote metacognitive awareness will be providing students with metacognitive strategy training.

Metacognitive strategy training coincides with Palinscar and Brown's Reciprocal Teaching model (1984). They hypothesized that multiple strategy

instruction should be based on an apprenticeship that enables readers to regulate their own reading process and reflect on their own knowns and unknowns during the process.

Within reciprocal teaching, Palinscar and Brown (1984) designed four instructional activities for comprehension-fostering and comprehension-monitoring to prompt the aforementioned six functions of strategies for monolingual English seventh grade students with poor reading comprehension. The four activities were summarizing (self-review), questioning, clarifying, and predicting. Summarizing activities coincided with attention and monitoring functions. Questioning activities required focusing on the main ideas and monitoring. Clarification activities involved evaluation for consistency and background knowledge. Lastly, prediction activities required for making and testing inferences. All activities also required the activation of background knowledge as a necessary component of reading comprehension. Apart from these strategies, the functions of understanding the purpose and background knowledge activation were ensured by answering questions on the text and discussing relevant knowledge at the beginning of instructional periods.

With these activities, Palinscar and Brown (1984) compared the effects of reciprocal teaching method and traditional classroom practices. In Reciprocal Teaching, teachers become guides or experts who model the learning process and required cognitive work, and students starting as novice observer learners become their own guide and get involved in the learning process. In this situation, the student deals with a simple aspect of the task, and at the same time, observe and learn from an expert who functions at a higher level. This model was influenced by Vygotsky's (1978) developmental theory which states that development takes place through expert scaffolding, which can be provided by a parent, teacher, or a more

knowledgeable other. These experts guide the learner and do the cognitive work by themselves. As learners become more experienced through being modeled to, they can perform more complex tasks, and the cognitive load starts to be shared between the learner and the expert. Finally, learners maintain the major thinking role and become able to support themselves through the learning process. The activities performed with the reciprocal teaching method resulted in significant improvements and maintenance in summary and questioning as well as comprehension.

Similarly, Winograd and Hare (1988) argued that strategy training should be based on several key questions: (a) what is the strategy?, (b) why should the strategy be learned?, (c) how should the strategy be used?, (d) when should the strategy be used?, (e) where should the strategy be used?, and (f) how should the use of the strategy be evaluated?

Research on the effects of practice designed for reading strategy training has shown that students with lower proficiency levels in L2, and struggling readers in L1 benefit more from certain types of strategies, especially from support strategies, compared to higher levels, or skilled readers (Fogarty et al., 2017; Huang, Chern, & Lin, 2009). McNamara et al. (2006) stated: "reading instruction that centers on providing guidance and training to make more and better inferences while reading successfully improves less skilled readers' comprehension*"* (p.149). Students with higher levels of proficiency already instinctively or explicitly use these strategies or have discovered their own ways of dealing with reading-related difficulties. However, this does not mean that strategy training will not be helpful for them. Studies also showed that students with a higher level of proficiency use global strategies more (Huang et al., 2009). This raises the possibility that teaching students

metacognitive strategies explicitly will increase their proficiency; in other words, their comprehension in reading.

While confirming the benefits of metacognitive awareness, and characteristics of skilled readers, some researchers grouped these characteristics under different types of metacognitive awareness. Pressley and Afflerbach (1995) identified three types of metacognitive strategies for text comprehension as before-reading, during reading, and after reading strategies. Before reading strategies consist of purpose setting, skimming for an overview, and activating background knowledge. These strategies parallel the first two functions defined by Palinscar and Brown (1984). During reading strategies involve note-taking, rereading, evaluation of the information, and guessing the meaning of words. The main idea, summarizing and discussing the text constitute after-reading strategies.

Similar strategies were defined under different terms by Mokhtari and Sheorey (2002). They grouped metacognitive strategies into three, global, problem solving, and support strategies. Three strategies listed by Pressley and Afflerbach (1995) as before-reading strategies which are purpose setting, skimming the text which is termed as previewing the text and activating background knowledge are also the components of global strategies defined by Mokhtari and Sheorey (2002) and Mokhtari and Reichard (2004). In addition to these strategies, they listed how text content fits its purpose, observing the text layout, noticing text characteristics, and predicting the text's meaning as global strategies by which learners monitor their reading. Similarly, strategies of rereading, evaluation of the information and guessing the meaning of words were the components of problem solving strategies which include an additional strategy on working out the conflicting information. In contrast, the note-taking strategy that is another during reading strategy defined by Pressley

and Afflerbach (1995), is grouped under support strategies by Mokhtari and Sheorey (2002), and Mokhtari and Reichard (2004). Support strategies also included making use of dictionaries, highlighting and translation to increase comprehension. With this taxonomy of metacognitive strategies, Mokhtari and Reichard (2002) developed the Metacognitive Awareness of Reading Strategies Inventory (MARSI), which is used as a data collection instrument in this research, to assess the awareness and perceived strategy use of adolescent and adult learners.

While classifications of Pressley and Afflerbach (1995), and Mokhtari and Sheorey (2002) include similar components, they lack two functions underlined by Palinscar and Brown (1984). These two functions are monitoring ongoing activities to see if comprehension is occurring, by engaging in such activities as periodic review and self- interrogation; and drawing and testing inferences of many kinds, including interpretations, predictions, and conclusions. While Oxford (1990) grouped strategies in detail as direct and indirect with six subcategories of strategies, and Palinscar and Brown provided six common functions of strategies that help learners, Mokhtari and Sheorey (2002) and Mokhtari and Reichard (2004), and Pressley and Afflerbach (1995) include the same strategies under metacognitive strategies. All of them valued the active participation of students, with differences in the terminology and additional strategies. The common points in these taxonomies are the benefit of background knowledge as an aid to inference and the importance of vocabulary for guessing. Another point in common is the emphasis on inference making as forming associations and of meaning. The different terminologies defined by Afflerbach and Pressley (1995), and Mokhtari and Sheorey (2002) and their common points were summarized in Table 2.

Table 2. Different Terminologies for Metacognitive Strategies and Common Aspects

Pressley and Afflerbach (1995)	Before reading -purpose setting, -skimming for an overview, * -activating background knowledge	During reading -note-taking, -rereading, -evaluation of the information, -guessing the meaning of a word	After reading -Main idea finding, -Summarizing** -Discussing*
Mokthari and Sheorey, (2002)	Global strategies -purpose setting, -previewing the text, * -activating background knowledge -how text content fits its purpose, ** -observing the text layout,** -noticing text characteristics** -predicting the text's meaning**	Problem solving strategies -rereading, -evaluation of the information -guessing the meaning of a word -working out the conflicting information*	Support strategies -note-taking -highlighting**

Note. *same strategy with a different name;
**strategy unique to only one of the sources

2.5 Technology-enhanced learning environments for reading

Technology has been increasingly used for providing reading instruction and strategy training to help reading comprehension, and educators and researchers developed online tools and portable assistive technologies for reading comprehension in L1. For the monolingual and bilingual learners at varying ages, the aim was mostly to help struggling readers with learning disabilities or with low reading levels (Dalton, Proctor, Uccelli, Mo, & Snow, 2011; McNamara et al., 2006; Meyer et al., 2011).

Studies on reading through computer-assisted language learning, hypermedia, and online tools suggested the potential for supporting the students' development (Kamil, Intrator, & Kim, 2000; Leu, 2000; Reinking, 1988; Strangman & Dalton, 2005). The types of support found in the literature are providing access to the

content, additional information to comprehend the text, and strategic processing of the text (Strangman & Dalton, 2005).

2.5.1 Studies on reading strategies in digital/online environments

Reading has been subjected to a great deal of research also in technology-integrated learning environments. These environments mostly consist of websites, online portfolios, learning management systems, and evaluating the reliability of the content of web sites. Similarly, studies on reading strategies mostly focused on either identification of students' strategy use in technology-integrated learning environments, as strategies used by students show similarity in print and online environments (Anderson, 2003; Elshair, 2002; Foltz, 1993). A limited number of strategy intervention studies focus on components of reading, especially vocabulary, by relating these components only to a certain sub-type of strategy. As a result, the literature provides almost no tool-based study on the effects of comprehensive strategy training to support reading comprehension.

As a part of identification of strategy use in technology-enhanced learning environments, Anderson (2003) used a web-based reading program, English Reading Online, to explore the metacognitive strategy use of EFL students by using a modified online version of Survey of Reading Strategies (SORS, Mokhtari & Sheorey, 2002) with a focus on the subcategories of global, problem solving, and support strategies. The results showed that the students preferred mostly problem solving strategies, and there was no significant difference between strategy preference of EFL and ESL learners.

Informed by Anderson's study, Huang, Chern, and Lin (2009) created a web-based reading program (English Reading Online) to examine high to low proficiency

level EFL learners' use of online reading strategies and the effect of these strategies on comprehension. They adapted global, problem solving, and support strategies, and added another category: socio-affective strategies. Text reviews, prediction keywords and outlines, and prediction making options were provided as global strategies. Problem solving strategies were online summary services, reading-rate training, text-to-speech software, and semantic mapping tools. Support strategies consisted of online dictionaries, online grammar resources, and online translation, highlighting tools, and individualized electronic notebooks. Socio-affective strategies were "online chat rooms, discussion boards, email services, and music boxes" (p. 15). They found that students from all proficiency groups used support strategies the most, while the problem solving strategy was used the least. Also, the students with a high proficiency level mostly preferred global strategies the most, and along with global strategies, their use of support strategies predicted higher recall scores. For the low proficiency group, support strategies were the most consulted, yet the low proficiency group students who made use of global strategies achieved higher recall scores.

Zenotz (2011) compared university students with L1 English in two groups in an online reading environment and activities on the same topic. The experimental group received training on how to use metacognitive strategies. The strategies that the students received instruction on were predicting, activating previous knowledge, observing the text layout, setting a purpose, and being critical. An additional strategy was guessing from context. The strategy training was based on Winograd and Hare's model (1988) that includes declarative (what), procedural (how), and conditional (when, where, and how to evaluate) components of metacognitive knowledge (p.89). During the implementation, a metacognitive activity was completed, and four hours

of strategy training was provided afterwards. The training was face to face with a guide read aloud by the teacher. In addition, the students kept a progressive diary and answered the following questions after receiving the instruction: "(1) 'Write about the reading strategies you have used today and how useful they were. Can you explain why?' (2) 'Do you think "strategy training" is useful for you? Why?' (3) 'How satisfied are you today with your work on reading? Why?'" (p. 91). After the intervention, students took semi-linear and non-linear online reading comprehension tests. The results showed that the experimental group's reading comprehension scores significantly increased in linear and non-linear reading. The effects of strategy training on the number or type of strategies used and the students' perceptions of strategies were assessed by Anderson's OSORS before and after the implementation, and no significant difference was found.

Several studies on the component of vocabulary compared the multimedia presentations with traditional classroom instruction (O'Hara & Prichard, 2008; Tsou, Wang, & Li, 2002). Tsou, Wang, and Li (2002) found that students receiving multimedia representations of vocabulary outscored students in a traditional environment in terms of the improvement in knowledge of functional words. Similarly, Silverman and Hines (2009) presented L2 and L1 speakers with video clips illustrating vocabulary items. Results showed that the students who worked with the hypermedia presentation increased their general vocabulary knowledge compared to those who did not work with it. In addition, the gap in vocabulary knowledge between L1 and L2 students became narrower.

Other studies included environments designed for vocabulary. For example, Proctor, Dalton, and Grisham (2007) designed a multimedia digital reading environment, called Universal Learning Environment (ULE) for fourth grade

monolingual and bilingual students with a focus on vocabulary. They compared the scores of English only students and English language learners in a pre and post-test. The environment pre-taught five power words in English and Spanish. Also, it included activities on summarization, prediction, clarification, questioning, or visualization, hyperlink to definitions or Spanish translations, retelling and synchronized highlighting. A coach in the environment provided feedback either in English or Spanish. User logs tracked "students' interactivity, including vocabulary work, strategy responses, and mouse click selections (e.g., selecting Spanish translations, accessing the strategy and vocabulary coach supports, viewing hyperlinked vocabulary items, and posting vocabulary items to My Glossary)" (p.82). Thus the researchers observed the effects of using ULE on vocabulary and comprehension increase, and whether the embedded strategy support would influence this increase. The results showed some vocabulary growth from pre and post-test, but with no statistical significance. However, there was a significant difference between monolingual and bilingual students regarding the strategy preference. The ESL learners frequently used the hyperlinked glossary, especially those who scored lowest in the pre-test. Significant comprehension gains in both groups, on the other hand, were mostly related to the users' frequency of access to the coaching avatars.

Proctor et al. (2011) replicated the study of Proctor, Grisham, and Dalton (2007) with a larger number of participants, longer duration of intervention, and investigated the effects of universally designed depth of vocabulary interaction delivered via the Internet. They focused on the reading comprehension skills of 5th grade monolingual English and bilingual English-Spanish speakers. They found

significant intervention effects on a standardized measure of vocabulary knowledge; however, the effect for comprehension was not significant.

Studies on the prior knowledge components within online environments focused on the ways of compensating the lack of prior knowledge in terms of the topic of reading, and text structure. Topic knowledge can be increased with immediate, out-of-text sources (Erçetin, 2010). These sources can include videos, animations, and graphics provided with buttons or hyperlinks. Hillinger and Leu (1994) examined the possibilities of hypermedia for readers with low prior knowledge in a complex informative topic, repairing and maintenance manual of a specific kind of plane engine. The low prior knowledge experimental group constituted of university students, and the high prior knowledge control group consisted of members of the air force propulsion unit who were responsible for the repair of planes. The hypermedia manual had two conditions, the first one was system-controlled, and the second one user-controlled. In the system-controlled condition, users went through linear objectives including identifying the components by zooming in, opening the text window to read instructions, and watching how to take apart the sections of the engine. Further videos, texts, and animations were available to explain the functions of the different sections. In the user-controlled condition, the support types were the same, except the hypermedia was not linear, i.e. users were free to explore any part of it, watch any video or animation in the order they want. Low prior knowledge learners achieved the same level of learning with high prior knowledge students. Also, low prior knowledge students performed best under the system-controlled condition for specific, targeted information, while high prior knowledge students performed best under user control.

In terms of the inference component of reading, even though the importance and necessity of generating inferences for reading comprehension have been repeatedly underlined in the literature, interventions implemented within online environments usually cover inference related to vocabulary and prior knowledge. This can be expected due to the complex nature of reading, where components and strategies are intertwined and promote each other. There are a few intervention studies conducted using expository texts. For example, McNamara et al. (2006) studied inference strategy in the iSTART tool. They compared learners with high strategy knowledge and low strategy knowledge, and their answers to text-based and bridging information questions which require bridging two or more sentences to form a correct answer. Findings showed that participants with low strategy knowledge scored marginally higher on text-based questions compared to bridging information questions. An opposite result was found for participants with high strategy knowledge. These students showed significantly higher scores in bridging information questions than in text-based questions. The experimental group in iSTART had higher scores than the control group, but the results were not significant.

The reading strategy training designed in this study will make use of expository texts for curricular concerns and will cover global and local inferences. While local inference will focus on the integration of text-based information to make inferences through bridging-inference questions, global inference questions will prompt the learner to associate text-related information with their world knowledge.

2.5.2 Strategy training in digital/online environments

Dalton, Proctor, Uccelli, Mo, and Snow (2011) used a universally designed web-based scaffolding text environment, entitled Improving Comprehension Online (ICON), to increase monolingual and bilingual 5th graders' reading comprehension. They designed three versions. The first one included an adaptation of reciprocal teaching comprehension strategies such as prediction, questioning, clarification summarization, visualization and feeling reflection. The second version provided interactive vocabulary activities and support through pre-teaching of power words with definition, example sentence, visuals and audios, semantic world map, caption generation and noting down the meanings of hyperlinked words into working logs provided by the tool. The third version was a combination of strategies in the first version and vocabulary activities. The combination and vocabulary groups outperformed the strategy group in researcher designed vocabulary assessment. However, none of the versions showed a significant effect in terms of comprehension.

Similarly, Meyer, Wijekumar, and Lin (2011) compared two different versions of a web-based tutoring system to examine the effects of structure strategy intervention on reading comprehension with 5th-grade monolingual English students. The results showed that students in the experimental group, where individualized instruction was provided significantly improved their scores from pre to post standardized reading comprehension test. Students in the experimental group also showed higher mastery achievement goals when working in the lessons. Also, the students in the experimental group had greater improvement in using signaling, better work in lessons, and more positive post-test attitudes toward computers. Additionally, students in both groups improved their recall of ideas from texts and

their use of the text structure strategy and comparison signaling words. However, these findings were not statistically significant.

McNamara, O'Reilly, Best, and Ozuru (2006) examined the effect of strategy training on the reading comprehension of L1 adolescent readers. The training was provided through an automated reading strategy trainer called the Interactive Strategy Trainer for Active Reading and Thinking (iSTART), which is a web-based application that utilizes animated agents (McNamara et al., 2004). The training provides information about self-explanation, which is an oral or written statement of what a sentence or part of text mean to the reader, and five reading strategies of comprehension monitoring, paraphrasing, prediction, elaboration, and bridging. The information about strategies was provided with students' watching and listening to a pedagogical teacher-agent and two student agents. The teacher agent teaches and exemplifies self-explanation and the five reading strategies to two student agents, and the student agents ask questions about the strategies and examples. This introduction module is followed by demonstration and practice modules. At the end of practice on self-explanation, feedback is provided to readers by the teacher-agent. The introduction and practice modules also form prior knowledge on how to use strategies. The results showed that in terms of self-explanation iSTART training and prior knowledge in reading strategy resulted in more relevant elaborations. Likewise, they increased the comprehension of science texts.

2.6 Engagement in online environments

As an essential predictor of learning and performance, learner engagement constitutes a crucial construct in educational practices, and poor engagement with classroom practices causes reduced learning and performance (Wang, Bergin &

Bergin, 2014; Skinner, Kindermann & Furrer, 2009). Recently, engagement gained an important role in online learning environments (Beffa-Negrini, Cohen, & Miller, 2002; Conrad, & Donaldson, 2004; Palloff & Pratt, 2003).

Despite its benefits, an online learning environment poses a challenge in terms of managing class interaction and complex learning tasks (Bullen, 1998). The lack of physical presence of a teacher and other learners may negatively affect the communication and interactions between the learner and the teacher as well as among the learners, as long as such environments are not carefully designed. (see, for example, Chen et al., 2010). Therefore, designing online environments that increase learner engagement is of crucial importance. Understanding the possible success or failure of a student usually depends on the motivational factors of students (Miltiadou & Savenye, 2003), which are also related to engagement in learning.

The design of engaging online environments is informed by the behaviorist, cognitive, and constructivist learning theories that examine how internal intelligence, inspirations, and extrinsic factors motivate learners (Chakraborty, 2017). Behaviorist learning theory assumes that when the learners are directed to a sequential learning process, explained the learning outcomes directly, and provided direct feedback, their comprehension of the material increases (Ally, 2004).

One of the important implications of the cognitive theory for the design comes from its focus on the short duration of the working memory (Sweller, 1994). When the information is presented in smaller chunks, the key information is located in the center of the screen, and the learners are explained why they learn what they learn it can be possible to prevent the negative effects of the limited capacity of short term memory (Ally, 2004). Constructivist theories of learning, on the other hand,

underline that when learners interpret their own learning processes and construct knowledge, their engagement increases. Meaningful activities, practice-based assignments, and interactive sessions that address “what”, “how” and “why” questions in an online environment increase engagement (Ally, 2004), and thereby contribute to better learning.

It is possible to identify in online multimedia environments that aim to engage learners, the aspects of instructional design based on the three well-known theories of learning briefly summarized above. These are consistent with the principles of multimedia design (Mayer, 2014), which constitute one of the core design principles of the Meta-S tool used in this study. The findings from the implementation of the behaviorist, cognitive, and constructivist strategies in online environments also parallel metacognitive strategies.

In a study of engagement of students from low Socioeconomic Status (SES) and high SES backgrounds, Yılmaz (2017) compared two groups of students from two different SES schools, studying the use of the block-based programming language, Scratch, as part of their coursework. The students’ learning was assessed by the “Plicker” application three times, and their pre-engagement and post engagement were measured with Sever’s (2014) Turkish version of Classroom Engagement Inventory, which has five subscales, based on the five factors of affective engagement, behavioral engagement-compliance, behavioral engagement-effortful classroom participation, cognitive engagement, and disengagement. Yılmaz (2017) found that the students with lower SES. significantly increased only their cognitive engagement, while the students with higher SES. had significant increases in three of the five subscales. None of the students had a significant increase in behavioral engagement-effortful classroom participation. However, these results

showed that behavioral, emotional and cognitive characteristics of the learners can be manipulated with Web 2.0. tools, due to their colorful interface, easy user control, and competitive effects among students. Yılmaz (2017) argued that this type of manipulation enabled learners to be more motivated and thereby engaged them more in the lesson.

2.7 Design principles for an online/multimedia tool

The design of any online or digital multimedia tool for reading strategy training must be based on a sound theoretical framework if the purpose is to increase learners' strategy use and thereby their reading comprehensions.

Therefore it is necessary to base the design on the findings from the literature on reading comprehension, strategy training, and design principles. This study aims to bring together these three crucial frameworks for a beneficial implementation. The instructional design of Meta-S was based on principles of Reciprocal Teaching (Palinscar & Brown, 1984), scaffolding design guidelines for learning software in science inquiry (Quintana et al., 2004) and cognitive principles for multimedia learning (Mayer, 2014). Reciprocal teaching and guidelines for scaffolding design are based on Vygotsky's (1978) developmental theory of Zone of Proximal Development (ZPD). While reciprocal teaching is mostly used in conventional learning environments, scaffolding has more recently been used in interactive learning environments (Quintana et al., 2004). In this case, scaffolding refers to software tools, and not the teacher or a more knowledgeable person that supports the learner. In software tools, scaffolding makes the learning process more tractable to learners with features such as reminders and graphic organizers so that learners can plan and organize their problem solving (Quintana et al., 1999). Therefore, even

though the task or content can become more difficult to handle in the short term, unlike other tools, scaffolding tools provide more productive opportunities.

In terms of scaffolding in technology-based tools, Sharma and Hannafin (2007) suggested two design aspects of cognitive and interface design that were based on hard and soft scaffolds discussed by Saye and Brush (2002). Sharma and Hannafin explained hard scaffolds as the scaffolds that tools provide. These scaffolds have fixed functions and help learners on the surface base. However, soft scaffolds can be arranged according to the needs and performances of the students. Sharma and Hannafin (2007) proposed guidelines for effective scaffolding in software tools by bringing these scaffold types together, in addition to the principles for scaffolded software for science inquiry (Quintana et al., 2004). One of the guidelines emphasizes more explicit cognitive processes, which is ensured by presenting different sources, emphasizing target structures, and providing metacognition to enable learners to work iteratively.

Seven guidelines for scaffolding software provided by Quintana et al. (2004) point out the need for scaffolding for inquiry, sense-making, process management, and articulation and reflection in learning science inquiry. Sense-making describes the learners' process of building hypotheses, making comparisons, observing the content, analyzing the results and reaching conclusions. Even though the learner can have some struggles due to the complexity of the task, software tools can help learners by "using representations and language that bridge learners' understanding, organizing tools around the semantics of the discipline and using representations that learners can inspect in different ways to reveal important properties of underlying data" (Quintana et al., 2004, p. 345). Also, visual organizers can be used to build a bridge between the previous knowledge of the learners and novel information.

Furthermore, concept descriptions and guidance throughout the process can be provided with such tools (Quintana et al., 2004).

The area of process management refers to planning and making decision procedures. Some possible problems can be experienced by the learners in planning what steps to take and deciding on the best alternative. In this case, the software should "provide structure for complex tasks and functionality, embed expert guidance, and automatically handle non-salient routine tasks" (Quintana et al., 2004, p. 366). The processes of articulation and reflection refer to the process of making conclusions and inferences from the analysis. Students may face problems in terms of explaining their ideas competently and making sufficient conclusions. Scaffolding software should help in "facilitating ongoing articulation and reflection during the investigation" (Quintana et al., 2004, p. 345) to help solve these problems.

Although these guidelines were originally designed for addressing science inquiry, some of them also provide guidance for the design of foreign language learning tools, because the processes of sense-making, process management, and articulation and reflection are important processes also in language learning. It is also necessary for fostering language learning to provide conceptual and visual organizers, activate prior knowledge, make the strategies explicit, provide multiple presentations of the same data, and expert guidance; and guiding in planning and monitoring the work. Therefore, Quintana et al.'s (2004) scaffolding guidelines are informative for designing language learning environments and provide proper design guidance for online reading strategy training in EFL.

An important scaffold, providing expert guidance, is mostly realized by teachers in a conventional classroom setting. This role of the teacher is replaced with

pedagogical agents in scaffolding software tools. Therefore, using a pedagogical agent is important in an online tool designed to scaffold reading strategy training.

Pedagogical Agents (PAs) or coaching avatars are found to be useful for learning in a number of studies (Moreno & Mayer, 2004; Ozogul, Jonson, Atkinson, & Reisslein, 2013; Wang, Johnson, Mayer, Rizzo, Shaw, & Collins, 2008) PAs can present various representations of information including texts, visuals, diagrams that improve learning (Atkinson, 2002; Moreno, Mayer, Spires, & Lester, 2001; Moreno, Reisslein, & Ozogul, 2010). The internal properties of PAs involve gestures (Moreno et al., 2010), such as those found in animated PAs, and delivering feedback messages, verbal guidance, modeling (Azevedo et al., 2009; Graesser et al., 2004) and direct learner attention. Similarly, feedback from an agent, based on the readers' answers, provides an individualized reading experience (e.g. Meyer et al., 2011). The personalized agents, which use the pronouns "I" and "you" to evoke the feeling of being in an informal conversation with the learner, were also found to be a useful characteristic (Mayer, Fennell, Farmer, & Campbel, 2004; Moreno & Mayer, 2004). When PAs provide immediate, detailed and user-friendly feedback, the performance of the students was affected positively (McMaster et al., 2015; Zenotz, 2011).

Another crucial aspect of the design is the instruction provided by the scaffolding tool. The knowledge construction metaphor of learning emphasizes that learning occurs as a result of active cognitive processing. Cognitive Load Theory (Sweller, 1994) identifies three types of cognitive loads that determine how effectively instruction is designed: extraneous, intrinsic and germane cognitive loads. Mayer (2014) later revised the terminology and developed design principles based on the findings from the cognitive load research. Extraneous processing refers to the processing which does not foster the instructional objective, which is mainly caused

by the inappropriate design of learning material. Intrinsic, or essential, processing results from the complexity of the learning material and involves paying attention to the key aspects and relations. Germane, or generative processing, which is mostly related to motivation for learning, involves attending to relevant information, organizing it mentally into a coherent structure, and combining it with knowledge already learned. Consequently, while designing a multimedia instruction and any kind of software tools, it is important to take cognitive constraints of learners into consideration.

In light of research findings in this area, Mayer (2005, 2014) theorized a cognitive theory of multimedia learning and proposed design principles for multimedia materials to enhance student learning. These principles include multimedia, contiguity, coherence, modality, redundancy, personalization, segmenting, embodiment, and signaling principles. They are helpful in determining what to include or exclude in the design process of an online multimedia tool.

The multimedia principle emphasizes the importance of providing alternative representations, by presenting materials not only in words but both in words and pictures. The principles of contiguity and modality are based on dual coding theory which assumes that people have two distinct systems for processing information; one system represents information verbally and one the other visually (Clark & Paivio, 1991; Mayer & Anderson, 1991).

The modality principle emphasizes that words should be presented as auditory narration rather than on-screen texts in multimedia instructional material, especially when the images include animations, which require the students to focus their visual capacity. This principle is supported by short term memory, attention and

recall studies. The effective capacity of working memory can be increased by employing both visual and auditory channels (Frick, 1984; Penney, 1989; Wickens, 1984). In their earliest demonstration of a modality effect, Mayer and Moreno (1998) found out through retention, matching, and transfer tests that when verbal explanations are provided with audios, students learn better compared to only visual or only audio explanations.

Similarly, the contiguity principle underlines that when words and pictures are presented contiguously in time or space, the effectiveness of multimedia instruction increases (Mayer & Anderson, 1992). Based on this principle, two expected effects of temporal contiguity and spatial-contiguity occur. Studies on spatial contiguity effect found that when printed text and pictures are physically integrated or close to each other rather than physically separated, the learning is enhanced (Mayer, 1989). Experiments on temporal contiguity resulted in enhanced learning when visual and spoken materials are temporally synchronized, i. e. presented simultaneously rather than successively (Mayer & Anderson, 1991).

The principle of coherence posits that the removal of irrelevant information in multimedia lessons enhances learning due to the fact that human working memory has a limited capacity. Moreno and Mayer (2000) argued that additional information that does not contribute to the intelligibility of the lesson or not related to the rest of the text should not be included in multimedia materials for learning. These kinds of materials “decrease the effectiveness of working memory capacity and consequently hinder the learning of the core material” (p.118). The coherence effect also applies to audios and sounds. Moreno and Mayer (2000) pointed out that irrelevant sounds should also be minimized, because they may overload the working memory, even

though songs/music or interesting sounds may seem attractive in accordance with the Arousal Theory (Weiner, 1990).

Redundancy principle, on the other hand, emphasizes that audio and on-screen text which duplicates the narration should not be given concurrently. It should be "consistent with a dual-channel theory of multimedia learning in which adding on-screen text can overload the visual information-processing channel, causing learners to split their visual attention between 2 sources" (Mayer, Heiser, & Lonn, 2001, p. 187). However, the redundancy principle does not seem to apply in foreign language learning contexts. Lee and Mayer (2018) compared the comprehension scores of college students who watched an instructional video in their second language. Among the three groups of video + text, video + narration + text, and video + narration, the video + text group outperformed the other two groups in comprehension scores. Lee and Mayer (2018) concluded that their findings "highlight boundary conditions for two principles of multimedia instructional design that apply for college students who are learning in a second language." (p. 648). Because foreign language learners need to process not only the narrated information but also the target language in which the information is presented, the on-screen text of the narration or the summary of the audio will be helpful when provided concurrently in online multimedia.

Segmenting principle reminds instructional designers of the importance of organizing the material in chapters and sections, instead of presenting it as a single entity, while signaling principle underlines that students learn better when cues are added that highlight the essential aspects, including bold text, appropriate headings, and list of main steps. Signaling seems useful for better comprehension since it directs learners to where to focus more, and what is more important, as well as

providing them with a chance to prepare their mindset for the upcoming information. Finally, the embodiment principle recommends that when PAs are included in multimedia tools, they should move on the screen, exhibit gestures, and even facial expressions, much like humans do.

Although the principles of multimedia design mostly addressed learners instructed in their native language, they also provide guidance for multimedia tools used for foreign language learning. Cognitive theories do not usually change according to the language which people speak; therefore, Mayer's (2014) design principles are also applicable in foreign language learning contexts. The only caution for foreign language learners lies in the implementation of the redundancy principle. Even though this principle emphasized the necessity of excluding identical text concurrent with the audio, presenting them together is helpful for foreign language learners. Listening to the audio while reading, helps the learner deal with decoding, if it matches the learner's reading pace, while at the same time understand the semantic and pragmatic meaning of the decoded units as a whole.

CHAPTER 3

METHODOLOGY

3.1 Design of the study

This study has a quasi-experimental pre-test post-test design. Two experimental and one control groups were selected from intact groups formed by the results of a proficiency exam held at the beginning of the academic year by the university in which the students were enrolled. This was preferred in order not to intervene in the classroom atmosphere (Creswell, 2012). The researcher was also the instructor of the students at the preparatory school and was teaching the reading lessons of all groups during the study. This helped ensure the consistency of implementation, and minimize confounding factors such as variation in teaching styles and approaches.

The dependent variables of the study were the post-test scores of reading comprehension, as measured by the reading section of a standardized reading exam, and an exam designed by the teacher/researcher for school use, as well as metacognitive awareness, and engagement, as assessed by standardized inventories. The independent variable was the method of instruction for reading strategy training, delivered online, or by the teacher in the classroom.

3.2 Participants

The study was conducted in three classrooms of the language preparatory school of a private university, where the researcher works as an English language teacher. Thus, the study made use of convenience sampling (Creswell, 2012).

The original number of participants was 87. The data from two students who missed classes during the data collection process were excluded from the study. The scores of an additional student were also excluded from analysis because they constituted an extreme outlier. Therefore, the final number of participants was 84, with 28 students in each group. There were 81 females and three males, and the age range of 18 – 24 (see Table 3).

Table 3. Participants

	N	Number of Females	Number of Males	Average Age
Control Group	28	27	1	19.21
In-Class Group	28	27	1	19.57
Online Tool Group	28	27	1	19.57

The native language of all the participants was Turkish. According to the placement of the university, their language proficiency level was assumed to be newly achieved B1 level according to the Common European Framework of Reference for Languages (CEFR), an international standard for describing language ability. The participants were accepted into 4-year programs in psychology, psychological counseling and guidance, and speech and language therapy, but they had not yet started their departments due to the compulsory English language preparatory year. The majority of the participants had satisfactory familiarity with using technology for learning purposes.

3.3 Procedures and implementation

Before conducting the study, necessary approvals were secured, from of the private university where the study was conducted, and from The Ethics Committee for

Master and PhD Theses in Social Sciences and Humanities at Boğaziçi University (Appendix A).

At the beginning of the study, the students were informed about the study, explained that their course grades would not be affected in any way, and were asked to fill out a consent form, should they wish to participate. The students then completed a demographic questionnaire, and four pre-tests, two reading tests to measure reading comprehension, and two inventories for metacognitive awareness and engagement. The study lasted for five weeks in total; training offered in three weekly sessions, and two weeks for pre- and post-tests.

The in-class experimental group was provided reading strategy training by the teacher in a regular classroom setting, while the online experimental tool group was delivered the same training by an experimental scaffolding tool in the computer lab. Each training session lasted 90 minutes.

In week two, the Meta-S trained the students on what metacognitive strategies are, and how, when, and why they can be applied, using the text "What does the ocean mean to us?", taken from the textbook, *Password 3*. In week three, they practiced metacognitive strategies on the online tool using the reading passage "The Crab". In week four, they practiced metacognitive strategies on the passage "Food for Thought". At the end of the last session of practice, students answered some questions to reflect on their experiences of using the online tool and receiving metacognitive strategy training.

The in-class experimental group received the same training with the same texts, and with the same strategy information, but it was provided by the teacher. The practice sessions were in the form of questions and answers between the students and

the teacher. In both the experimental groups identical reading strategies were covered, using the same activities within roughly the same amount of time The control group used the same reading passages, but they received regular instruction, with no particular emphasis on metacognitive reading strategies other than that provided by the textbook.

In the fifth week, post-tests were given. The online-tool group was also given an additional feedback sheet to reflect on their learning experience on Meta-S. The summary of the procedural details of the intervention can be seen in Appendix B.

3.4 Materials

3.4.1 Meta-S, the experimental scaffolding tool

Developed specifically to help EFL students learn types of reading strategies, Meta-S is based on a learner-centered design which aims to scaffold the students on what to learn regarding metacognitive strategies, why to learn, and where and when they can use these strategies. The practice sessions in Meta-S present an environment for students to implement the strategies covered. The instruction in Meta-S follows reciprocal teaching, and scaffolding to make the learning process more tractable to learners with features such as reminders and graphic organizers so that learners can plan and organize their problem solving (Quintana et al., 1999) and check their understanding.

The reasons for designing Meta-S were: 1) providing a user friendly, research-based and motivating environment which allows learner control; 2) increasing the learners' active participation and engagement in the reading lessons which was mostly perceived as passive listening; 3) rendering the meaning-making

process more trackable for learners via detailed feedback, and the monitoring and evaluating functions, and 4) scaffolding learners to enhance their strategic knowledge and reading comprehension more than they normally would in a regular lesson.

Meta-S provided scales and checklists to enable learners to monitor and evaluate their own learning processes, which actually constitute the bases of metacognitive awareness. This was made possible in Meta-S with reflection slides and Likert scales presented after the training in each category was completed. The details on strategies taught and practice tasks can be found in Appendix C.

Meta-S was developed on the Articulate Storyline 360 platform, which allows easy manipulation of layers and conditions, especially important for providing specific feedback, and offers a set of images to be used as a pedagogical agent, as well as a variety of ready-made quizzes which can be adjusted according to need. Articulate online made it possible to deliver Meta-S online, where user records were kept by an online tracking add-on which allowed storing and creating reports on user behaviors such as the number of slides viewed, mostly visited slides, and time spent on each lesson.

3.4.2 Reading strategies included in the training

The main goal was to train students on metacognitive strategies so that they would realize how to approach any reading material and increase their comprehension. The strategies covered in the experimental groups were based on Mokhtari and Reichard (2002)'s metacognitive reading strategies, which were taught and practiced under the sub-categories of global, problem solving, and support strategies. Greater emphasis was given to the global strategies due to their benefits for increasing reading

comprehension. Furthermore, as EFL learners with higher proficiency use global strategies more often, teaching them to students with lower levels can increase the latter's reading comprehension more and provide a skillful reading.

Five global strategies were addressed in the study: (a) having a purpose, (b) predicting what the text is about, (c) activating background knowledge on text structure, (d) noticing the text features, (e) making local and global inferences. Two problem solving strategies were: (a) guessing words from the context with signal words, word classes, and words in the vicinity, and (b) rereading. The support strategy addressed was note-taking.

Having a purpose before reading is important for learners to prepare their mindset for the text they will read and assess their understanding by checking whether they reach their purpose. The pedagogical agent in Meta-S explained the importance and necessity of having a purpose, and then the students were asked to write their purpose on the notepad, a feature of the tool to take notes. At the end of the global strategies, the students were asked to reflect on their reading by responding to a reflection scale, which included a question on whether they fulfilled their purpose. Figure 2 shows a screenshot of the reflection scale.

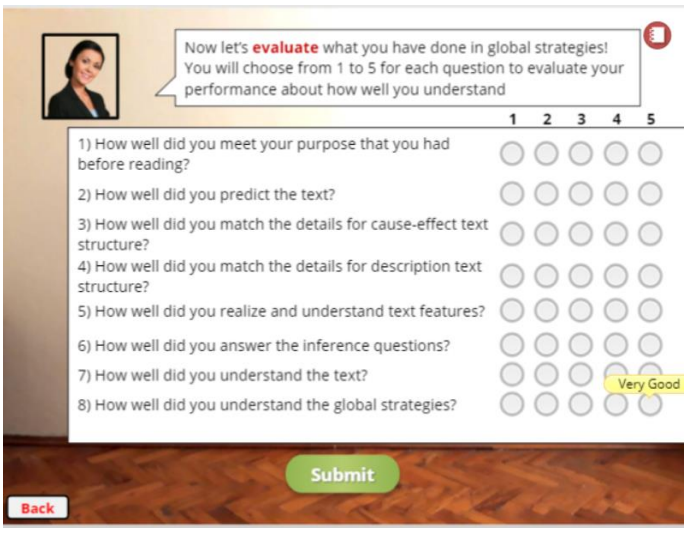

Figure 2 A screenshot of the reflection scale

In the in-class experimental group, the teacher emphasized the importance of having a purpose, and asked the students about their purpose, before starting to read. At the end of the lesson, the teacher asked orally whether the students reached their purpose.

Predicting what the text is about is trying to guess the topic and organization of a text by making use of several cues. It is another way of making inferences. Predicting is an important strategy that allows readers to form some hypothesis before starting to read and have a general understanding. To predict a text, learners look at the title, the first and the last sentences, and check any additional information such as pictures or graphs. In the online tool, the students were presented with a concurrent step by step audio narration and visual demonstration of predicting. While the narration talked about a step, only the related parts of the text were shown, such as the title, or the first sentence, while the rest of the text was blocked. After the concurrent video narration and demonstration, students were given one minute when they clicked the "I am ready" button to skim and scan the text. A visible countdown function was added to the tool to prevent students from reading the whole text or spending much time. This function was programmed to jump to the next slide when the given time of skimming and scanning is over. After skimming and scanning, students were asked to write a topic sentence that shows their prediction (see Figure 3).

The global strategy of understanding the text structure involves activating background knowledge, which comprises the knowledge of text structure, and content knowledge. Activating the background knowledge on text structure is a strategy that enables the reader to understand and appreciate that the writer uses a logical order and hierarchical organization. The texts used in the training sessions

were chosen to include four most common text structures: compare-contrast, cause-and-effect, description, and problem solution. In Meta-S, the steps for predicting text structure, and finding evidence for the predicted text structure were shown, and justifications were given. The logical and hierarchical organization of the main idea and details were provided through graphic organizers.

Figure 3 Screenshots of the prediction steps from Meta-S

The students then practiced finding evidence for text structure and placed the sentences on a graphic organizer to form the logical organization of the text. In another activity, they matched the sentences according to the hierarchical order. Additional information on text structure, such as videos, website, pictures or other

external links were also provided. This information was accessed by clicking the "extra info" button. In the in-class experimental group, the teacher drew a chart to show the logical and hierarchical organization of the main idea. For the practice session, she drew a blank chart and brainstormed with students to give about the main ideas and details in the text. Figure 4 shows screenshots of the practice part on text structures and feedback in Meta-S.

Figure 4 Screenshots of the practice part on text structures and feedback

Activating background knowledge as content knowledge means activating topic schemas of previously learned topics. Thus, it facilitates learning by relating the new information to prior knowledge. This helps understand the text in general as well as at the level of making inferences and guessing unknown words. In the online tool,

this content knowledge was provided in feedbacks for questions regarding the unknown words or inference making.

The global strategy of noticing text features involves understanding the text features such as question marks, quotation marks, or exclamation points, parenthesis, and charts, and the use of bold and italic styles, which help learners to understand the purpose of the writer and gives several clues about the text. In the training session of the online tool, the benefits of this strategy and functions of text features were explained. The students were then presented with several parts of the texts and were asked to find the text features with hotspots. When they found it, a multiple-choice question about the function of this particular text feature was asked.

Inference making is vital in fostering reading comprehension. The inference making strategy requires reading between the lines in a text that contain meaning that is not directly written. The importance of inference making, two types of inference; local and global inferences, and how to make inferences were presented to the students in the training sessions, and different exercises were provided. The students were given a sentence and asked to select a possible inference from the choices given. They were asked to drag and drop the pictures of vertebrate and invertebrate animals into the correct box after inferring the meaning of the term “invertebrate” from the text. They were asked to write their own inferences from a phrase within the text they read. In order to make inferences, the students also needed to activate their knowledge on the possible relations among sentences. Figure 5 shows the screenshots of the explanation and practice sections on inference making.

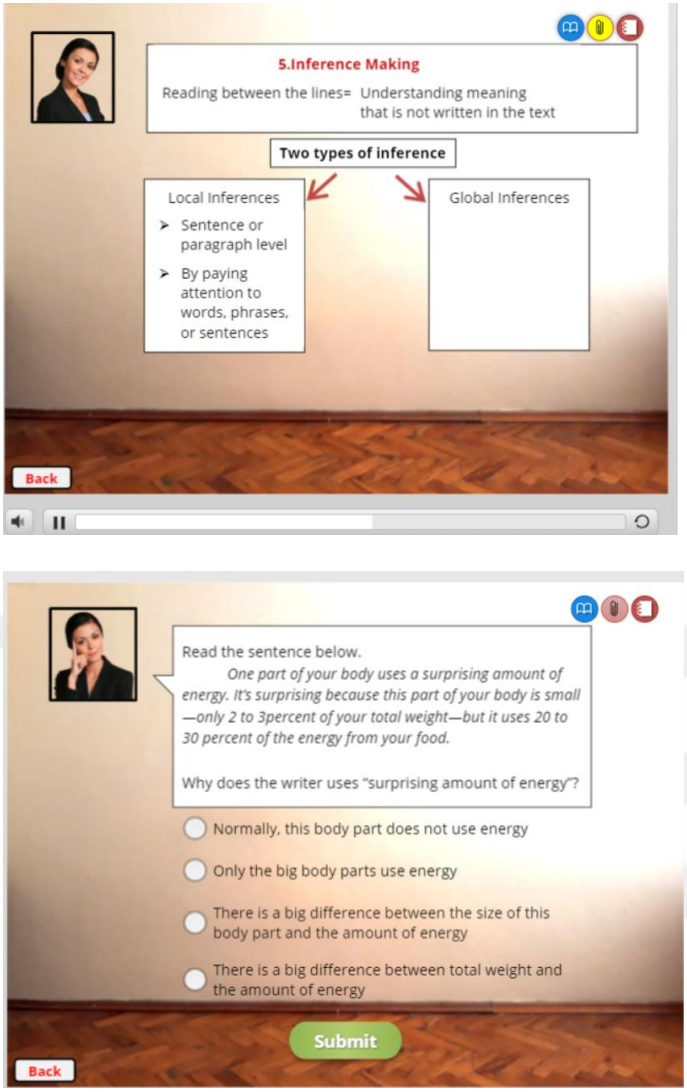

Figure 5 Screenshots of the training and practice parts on inference making

As for the in-class experimental group, the teacher orally explained these relationships during the lesson. Background knowledge on the topic was also provided with this way, which is essential for making necessary inferences while reading.

In terms of the problem solving strategies, guessing the unknown words from context was emphasized, because it is a crucial strategy in reading comprehension, especially for foreign language learners. For teaching and practicing this strategy, three ways to predict words; signal words, word classes, and words in the vicinity were provided. During the practice sessions, students answered several multiple-

choice and hotspot questions about the word class, signal words, and words in the vicinity. After answering these questions, they were asked to write their guess about the meaning of the word in a textbox which provided feedback. If the guess was incorrect, the feedback showed acceptable meanings and explained the correct implementation of the strategies step by step.

The training of the support strategy of taking notes was provided through emphasizing the benefits, and the necessity of taking notes. In Meta-S, learners were provided with a notepad which was always accessible by clicking a button named My NotePad and any note the student wrote any time during the session was stored in user logs. The notepad function allowed the students to take notes whenever they want and provided separate parts for answering comprehension questions on reading strategies and reading the text. Figure 6 shows the screenshot of the notepad.

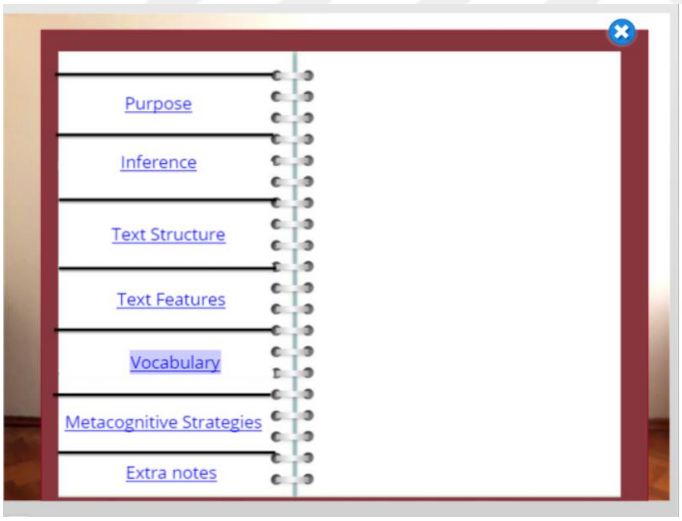

Figure 6 A screenshot of the notepad in Meta-S

3.4.2 Reading passages from the textbook

The three narrative texts in the strategy training were taken from the students' textbook used in the reading lessons at the university: *Password 3: A Reading and*

Vocabulary Text by Pearson. These texts were selected to make sure that the intervention is fully integrated with the curriculum followed at the preparatory school, and the most common text structures the knowledge of which would have an important contribution to reading comprehension were included. While the first text was used to train the students on the types and implementation of metacognitive strategies, the second and third texts were used to enable students to practice metacognitive strategies in the components of vocabulary, prior knowledge and inference making.

The first text "What does the Ocean Mean to Us?" was used in the second week of the study to train the students on metacognitive strategies. The text was about the effects of oceans on earth and people in terms of emotions, livelihood, and ecosystem. The text structure of the text was cause and effect, and problem solution.

The second text, "The Crab" was used in the third week in the practice session. It was about different crab types, their similarities, differences, their surprising features, and the use of the word "crabby" in English. The text structures of this text were compare-contrast, and description.

The third text "Food for Thought" was used in the fourth week. It was about the effect of food on the human body, the relationship between food and brain functions and a brief history of the change of brain size. The text structure was a combination of cause-and-effect and description.

3.5 Instruments

3.5.1 Reading comprehension tests

Two tests were used to gather data on reading comprehension; the reading section of the Cambridge Preliminary English Test (PET), which is an international standardized placement exam ((B1 Preliminary (PET), 2016)), and the reading sections of the teacher/researcher designed Midtrack (MT) exam used schoolwide for mid-semester evaluation at the university.

PET was used as a standard measure of reading comprehension because it is an international standardized test developed by Cambridge for the assessment of reading comprehension (see Appendix D for sample questions). It consists of 35 questions, including multiple-choice, true-false, and matching, with a focus on inference and vocabulary questions. Each question is worth one point and the total score is 35.

As a pre-test, it was used to understand whether there was a statistically significant difference in initial reading scores of the groups before the treatment. As a post-test, it was used to assess whether strategy training intervention caused any gains in the reading scores and whether there was a difference in the scores among the groups. The PET was also preferred because the effects of interventions on student scores from standardized reading comprehension tests are not common, and the ultimate goal of any training, including the one provided in this study, is to help students eventually increase their reading skill to an acceptable level documented by standardized test scores.

The reading section of the schoolwide Midtrack exam (MT) consisted of two reading passages with a total of 12 questions, six questions in each. Each question

had the value of one point, and the total score was 12. The test included local and global inferences, vocabulary referent, main idea, detail and purpose of the writer questions which were compatible with the strategy training.

Midtrack exams were a part of the institutional requirements of the university. The reading section of the MT exam (see Appendix E for sample questions) was prepared by the researcher in accordance with the testing requirements of the preparatory school. The passages in the reading sections were taken from *PTE (Pearson Test of English) General, Skills Boosters Level 3 Teacher's Book*. PTE is a standardized test and Level 3 corresponds to the B2 level in the CEFR. For this reason, the passages were tailored to the B1 level. Some questions were added, omitted or adjusted to comply with the testing principles of the preparatory school. These alterations did not interfere with the validity and reliability of the exam because it has high inter-rater reliability. As an institutional procedure of the university in which this study was conducted, any part of a midtrack exam goes through four different proofreaders, consisting of two instructors, one supervisor, and one native speaker of English. After the first proofread process, the exam part is re-adjusted or re-prepared according to the feedback and proofread.

3.5.2 Metacognitive Awareness of Reading Strategies Inventory (MARSI)

The Turkish version of the Metacognitive Awareness of Reading Strategies Inventory (MARSI, Mokthari, & Sheorey, 2002) “Okuma Stratejileri Üstbilişsel Farkındalık Envanteri” (Öztürk, 2012) was used to assess the participants’ metacognitive awareness before and after the intervention. The survey consists of 30 questions that focus on three subcategories of metacognitive strategies, global,

problem solving and support strategies. The Turkish version of MARSI contained 13 items for global reading strategies. Examples included “I decide what to read closely and what to ignore;” and “I have a purpose in mind when I read.” There were eight items for problem solving strategies. Examples included “I try to guess the meaning of unknown words or phrases”. There were nine items for support strategies. Examples included “I take notes while reading”.

MARSI was designed to “assess adolescent and adult readers’ metacognitive awareness and their perceived use of reading strategy while reading academic or school-related materials” (p. 1). The original inventory has the reliability of .89. For the Turkish version, Öztürk (2012) found that “the correlation coefficient between the Turkish and English forms scores was .96. All factors’ reliability coefficients in the inventory ranged between .76 and .85.” (p. 1). The purpose of using the survey in this study was to determine whether metacognitive strategy training has any effect on the students’ metacognitive awareness and whether the two types of delivery medium for training have differential effects on metacognitive awareness.

The scoring of the inventory is based on 5 points Likert scale, and the maximum score of is 150 (reverse coding included). The internal consistency of pre-test MARSI scores was tested for reliability in each condition for this study and the Cronbach’s alpha (α) was found to be .868 (see Appendix F for the details of the reliability test for MARSI).

3.5.3 Classroom Engagement Inventory (CEI)

The Classroom Engagement Inventory (CEI) which was originally developed by Wang, Bergin, and Bergin (2014), was adapted for use in Turkish by Sever (2014) as

"Derse Katılım Envanteri". It consists of 23 items assessing the level of engagement and disengagement of students in the lesson. The questions consisted of five subscales for the "affective engagement, behavioral engagement-compliance, behavioral engagement-effortful classroom participation, cognitive engagement, and disengagement factors" (Sever, 2014, p. 174).

The correlation values for the language equivalency and consistency between Turkish and English forms were reported between $r = .969$ and $.699$ ($p < .05$) (Sever, 2014). The Cronbach's alpha (α) of internal reliability was .930. The same instrument was later used by Yılmaz (2017) and the Cronbach's alpha (α) was found to be .831 with her sample.

The scoring of the inventory based on 5 points Likert scale, 1 point for "never", 5 points for "always" for the first four subscales. The disengagement subscale, on the other hand, is reverse coded, 5 points for "never", and 1 point for "always". The possible maximum score of the inventory is 115. Reliability scores were also calculated for the sample in this study, and the Cronbach's alpha (α) was found to be .829, at pre-test (see Appendix G for the details of the reliability test for CEI).

3.5.4 Feedback questionnaire

The participants in the online tool group were given a feedback questionnaire (Appendix H) at the end of the last session, to get their feedback both about the design of the tool and how the tool might have helped their learning. There were five questions: (1) What do you think about the strategy study that you have had? (2) Which strategies helped you the most? (3) How did these strategies help you? (4)

Which features of the tool did you like the most?, and (5) What were the difficulties that you experienced in the tool or in the instruction if you had any?

The feedback was gathered from 27 students because one of the students did not fill out the feedback sheet.

3.6 Data analysis

3.6.1 Data cleaning and outliers

The analyses reported here are based on data from a total of 84 students, 28 students in each of the two experimental groups and the control group. Originally, data was collected from 87 students. The scores of 2 students from the in-class experimental group were removed before the analysis because they were absent during strategy training or during some of the tests.

The data were examined for outliers through histograms and box plots (Field, 2018). Three outliers, one of which was an extreme outlier, were found in pre-test analyses. The hard copy scores of these 3 participants confirmed that there were no errors in score entry. The extreme outlier was a participant from the control group who had extreme high scores in pre PET, and MT exams in accordance with interquartile range (IQR > 1.5) (Hoaglin, Iglewicz, & Tukey, 1986). Her data was removed from the analysis. The two non-extreme outliers were changed into lower scores without distorting the statistics, as recommended by Tabacknick and Fidell (2007). The reason for keeping these two scores was that they were not extreme outliers and it was important to keep the number of participants in each group equal because there was not a random sampling. Then all the data were checked to see whether or not the necessary assumptions for statistical analyses were met.

3.6.2 Assumption of normality of distribution

The pre-test and post-test data were checked for normality of distribution via skewness and kurtosis values, and Shapiro-Wilk test, as shown in Table 4.

Table 4. Descriptive Statistics of Pre-test and Post-test Scores per Condition

Pre-tests	Control Group (n = 28)		In-Class Experimental Group (n = 28)		Tool Experimental Group (n = 28)	
	M(SD)	95% CI	*M(SD)*	95% CI	*M(SD)*	95% CI
PET	20.85 (3.69)	19.42-22.29	15.46 (2.92)	14.33-16.59	13.57 (4.12)	14.33-16.59
MT	9.46 (1.20)	8.99-9.93	7.28 (2.22)	6.42-8.14	6.89 (1.68)	6.23 - 7.54
MARSI	99.64 (15.40)	93.66-105.61	106.57 (14.97)	100.76-112.37	110.42 (12.07)	105.74-115.11
CEI	82.50 (8.47)	79.21-85.78	80.50 (11.24)	76.13-84.86	87.35 (8.26)	84.15-90.56
Post-tests	*M(SD)*	95% CI	*M(SD)*	95% CI	*M(SD)*	95% CI
PET	19.46 (3.51)	18.10-20.82	17.07 (2.29)	16.18-17.96	17.64 (2.89)	16.51-18.76
MT	8.92 (1.60)	8.30-9.55	8.50 (2.02)	7.71-9.28	7.96 (1.81)	7.26 - 8.66
MARSI	101.03 (13.70)	95.71-106.35	113.25 (15.14)	107.37-119.12	118.85 (12.75)	113.91-123.80
CEI	78.14 (8.71)	74.76-81.55	85.17 (10.49)	81.10-89.24	87.57 (9.93)	83.71-91.42

Note. CI = Confidence Interval

The z values for skewness and kurtosis and the significance level for Shapiro Wilk tests within groups showed that the data is skewed or kurtotic for all three groups; however, they did not significantly differ from normality as the values were between -1.96 and 1.96 (West, Finch, & Curran, 1995). Furthermore, the null hypothesis of

data being normally distributed was not rejected according to the Shapiro-Wilk test ($p > .05$). Table 5 shows the results of skewness and kurtosis analysis and Shapiro-Wilk tests for pre-test scores for each condition.

3.6.3 Assumption of homogeneity of variances

The assumption of homogeneity of variances was tested to find out whether the effects differed as a function of independent variables of PET, Midtrack exam, metacognitive awareness, and engagement. For this, the Levene's equality of variances test was conducted. For each instrument the assumption of homogeneity of variances was met for PET score $F(2,81) = 0.57$, $p = .567$; for MT score $F(2.81) = 0.94$, $p = .336$; for MARSI score $F(2,81) = 0.28$, $p = .755$; and for CEI score $F(2.81) = 1.51$, $p = .226$.

3.6.4 Comparison of the pre-test scores

The pre-test scores of the three groups were compared in order to find out whether or not the groups were equal at the beginning of the study so that a mixed ANOVA could be performed. However, for each dependent variable, a statistical difference was found favoring different groups.

A one way ANOVA showed that there was a significant difference in the pre-test scores of PET between groups $F(2.81) = 30.60$, $p = .000$, and of MT scores $F(2.81) = 17.45$, $p = .000$. The follow up Tukey's post hoc test showed that the control group's PET ($M = 20.85$) and MT exam scores ($M = 9.46$) differed significantly at pre-test from both the in-class group (for PET score, $M = 15.46$; for MT exam, $M = 7.28$) and

the online tool group (for PET score, $M = 13.57$; for MT exam, $M = 6.89$), while there was no significant difference between the two experimental groups.

Table 5. Skewness and Kurtosis Analyses and Shapiro-Wilk Normality Test per Condition

	Control		In Class		Tool	
Pre-tests	$Z_{Skewness}$ $Z_{Kurtosis}$	Sig.	$Z_{Skewness}$ $Z_{Kurtosis}$	Sig.	$Z_{Skewness}$ $Z_{Kurtosis}$	Sig.
PET	.693 (*SE* = 0.44) .636 (*SE* = 0.86)	.416	.045 (*SE* = 0.44) -.977 (*SE* = 0.86)	.598	-.265 (*SE* = 0.44) .187 (*SE* = 0.86)	.820
MT	-.108 (*SE* = 0.44) -.576 (*SE* = 0.86)	.073	.893 (*SE* = 0.44) -.187 (*SE* = 0.86)	.115	.183 (*SE* = 0.44) -.847 (*SE* = 0.86)	.232
MARSI	.204 (*SE* = 0.44) -.215 (*SE* = 0.86)	.997	.736 (*SE* = 0.44) -.165 (*SE* = 0.86)	.908	-.569 (*SE* = 0.44) -.905 (*SE* = 0.86)	.427
CEI	1.687 (*SE* = 0.44) .416 (*SE* = 0.86)	.120	.006 (*SE* = 0.44) -.486 (*SE* = 0.86)	.931	-.721 (*SE* = 0.44) -.817 (*SE* = 0.86)	.279
Post-tests	$Z_{Skewness}$ $Z_{Kurtosis}$	Sig.	$Z_{Skewness}$ $Z_{Kurtosis}$	Sig.	$Z_{Skewness}$ $Z_{Kurtosis}$	Sig.
PET	.632 (*SE* = 0.44) .808 (*SE* = 0.86)	.384	-.843 (*SE* = 0.44) -.682 (*SE* = 0.86)	.067	-.850 (*SE* = 0.44) .038 (*SE* = 0.86)	.278
MT	-1.151 (*SE* = 0.44) -.113 (*SE* = 0.86)	.050	-1.562 (*SE* = 0.44) .283 (*SE* = 0.86)	.097	.038 (*SE* = 0.44) -1.395 (*SE* = 0.86)	.072
MARSI	.129 (*SE* = 0.44) -1.249 (*SE* = 0.86)	.467	1.444 (*SE* = 0.44) -.148 (*SE* = 0.86)	.058	-1.655 (*SE* = 0.44) .113 (*SE* = 0.86)	.083
CEI	-.090 (*SE* = 0.44) -.371 (*SE* = 0.86)	.821	1.145 (*SE* = 0.44) -.861 (*SE* = 0.86)	.126	.857 (*SE* = 0.44) -.385 (*SE* = 0.86)	.486

Note. Acceptable z value for skewness and kurtosis is between -1.96 and 1.96
Sig. value is the result of the Shapiro-Wilk Test ($p < .05$)

For the engagement inventory, one way ANOVA yielded in a significant difference $F(2.81) = 3.91$, $p = .024$. Tukey's post hoc test showed that the online tool group ($M = 87.35$) had significantly higher engagement than the in-class group ($M = 80.50$) at the beginning of the study, while there was not a statistically significant difference between the control group ($M = 82.50$), and in-class group, and control group and tool group.

For metacognitive awareness, one way ANOVA resulted in a significant difference $F(2.81) = 4.13$, $p = .020$, as well. Tukey's post hoc test showed that the online tool group ($M = 110.42$) had more awareness than the control group ($M = 99.64$) at the beginning of the study, while there was not a statistically significant difference between the control group and in-class group; and in-class ($M = 106.57$) group and tool group.

The differences in reading comprehension and engagement scale were expected to a certain extent, because the control group seemed to perform better in the regular language classes, based on the informal assessment of their language teachers. The same informal assessment from their language teachers also designated the in-class group as the least motivated or engaged group. Because a significant difference was detected at pre-test for PET and Midtrack exam scores, ANCOVA seemed an appropriate statistical test. Since the data already met the assumption of normality and homogeneity of variances, it was checked for linearity of regression and the homogeneity of regression slopes.

3.6.5 Assumption of linearity

The assumption of linearity was tested for each instrument with the scatter-plot graphs, and it was found that this assumption was violated. The residual scores do not have a straight-line relationship with predicated dependent variables (Pallant, 2007). The graphs of linearity for each condition can be seen in Figure 7, 8, 9 and 10.

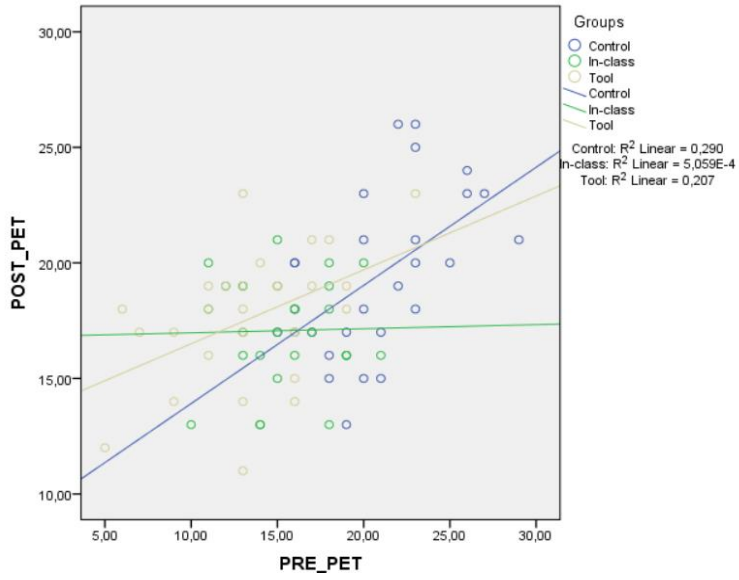

Figure 7 The assumption of linearity for PET scores

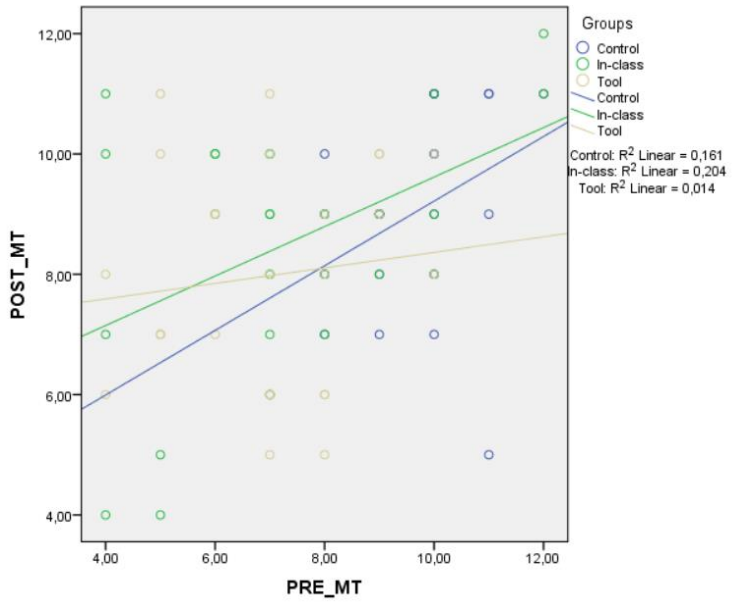

Figure 8 The assumption of linearity for MT scores

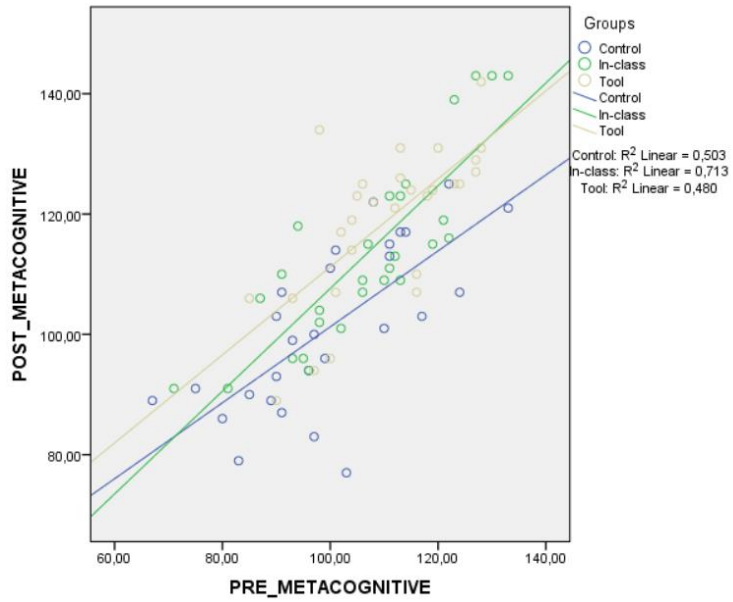

Figure 9 The assumption of linearity for MARSI scores

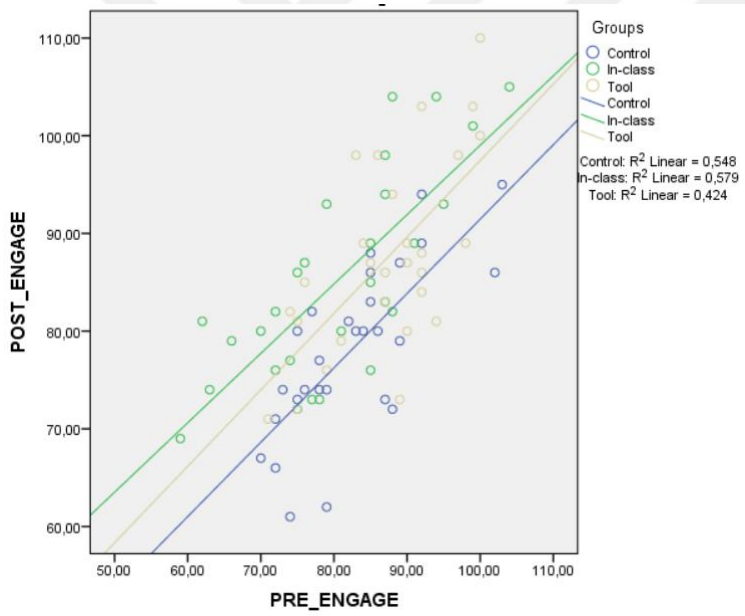

Figure 10 The assumption of linearity for CEI scores

3.6.6 Assumption of homogeneity of regression slopes

The assumption of homogeneity of regression was checked with the interaction effect with ANCOVA. All the instruments showed interaction; therefore, they violated the

assumption of homogeneity of regression slopes (for PET, groups*petscore, p = .000, for MT test groups*midtrack p = .004, for metacognitive awareness scale, groups*metacognitive, p = .000, and for engagement scale, groups*engage, p = .000).

3.6.7 Choosing a statistical test

As the assumption of homogeneity of regression slopes was not meet, and the number of participants was not enough for a robust ANCOVA (n < 30), the alternatives were examined. If the assumption of the homogeneity of regression slopes is violated, Tabachnick and Fidell (2007) recommend three alternatives; analysis of difference scores, blocking method, and hierarchical model. The blocking model was not preferred because it was not recommended after assigning the groups and conducting pre-tests. The hierarchical model was not preferred because it is mostly used for a larger number of groups, and examines nesting of students within classes, classes within schools, and schools within regions. Therefore, the analysis of difference scores (gain score analysis) was selected.

Tabachnick and Fidell (2007) define this alternative as the conversion of the difference between pre-test and post-test scores into an independent variable to be analyzed in ANOVA and possible problems such an analysis may cause. A possible problem is a ceiling or floor effect. A small change between scores can be caused either by the pre-test score, which cannot be changed by treatment effect as it is near the end of the scale or by the small effect of treatment. Secondly, difference scores have less reliability than pre-test-post-test scores and should only be used with highly reliable tests.

Therefore, caution was exercised while opting for this type of analysis. The data was already checked and adjusted for outliers. In addition, the number of participants across groups was the same (N = 28). Furthermore, the instruments used in this study had high reliability scores.

3.6.8 User feedback for the online tool Meta-S

The feedback about the online tool Meta-S collected from the students at the end of the final session was first read through for a general sense of the material. The students' answers for each of the five questions were entered into an Excel sheet. Then the data was coded for each question. The common themes within the answers were detected and the total number of users' answers that fall under these themes was summed for each question. Not all questions were answered by 27 students and some student gave only simple one-word answers such as yes, no, or good. These answers were not included in the common themes.

CHAPTER 4

FINDINGS

In this quasi-experimental study, three sets of analyses were conducted to reveal the effects of Meta-S on students' reading comprehension, metacognitive awareness, and engagement in the lesson. The first set of tests were conducted for the effect of strategy training on standardized (PET) and researcher designed (MT) tests for reading comprehension scores of students in general, and also for high and low levels of reading comprehension. The second set of analyses examined the effect of strategy training on metacognitive awareness. The final set of analyses examined the effect of strategy training on engagement. The findings section is organized around three main research questions of this study.

4.1 The effects of metacognitive reading strategy training on reading comprehension in two different modalities

In this section, the findings about the first research question are discussed.

Descriptive statistics for the PET difference scores showed that the mean of difference scores for the online tool group was higher than the in-class and control groups and that the mean of difference scores for the in-class group was higher than the control group. Table 6 shows the descriptive statistics for PET per condition.

Table 6. Descriptive Statistics of PET Difference Scores

	N	*M*	*SD*	*SE*	95% CI	
					Lower	Upper
Control	28	-1.39	3.47	0.66	-2.74	-.05
In-class	28	1.61	3.68	0.69	0.18	3.03
Online Tool	28	4.07	3.81	0.72	2.59	5.55
Total	84	1.43	4.25	0.46	0.51	2.35

Note. - *M* value in the control group show the decrease of total PET score from pre-test to post-test condition

A one-way between-groups ANOVA for PET difference scores yielded a statistically significant effect $F(2.81) = 15.71$, $p = .000$, $\eta_p^2 = .279$. Therefore, the null hypothesis that strategy training would result in no change in reading comprehension scores was rejected. Table 7 shows the one way ANOVA between-subject results for PET difference scores.

Table 7. One Way ANOVA Between Subject Results for the Difference Scores in PET

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Partial η2
Corrected Model	419.36	2	209.68	15.71	.000	.279
Intercept	171.43	1	171.43	12.84	.001	.137
Groups	419.36	2	209.68	15.71	.000	.279
Error	1081.21	81	13.35			
Total	1672.00	84				
Corrected Total	1500.57	83				

To further analyze the nature of this difference, Tukey's post hoc test was performed. The results indicated that the difference in mean scores between the in-class condition ($M = 1.61$, $SD = 3.68$) was statistically significant when compared to that of the control condition ($M = -1.39$, $SD = 3.47$) $p = .008$. The mean scores from the online tool condition ($M = 4.07$, $SD = 3.81$) also showed a statistically significant difference compared to the control condition $p = .000$. The comparison between

experimental groups showed that the online tool group had statistically higher difference than the in-class group, $p = .036$; therefore, increased its reading comprehension more than the in-class group. The multiple comparisons with the follow-up post hoc Tukey's test for PET difference scores are given in Table 8.

Table 8. Tukey's Post Hoc Test Results for the Difference Scores in PET

(I) Groups	(J) Groups	Mean Difference (I-J)	*SE*	Sig.	95% CI	
					Lower	Upper
Control	In-class	-3.00*	0.98	.008	-5.33	-0.67
	Tool	-5.46*	0.98	.000	-7.80	-3.13
In-class	Control	3.00*	0.98	.008	0.67	5.33
	Tool	-2.46*	0.98	.036	-4.80	-0.13
Online	Control	5.46*	0.98	.000	3.13	7.80
Tool	In-class	2.46*	0.98	.036	0.13	4.80

Note. *The mean difference is significant at the .05 level.

For the researcher designed Mid-track exam, the descriptive statistics showed that the mean of difference scores for the in-class group was higher than the online tool and control groups. The mean difference scores for the online tool group were higher than the control group. Table 9 shows the descriptive statistics of MT exam difference scores.

Table 9. Descriptive Statistics of MT Exam Difference Scores

	N	*M*	*SD*	*SE*	95% CI	
					Lower	Upper
Control	28	-.54	1.57	0.30	-1.15	0.07
In-class	28	1.21	2.23	0.42	0.35	2.08
Online Tool	28	1.07	2.32	0.44	0.17	1.97
Total	84	0.58	2.20	0.24	0.11	1.06

Note. - *M* value in the control group show the decrease of total MT score from pre-test to post-test condition

A one-way between-groups ANOVA was conducted to compare the differences in the Midtrack difference scores among the groups. The analysis yielded a statistically significant difference $F(2.81) = 6.16$, $p = .003$, $\eta_p^2 = .132$. Table 10 shows the one way ANOVA between-subject results for Mid-track difference scores.

Table 10. One Way ANOVA Between Subject Results for the Difference Scores in MT Exam

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Partial η2
Corrected Model	52.88	2	26.44	6.16	.003	.132
Intercept	28.58	1	28.58	6.66	.012	.076
Groups	52.88	2	26.44	6.16	.003	.132
Error	347.54	81	4.29			
Total	429.00	84				
Corrected Total	400.42	83				

The follow-up Tukey's post hoc test indicated that the mean score for the in-class group was significantly higher ($M = 1.21$, $SD = 2.23$) than that of the control group ($M = -.54$, $SD = 1.57$) $p = .006$. The mean score for the online tool group ($M = 1.07$, $SD = 2.32$) was also significantly higher from the control group, $p = .013$. However, in-class and online tool conditions did not significantly differ from each other $p = .964$. Table 11 shows the details of the multiple comparisons with the follow-up post hoc Tukey's test for MT difference scores.

The results showed that for general reading comprehension assessed with the standardized PET exam, strategy training with the online tool had a statistically significant effect for increasing the general reading comprehension of adult English learners compared to control group and in-class experimental group. For the researcher developed reading test, strategy training was found to increase reading comprehension statistically significantly for both groups compared to the control

group; however, no significant difference was found between the medium of the strategy training.

Table 11. Tukey's Post Hoc Test Results for the Difference Scores in MT Exam

(I) Groups	(J) Groups	Mean Difference (I-J)	*SE*	Sig.	95% CI	
					Lower	Upper
Control	In-class	-1.75*	0.55	.006	-3.07	-.43
	Tool	-1.61*	0.55	.013	-2.93	-.29
In-class	Control	1.75*	0.55	.006	0.43	3.07
	Tool	0.14	0.55	.964	-1.18	1.46
Tool	Control	1.61*	0.55	.013	0.29	2.93
	In-class	-.14	0.55	.964	-1.46	1.18

Note. *. The mean difference is significant at the .05 level

4.1.2. Reading comprehension level and the effect of strategy training

An additional statistical test was conducted for the two experimental groups to examine whether the students with lower levels of reading comprehension benefitted more (or less) than those with higher levels of reading comprehension. The continuous pre-test scores from the PET exam were grouped into high and low categorical values. The frequencies were calculated in regard to percentiles of 50 in SPSS to form these groups. According to this calculation, the students with the pre-test PET score of 16 or higher were assigned to the higher-comprehension group and those with 15 or lower were assigned to the lower-comprehension group. For MT, the scores of eight or higher were assigned to the higher group, and seven or lower were assigned to the lower group.

After the scores were grouped for an independent variable of reading level, the data were rechecked for normality. The normality assumption was violated for both the PET and MT difference scores. Two separate non-parametric Mann –

Whitney U tests were conducted for the PET scores and MT scores. Table 12 shows the descriptive statistics and normality assumption.

Table 12. Descriptive Statistics and Normality Tests of Pre-test Scores for High and Low Reading Proficiency Levels

	High (n = 23)				Low (n = 33)			
Pre-test	*M(SD)*	95% CI	$Z_{Skewness}$ $Z_{Kurtosis}$	Sig.	*M(SD)*	95% CI	$Z_{Skewness}$ $Z_{Kurtosis}$	Sig.
PET	17.91 (1.83)	17.12-18.70	2.110 (*SE* = 0.48) 1.306 (*SE* = 0.93)	.009	12.15 (2.59)	11.22-13.07	-2.987 (*SE* = 0.41) 1.474 (*SE* = 0.80)	.001
	High (n = 21)				Low (n = 35)			
MT	9.09 (1.26)	8.52-9.66	2.249 (*SE* = 0.50) 0.748 (*SE* = 0.97)	.001	5.88 (1.15)	5.48-6.28	-1.231 (*SE* = 0.39) -1.624 (*SE* = 0.78)	.000

Note. Acceptable *z* value for skewness and kurtosis is between -1.96 and 1.96
Sig. value is the result of the Shapiro-Wilk Test ($p < .05$)

The Mann - Whitney U test on the PET scores showed a significant difference between lower and higher levels of reading comprehension. The difference from the pre-test to post-test in the low level reading comprehension group (M = 4.84) was significantly more than that for the higher level reading comprehension group (M = -0.78), U = 97.00, p = .002. The effect size was measured with the formula $r = \frac{Z}{\sqrt{N}}$, and it was found to be large (z = -4.96) r = -.66 (Field, 2005, p. 532). The results of the Mann - Whitney U test for the PET exam can be seen in Table 13.

The Mann - Whitney U test on the MT scores also showed a significant difference between the difference scores of pre-test and post-test with lower and higher levels of reading comprehension. The difference from pre-test to post-test in the lower reading comprehension group (M = 2.08) was significantly more than that for the higher reading comprehension group (M = -0.40), p = .000.

Table 13. The Results of the Mann - Whitney U Test for Reading Proficiency Levels in PET

Reading Proficiency Level in PET	*N*	Mean Rank	Sum of Ranks	*U*	*p*	*r*
High	23	15.59	358.50			
Low	33	37.50	1237.50	82.50	.000	-.66
Total	56					

The effect size was found to be large (z = -4.11) r = -.55 (Field, 2005, p. 532). The results of the Mann- Whitney U test for the MT exam can be seen in Table 14.

Table 14. The Results of the Mann - Whitney U Test for Reading Proficiency Levels in MT Exam

Reading Proficiency Level in PET	*N*	Mean Rank	Sum of Ranks	*U*	*p*	*r*
High	21	17.05	358.00			
Low	35	35.37	1238.00	127.00	.000	-.55
Total	56					

Thus the increase in both the PET and the MT exam scores was significantly higher for students at lower reading comprehension levels compared to the increase for the students with higher levels of reading comprehension. The effect sizes were large, which means that after the strategy training, 66 percent and 55 percent of the variance in the difference scores for PET and MT scores respectively can be explained by lower reading comprehension levels.

4.2 The effects of strategy training on metacognitive awareness and engagement in two different modalities (Meta-S vs. teacher)

The descriptive statistics of the data from the metacognitive awareness inventory MARSI showed that the mean of difference scores of the online tool group was higher than the in-class and control group, and the mean difference scores of the in-class group were higher than the control group (see Table 15).

Table 15. Descriptive Statistics of MARSI Difference Scores

	N	*M*	*SD*	*SE*	95% CI	
					Lower	Upper
Control	28	1.39	11.21	2.12	-2.95	5.74
In-class	28	6.68	8.41	1.59	3.42	9.94
Online Tool	28	8.43	9.75	1.84	4.65	12.21
Total	84	5.50	10.19	1.11	3.29	7.71

A one-way between groups ANOVA for the difference in MARSI scores was conducted to test the hypothesis that strategy training would increase the metacognitive awareness of English learners. This analysis yielded a statistically significant effect $F(2,81) = 3.86$, $p = .025$, $\eta_p^2 = .087$. Therefore, the null hypothesis of no effect in scores was rejected. Table 16 shows the one way ANOVA between-subject results for MARSI difference scores.

A follow-up Tukey's post hoc test indicated that the mean score for the online tool condition ($M = 8.43$, $SD = 9.75$) was significantly higher than the control condition ($M = 1.39$, $SD = 11.21$) $p = .025$. There was no significant difference for the in-class condition ($M = 6.68$, $SD = 8.41$) when compared to the online tool condition $p = .785$, or the control condition $p = .117$.

Table 16. One Way ANOVA Between Subject Results for the Difference Scores in MARSI

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Partial η2
Corrected Model	751.36	2	375.68	3.87	.025	.087
Intercept	2541.00	1	2541.00	26.15	.000	.244
Groups	751.36	2	375.68	3.87	.025	.087
Error	7869.64	81	97.16			
Total	11162.00	84				
Corrected Total	8621.00	83				

Therefore, strategy training in the online tool condition was associated with greater gains in metacognitive awareness. The details of the multiple comparisons with the follow-up post hoc Tukey's test for MARSI difference scores can be seen in Table 17.

Table 17. Tukey's Post Hoc Test Results for the Difference Scores in MARSI

(I) Groups	(J) Groups	Mean Difference (I-J)	*SE*	Sig.	95% CI	
					Lower	Upper
Control	In-class	-5.29	2.63	.117	-11.58	1.00
	Tool	-7.04*	2.63	.025	-13.33	-.75
In-class	Control	5.29	2.63	.117	-1.00	11.58
	Tool	-1.75	2.63	.785	-8.04	4.54
Tool	Control	7.04*	2.63	.025	0.75	13.33
	In-class	1.75	2.63	.785	-4.54	8.04

Note. *. The mean difference is significant at the 0.05 level.

As for the engagement inventory, CEI, the descriptive statistics showed that the mean of difference scores for the in-class group was higher than the online tool and control groups. The mean difference scores of the online group were higher than that of the control group. The descriptive scores of CEI per condition can be seen in Table 18.

Table 18. Descriptive Statistics of CEI Difference Scores

	N	*M*	*SD*	*SE*	95% CI	
					Lower	Upper
Control	28	-4.36	6.20	1.17	-6.76	-1.95
In-class	28	4.68	7.55	1.43	1.75	7.61
Online Tool	28	0.21	7.75	1.47	-2.79	3.22
Total	84	0.18	8.02	0.88	-1.56	1.92

Note. - *M* value in the control group show the decrease of total CEI score from pre-test to post-test condition

A one way between groups ANOVA on the CEI difference scores yielded a statistically significant difference in favor of strategy training on lesson engagement $F(2,81) = 11.02$, $p = .000$, $\eta_p^2 = .214$. Therefore, the null hypothesis that strategy training would have no effect in engagement was rejected. Table 19 shows the one way ANOVA between-subject results for CEI difference scores.

Table 19. One Way ANOVA Between Subject Results for the Difference Scores in CEI

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Partial η2
Corrected Model	1143.07	2	571.54	11.02	.000	.214
Intercept	2.68	1	2.68	0.05	.821	.001
Groups	1143.07	2	571.54	11.02	.000	.214
Error	4201.25	81	51.87			
Total	5347.00	84				
Corrected Total	5344.32	83				

A follow-up Tukey's post hoc test was used to reveal that the mean score for the in-class condition ($M = 4.68$, $SD = 7.55$) was significantly different compared to the control condition ($M = -4.36$, $SD = 6.20$) $p = .000$. However, the difference between the in-class group and the online tool group ($M = 0.21$ $SD = 7.75$) was not significant $p = .059$. The difference between the control condition and tool condition was not statistically significant either $p = .052$. Thus, strategy training for the in-

class condition was associated with greater gains in engagement. The details of the multiple comparisons with the follow-up post hoc Tukey's test for CEI difference scores can be seen in Table 20.

Table 20. Tukey's Post Hoc Test Results for the Difference Scores in CEI

(I) Groups	(J) Groups	Mean Difference (I-J)	*SE*	Sig.	95% CI	
					Lower	Upper
Control	In-class	-9.04*	1.92	.000	-13.63	-4.44
	Tool	-4.57	1.92	.052	-9.17	0.02
In-class	Control	9.04*	1.92	.000	4.44	13.63
	Tool	4.46	1.92	.059	-.13	9.06
Tool	Control	4.57	1.92	.052	-.02	9.17
	In-class	-4.46	1.92	.059	-9.06	0.13

Note. *. The mean difference is significant at the 0.05 level

4.1.3 Participant perceptions of reading strategy training delivered via Meta-S

This section reports the findings from the feedback questionnaire responded by the participants who used the online strategy training tool Meta-S.

The most frequent answer to the first question, which asked the students' their thoughts about the training was "the study was very helpful to for me", given by nine students. One student responded, "I think this study and strategies greatly helped us improve our reading skills". The second most common answer was "I will use these strategies in the future" given by five students. One student commented that she would use these strategies when she reads articles related to her area of study. One participant expressed her problems with using an online tool.

In response to the second question about the helpful strategies, ten students commented that they used the strategy of guessing unknown words from the context

the most. One student said she did not need to use a dictionary any more thanks to guessing strategies. The second most common answers were the strategy for understanding the text structure, and the strategy of predicting what the text is about, both of which were cited by five students each. One student wrote that among all strategies, text structure strategy helped her most to comprehend the text. Another student expressed that predicting the text and confirming her prediction helped her a lot in terms of her aim to develop her reading skills.

When asked about the ways in which the strategies helped them, six of the students commented that they learned what to pay attention to during reading. One student noted that she realized her development, while she used to start reading directly with no intentions, now she knew what to pay attention to while reading.

In response to the fourth question about the features of the tool, four students commented on the step-by-step skimming and scanning activity. One student said the audio drew her attention and provided her guidance on skimming and scanning, and blocking of the rest of the text stopped her from reading the whole text. Two students commented on the videos and pictures. One of them mentioned the videos helped her understand the strategies better and the pictures made vocabulary learning easier.

The last question about the difficulties that the students had during the study was answered by three students. One of them stated her need for more concrete things such as books while learning, therefore getting used to the tool was difficult for her. Another one mentioned her difficulty in finding the main idea of a text. The last student commented on skimming and scanning due to the allocated time of one minute. She also mentioned that she had difficulty in answering comprehension questions in the notepad. The user feedback is summarized in Table 21.

Table 21. Feedback by the Users of Meta-S

Feedback question	Common themes	No of responses	Sample response
Q1: What do you think about the strategy training you have received?	It was helpful	9	I think this study and strategies greatly helped us improve our reading skills".
	Can be used in the future	5	When I read articles in my department, I will use these strategies
Q2: Which strategies helped you the most?	Guessing unknown words	10	I try to guess the meaning of a word instead of looking it up in a dictionary.
	Text structure	5	Finding the text structure helped me understand the text better.
	Predicting	5	Predicting what the text is about was helpful for me.
Q3: How did these strategies help you?	Pay attention	6	I realized that I improved a lot. While I used to start reading directly, now I know what to pay attention due to these strategies.
Q4: Which features of the tool did you like the most?	Skimming and scanning	4	I liked the skimming and scanning activity which shows what to do step by step with the audio and the blocking
Q5: What were the difficulties in the tool or in the instruction, if you had any?	*	3	I need more concrete materials such as books while learning, so getting used to the tool was difficult for me I had difficulty in finding the main idea of the text One minute was too short for me to skim and scan the text. Also, I had difficulty in answering comprehension questions in the notepad.

Note. Only three students answered the last question about the difficulty in the tool or in the instruction. Therefore, no common theme was found.

CHAPTER 5

DISCUSSION

The purpose of this study was twofold: 1. find out whether comprehensive reading strategy training affected reading comprehension skills, metacognitive awareness, and engagement in the reading lesson of adult EFL learners in the preparatory school of a university; 2. whether the medium of delivery made a difference, i.e., in a regular face-to-face classroom setting lead by the teacher, or via an experimentally designed online scaffolding tool, Meta-S.

Theoretical foundations and instructional design principles of this study includes strategy use in reading (Anderson, 2003; Oxford 1990, 2003; Winograd, & Hare, 1988) scaffolding guidelines for strategy training (Palinscar, & Brown, 1984; Quintana et al., 1999), metacognitive awareness (Mokhtari, & Reichard, 2002), and principles of multimedia designs (Lee, & Mayer, 2018; Mayer, 2015; Mayer & Moreno, 2010).

The study tried to find answers to three main research questions. The first question is about the comparison between the reading comprehension scores of the participants in the experimental groups and control group as assessed by both standardized and researcher designed reading tests. The second and third research questions explore the difference between the experimental and control group learners' metacognitive awareness and engagement in the lesson, based on the difference scores of pre and post-test results from metacognition and engagement scales, as well as the extent of difference between the two experimental groups.

The findings on reading comprehension showed that both the in-class and the online tool groups demonstrated progress in reading comprehension measured with a standardized reading test when compared to the control group. However, there was a significant difference between the gain scores of the online tool group compared to the in-class group. There was a small decrease in the scores of the control group, but this decrease was not statistically significant.

For the researcher designed reading test, a significant difference between the pre-test and the post-test scores was found between experimental groups and control group as well. However, while the online tool group's mean was higher, there was not a significant difference between the experimental conditions. There was a small but insignificant decrease in the scores of the control group.

The findings on metacognitive awareness showed that all groups demonstrated progress in their awareness; however, there was a significant difference favoring the tool group. This experimental group outperformed the control group in metacognitive awareness, but it showed no statistically significant difference when compared to the in-class group. There was no significant difference between the gain scores of the control group and the in-class group.

The findings on engagement showed that both of the experimental groups demonstrated progress in their engagement. However, while the in-class group's increase was statistically significant, there was not a significant difference between the pre-test and post-test scores in the online tool group. The control group's engagement scores showed a decrease in the post-test, but this was not statistically significant.

5.1 The effects of Meta-S on reading comprehension

The finding on the reading comprehension is in line with some of the rare results in the literature (Zenotz, 2011). While a larger number of studies showed insignificant increases in reading comprehension that resulted from electronic tool use (Dalton, Proctor, Uccelli, Mo, & Snow, 2011; McNamara, O'Reilly, Best, & Ozuru, 2006). Most of the studies in the literature are exploratory and consequently used researcher-developed tests as their instruments. Therefore, as one of the very rare studies in providing comprehensive strategy training in an online environment, this research has contributed to the literature by providing the effects of interventions on standardized reading comprehension tests which are not common.

An important point to note is that the studies that found insignificant increases were mostly conducted with monolingual or bilingual students. Zenotz (2011) found a statistical significance in reading comprehension for EFL learners. The participants of this study were also learners of EFL and their performance on reading comprehension increased significantly. Therefore, it seems important to explore the further possibility that strategy training for EFL learners might be more beneficial than for monolingual or bilingual learners. This possibility would also be consistent with the literature on that learners with a lower level of proficiency benefit more from strategy training than learners with a higher level of proficiency. This would also have significant implications for the design of technology-enhanced learning environments for the two linguistically separate groups of learners.

There is no other study to this researcher's knowledge that used a scaffolding tool designed within the principles of multimedia learning for a comprehensive strategy training that blended metacognitive strategies and predictive components of

reading comprehension and exemplified how these strategies can be activated and interpreted for several components. The results allowed inferring that using such a carefully designed tool can be helpful for adult learners of English as a foreign language in a Turkish university to teach metacognitive strategies and increase reading comprehension. The significant increase in the learners' scores exceeded the expectations of the researcher as reading is one of the most complex skills for ESL learners, and the researcher was familiar with the students' reluctance to engage in any reading activity as their teacher.

Another finding of this research consistent with the literature on reading comprehension was that the participants with lower levels of reading comprehension increased their scores significantly more compared to the participants with higher levels of reading comprehension as assessed at the beginning of the study. This finding suggests that students with lower levels of reading comprehension benefitted more from strategy training. Similarly, other studies that examined the performance of learners with higher and lower comprehension levels found that the learners with lower levels of reading comprehension benefit more from strategy training (Fogarty et al., 2017; Huang, Chern, & Lin, 2009; McNamara et al., 2006). The findings also showed that the medium of delivery did not make any difference when it comes to the benefits of training because no statistical significance was found between the two experimental groups. The learners with lower levels of reading comprehension seemed to benefit from strategy training, whether it was delivered via Meta-S or by the teacher in a face-to-face classroom setting.

In the Turkish education system, learning English as a foreign language is considered crucial, but it is experienced as a painful process by many students, who complain that despite their years of studying since primary school, they have not

been able to advance their levels of English to the expected level. Even though this research focused on reading skill, the strategies apply to other language learning skills. Therefore, providing such training with this tool from earlier proficiency levels can be a promising solution for the prevention of learning problems experienced by learners of English in Turkey.

These findings for practice imply that reading strategy training should be included in the instructional program of adult learners of EFL in the preparatory course at the university, particularly for those learners with lower levels of reading comprehension. However, given that this research was conducted with adult learners at the tertiary level, the implications should be treated with caution for younger learners. Further research is necessary for design implications for learners in elementary or secondary schooling.

5.2 The effects of using an online tool for strategy training

The finding that the online tool group significantly outperformed both the in-class experimental group and the control group in reading comprehension gain scores demonstrated that the type of medium affected the learning process, which is consistent with the literature on the positive effect of using digital tools for reading comprehension. While research in strategy training with digital tools usually yielded increased comprehension, a statistical significance between conventional strategy training and online environments is not often found (Zenotz, 2011). Therefore, this study contributes to the literature a less frequently found statistically significant effect.

This tool provided multiple ways of presenting the information, practicing the newly learned information, setting goals and checking if the goals were met, as well as giving learners a chance to evaluate their own learning process by making extra information available, providing a notepad to take notes to organize and assess their learning. All of these design features are in line with Quintana et al.'s (2004) recommendations for scaffolding tools, as well as Mayer (2015)'s principles of design for multimedia learning.

Even though assessing which strategies or features of the tool were helpful for learners was not within the scope of this study, feedback gathered from the participants on the benefits of text structure, graphic organizers, extra information, and vocabulary activities showed that most of the strategies and design features were favored by students. The feedback also showed that text structure and vocabulary strategies were found to be the most helpful strategies. This finding show parallelism with the literature that vocabulary (Anderson, & Freebody, 1983; Cromley, & Azevedo, 2007; Koda, 2005) and background knowledge (Anderson, & Pearson, 1984; Cromley, & Azevedo, 2007; Gersten, Fuchs, Williams, & Baker, 2001; Meyer et al, 2010; Kispal, 2008; Long et al., 1996; Rapp, & Braasch, 2014; Stanovich, 2000; Zhang, 2017) were important predictors of reading comprehension. It may be argued that the instructional design of this tool has been essential for the gain in reading comprehension of the participants in the online tool group.

5.3 The effects of strategy training on metacognitive awareness

Even though there are plenty of research on metacognitive awareness and reading comprehension (Mokhtari, & Reichard, 2004; Mokhtari, & Sheorey, 2002; Palinscar,

& Brown, 1984; Pressley, & Afflerbach, 1995), and metacognitive awareness and strategy training (Wang, 2016; Wilkins, 2014), studies on metacognitive awareness in online environments are rare (Altıok, Başer, & Yülseltürk, 2019). There is not any other study that examines the effect of providing comprehensive strategy training with a scaffolding tool on metacognitive awareness. This research has contributed to the positive effects of strategy training on metacognitive awareness. While some studies found a statistically significant increase (Altıok, Başer, & Yülseltürk, 2019; Wang, 2014), some found an insignificant difference (Wilkins, 2014). It should be noted that none of these studies examined two experimental groups comparing two different media of delivery against a control group. In this sense, this study may offer an important contribution to the research literature.

In addition, none of the above-mentioned studies provided comprehensive strategy training with a digital tool specifically designed for either L1 or L2 English learners. Therefore, this study may help bridge the gap in the literature in terms of the effects of metacognitive strategy training with a scaffolding tool to increase metacognitive awareness in L2 English. Despite the insignificant difference between the two experimental groups, feedback from the students on the usefulness of strategy groups and their help for monitoring and controlling learning processes supports the finding that students in scaffolding tool group increased their awareness significantly.

5.4 The effects of strategy training on engagement

Even though there are plenty of studies in the literature on motivation and engagement in online learning environments, there is no study in the literature to this

researcher's knowledge that examined the effects of providing comprehensive strategy training with a scaffolding tool on engagement. Most of these studies found a statistically significant increase in motivation or engagement (Shawn, 2007). The results of this study partially confirm the findings in the literature, because the engagement of the participants in the in-class group improved significantly, while the participants in the online tool group had no significant increase in the engagement scale. This finding might have resulted from a ceiling effect. The pre-test results of the engagement scale showed that among the three groups, the online tool group already had the highest engagement scores. Therefore, using a difference score might have resulted in this ceiling effect. Another reason for the insignificance of the difference scores can be the result of the physical lack of the teacher and interaction among students. It might also have resulted from the physical conditions of the laboratory and having to deal with time limitations and unfamiliarity or discomfort caused by the lab environment, which will be discussed in the limitations section. It might also be because of the plain reason that the tool had not met user expectations or increased their engagement. However, the feedback from participants in these groups demonstrated that they found the tool helpful and beneficial not only for the reading lesson but also for academic skills needed in other courses.

It is also important to note that no significance between engagement levels can be interpreted as a positive indication that the tool enabled learners to keep their engagement high even though the content was loaded with information. They had more cognitive load due to having to learn from another medium to which they are not accustomed, and with the absence of the teacher's facilitation. Even when there is no extra training or information provided, students tend to lose their engagement due

to the natural course of time, which was a possible case in the control group, whose engagement level slightly decreased at the end.

5.5 Implications for instructional design and further research

Based on the findings of the study some guidelines can be recommended for instructional design and strategy training in further studies, and for teachers of EFL who are willing to go the extra mile in reading lessons, and for technology integration with a carefully designed tool to turn a naturally receptive skill into an active one.

Research in strategy training in reading and using online environments for language teaching implicate the benefits of integrating to provide a more conscious learning process, active involvement for a mostly passive and receptive skill, and individual control of the pace and density of the learning process. Scaffolding tools can provide many opportunities related to instructional design and learners' needs. In terms of instruction, the learning objectives can be emphasized repeatedly and become accessible by a few clicks. This opportunity also helps students to follow the lesson at their own pace. Also, a pedagogical agent in the tool can help learners with informative and detailed feedback instead of general warnings or corrections. Students can get feedback for every activity, which is not possible in a conventional classroom setting due to the number of students and limited time.

Scaffolds and feedbacks are of significant importance for the design of technology integrated instructional materials. Providing notepads, graphic organizers which present a summary of the learning objectives to supply a purpose as well as presenting checklists and surveys to evaluate the learning process seemed to play an

important role in the significant results; therefore, they are recommended for design. In one student's words, "every strategy covered was helpful for my reading skills," which represents the majority of the comments, and the design of the strategy training did not only improve reading skills but also "helped my purpose in developing for my reading".

Furthermore, detailed, and informative feedback presenting the reasons for potential mistakes, concurrent narrative texts and audios, and hyperlinks to extra information are beneficial for EFL learners. It is vital to provide a step by step organization by emphasizing the beginning and the ending of each instructional section, reminding learners what they covered to integrate this previous learning with the new information, and providing several types of practice. Therefore, learners can put into use what they have just learned with multiple subcategories, especially when the content is comprehensive. When it is possible, the content must be divided into shorter periods of lessons to prevent loss of attention over extended periods of time. When dealing with content that includes metalanguage, such as metacognitive strategy training, the instructors and designers need to make sure that they take the students' level of English into account and use metalanguage sparingly, and in a way that can be comprehended by the learners with ease.

Another recommendation for ELT teachers is to spend time on teaching text structures. Several commonly used textbooks do not address text structure, which is crucial for understanding how a text is formed, how the information is organized, and it provides a hint of the writer's purpose. Furthermore, text structures are easily applicable to other skills in learning English, especially writing and speaking, because understanding the logic of text structures will help students organize their writing and speaking accordingly. In academic listening lessons, knowing the text

structure is of great help in predicting what kind of language and content is used, and even if the students do not understand every word or miss some parts, they still have some intuitions to make informed guesses when they know about text structures. The students' comments were mostly about the benefit of the tool not only for their reading skills but also for writing skills.

The findings suggest that teaching students strategies for guessing unknown vocabulary from the context can be integrated into regular instruction or online tools, rather than directing students to dictionaries to aid the acquisition of new vocabulary. Vocabulary learning is an important part of English, and many students complain that texts are too complicated because they do not know the meanings of many words, or that they cannot convey what they mean in writing as they do not know enough vocabulary. The emphasis should be given to strategy training for vocabulary, which dramatically affects students' proficiency level and increases inference making ability, to break the habit of students in terms of relying solely on dictionaries or online translators. Teaching this strategy was also appreciated by the students, as apparent in one of the comments in the feedback sheet: "From now on I will use these strategies before and during the reading because they fastened my reading and helped me understand more".

As another essential predictor for reading comprehension, the instructional design should focus on inference making. Forming, testing, and reforming inferences as well as understanding the underlying messages between the lines is one of the most important landmarks of proficiency dividing the elementary and upper-intermediate levels. In the elementary proficiency levels, reading instruction does not usually focus on inference making, and the lack of this instruction makes it very difficult for a learner to understand a text. Therefore, working on inference making

strategies from earlier proficiency levels has the potential to ease the transition period. The understandable concern that including this kind of strategy would be beyond the level of students can be dismissed when this training is combined with vocabulary strategies as well as text structure strategies. Apparent support about the argument that this kind of strategy would not overwhelm the students is provided in one of the comments of a student: “I don’t use a dictionary anymore when I read a text. I learned this with strategies… I am going to use these strategies again. I think when I read articles in my department; these strategies will be useful for me”.

In addition, using a scaffolding tool for this strategy would decrease the burden on students as it provides a chance to revisit anytime needed, and start over or go back and forth among strategies, enabling practice as much as students need. Using a scaffolding tool is also more convenient and time saving for the EFL teachers, who are usually required to attend multiple learning needs from varied levels of language proficiency in a single class.

The benefits of scaffolding tools respond to the needs and interests of students and confirm the need for following the latest improvements in the educational field. Scaffolding tool design is of utter importance for eliciting learning gains. When the design of a learning tool is not based on a theoretical framework, and comprise features that are directly aligned with the relevant findings and recommendations in the literature for specific learning needs, the focus is lost. Therefore, the actual benefits of such a learning tool are undermined, to the extent that it becomes a mere add-on, not a medium of learning. This study was based on two foundations; strategy training for reading comprehension, and principles of multimedia design and scaffolding guidelines. It led to the intended learning, and the students were able to increase their reading comprehension. Educational

technologists and designers of instruction and learning design must make sure that they base all design ideas on the relevant theoretical framework(s), and carefully include features that enable learners to monitor and evaluate themselves.

As the literature is limited on the effect of metacognitive strategy training through an online scaffolding tool on reading comprehension of EFL students, further research is needed for different student profiles, and learning environments, such as elementary and secondary schools. Further research can focus on scaffolding tools similar to the one used in this study, with slight variations, such as different types of text on a variety of topics, and multiple representations of essential information. Also, design implications for EFL learners at different levels of schooling can be focused on.

This study was conducted with 84 students, lasted for five weeks, and its effects were measured with post-test scores obtained right after the treatment ended. A study with a larger number of participants and for a longer period of time can be conducted. Also, a follow-up examining the effects of such training later in time or after transferring to another level of schooling can be useful to bridge the gap in the literature

A significant increase in engagement, which is considered a crucial element for language learning, could not be found for the online tool group in this study. Since the research literature has many significant findings on increased engagement and motivation with technology integration, a replication of this study under better lab conditions could be a promising contribution to the field. Also, features that enable student interaction, which is a necessary component of engagement that

increases active involvement (Beffa-Negrini et al., 2002), can be incorporated into the design of the tool.

Furthermore, the effects of such a design on other skills of English, such as writing can be studied. Writing skills is another troublesome area for EFL learners as it is about production, where much scaffolding is needed. The practice on this or other similar tools, especially about text structures, can help learners for their writing skills.

5.6 Limitations of the study

The findings of this study are restricted to university level students who are learning English as a foreign language, the strategy training lasted for three weeks, and no follow-up tests were conducted. Therefore, the findings of the study require confirmations from further research.

A main limitation of the study was the insufficiency of the laboratory conditions where Meta-S was used. The lab was located in the basement with many computers out of order, ripped extension cables and broken plugs. The lab was not accessible to the use of preparatory school teachers. This problem was solved by negotiating special permission by the researcher; however, this permission did not allow the researcher to change any of the physical conditions. The lab had flooded on the day of the first session, and during the second session, there was a general maintenance underway. Therefore, both sessions had to start late, and in the final session, the fuses blew and the re-launching of the system had to be waited. As a result of these hurdles, eight of the students could not finish using the tool in the given time. As a solution, three students who do not have a computer completed the

tasks in the office of the researcher before the following session. The remaining five students completed unfinished tasks at their homes. Their task completion was ensured and checked by the reports generated by the Articulate online.

Another limiting aspect can be that some students may have low interest or less comfort using online learning tools. In response to a feedback question on tool use, one student mentioned her discomfort of using computers: “I think this study is more suitable for those who can study through computers. As I look for more concrete things while learning, I had a hard time focusing my attention. However, this study helped me a lot in terms of reading, guessing the paragraph at the beginning and what to pay attention while reading”. For this particular student, there was an insignificant decrease in the scores of researcher designed reading comprehension test (MT), engagement and metacognitive awareness.

Another limitation of the study is related to the fact that the researcher was also the teacher of the students. Even though this has certain advantages in terms of access, and a better chance for increased attention to the study, it also has possible adverse outcomes. The first one is the fear of being misjudged by the teacher. Even though the researcher made sure that the study and the results would not affect their grades or the views of the teacher, through verbal explanations as well as overtly stated in the written approval form, the students might still have reservations. Therefore, they may not have reflected their real thoughts and answers during the pre-test survey scales. A second possible negative outcome is the complete opposite of this. The students may have underestimated the training or the tests. They might not have given importance to the process and not complete the tests as the researcher emphasized that there would be no negative consequences for the actions of the students. This possibility could have been the case for one student in the in-class

group, and two students in the control group. This limitation was resolved by removing the scores of these students from data analysis.

APPENDIX A

ETHICS COMMITTEE APPROVAL

T.C.
BOĞAZİÇİ ÜNİVERSİTESİ
Sosyal ve Beşeri Bilimler Yüksek Lisans ve Doktora Tezleri Etik İnceleme Komisyonu

Sayı: 2019 - 24

7 Mart 2019

Gamze Uçak
Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü

Sayın Araştırmacı,

"İngilizce öğrenenler için okuduğunu anlama stratejilerinin geliştirilmesine yönelik deneysel bir destek aracının tasarımı ve değerlendirilmesi" başlıklı projeniz ile ilgili olarak yaptığınız SBB-EAK 2019/08 sayılı başvuru komisyonumuz tarafından 7 Mart 2019 tarihli toplantıda incelenmiş ve uygun bulunmuştur.

Dr. Öğr. Üyesi İnci Ayhan

Prof. Dr. Feyza Çorapçı

Doç. Dr. Mehmet Yiğit Gürdal

Doç. Dr. Ebru Kaya

Dr. Öğr. Üyesi Şebnem Yalçın

APPENDIX B

THE INTERVENTION PROCEDURE FOR ALL GROUPS

	Control Group	In-Class Experimental	Online Tool Experimental
Week 1 (2 Lessons 90 minutes)	Consent Form Demographic Questionnaire Pre-tests: -PET -MT exam -MARSI -CEI	Consent Form Demographic Questionnaire Pre-tests: -PET -MT exam -MARSI -CEI	Consent Form Demographic Questionnaire Pre-tests: -PET -MT exam -MARSI -CEI
Week 2 (2 Lessons 90 minutes)	Reading text: What does the Ocean Mean to Us? Exercises from the book: -Quick comprehension check -Exploring vocabulary -Developing reading skills (Topics of paragraphs, Main ideas, Using Graphic Organizers, Critical Thinking Discussion)	Reading text: What does the Ocean Mean to Us? The overview of the metacognitive strategies, when and where they can be used, why they should be used, and how they can be used were explained and modeled by the teacher. The strategy training provided by the teacher consisted of; Global (having a purpose, predicting the text, activating prior knowledge on text structure, noticing text features and making inferences) Problem Solution (re-reading, guessing unknown words from the context Support (note-taking)	Reading text: What does the Ocean Mean to Us? The overview of the metacognitive strategies, when and where they can be used, why they should be used, and how they can be used were explained and modeled by the coaching avatar in Meta-S The strategy training provided within Meta-S consisted of; Global (having a purpose, predicting the text, activating prior knowledge on text structure, noticing text features and making inferences) Problem Solution (re-reading, guessing unknown words from the context Support (note-taking)

		* The teacher provided the training by talking and writing on the board	* The coaching avatar provided the training with recorded audio, text slides, and step by step demonstration by blocking the rest of the text.
		** Extra videos and exercises on text structures were shown to students by the teacher by reflecting them on the board with the projector	** Extra videos and exercises on text structures were available to students with hyperlinks presented when the button *Extra Info* was clicked
		The text structures of the text were description and problem solution.	The text structures of the text were description and problem solution.
		After the strategy training, the exercises were completed from the book.	After the strategy training, the exercises were completed from the book.
Week 3 (2 Lessons 90 minutes)	Reading text: The Crab	Reading text: The Crab	Reading text: The Crab
	Exercises from the book: -Quick comprehension check -Exploring vocabulary -Developing reading skills (understanding text features, reading for details, definitions, main ideas and supporting details, critical thinking discussion)	The previous lesson on strategy training was revised by the teacher by asking questions to students.	The previous lesson on strategy training was revised by clicking on the hyperlinks to related parts within Meta-S.
		The text structure studies were compare-contrast and description.	The text structure studies were compare-contrast and description.
		The text features subheadings and parentheses (with functions)	The text features subheadings and parentheses (with functions)
		*** The questions from the book were answered after a related part of the strategy training was finished.	*** The questions from the book were integrated into the related parts within Meta-S, the students

The students answered the questions from the book and shared their answers with the class. The teacher asked students to reflect on what strategy they used while answering the question. Detailed feedback and remodeling were provided by the teacher.	answered multiple-choice, hotspot, dragging dropping, matching and text entry questions that also enabled to reflect on what strategy they used while answering the question. Detailed feedback and remodeling were provided by the coaching avatar.
****At the end of each subcategory of metacognitive strategies (global, problem solution and support strategies) the teacher explained the importance of monitoring and checking their learning and prompted them to reflect on what they have covered and what they have not covered by asking.	****At the end of each subcategory of metacognitive strategies (global, problem solution and support strategies) the coaching avatar explained the importance of monitoring and checking their learning and prompted them to reflect on what they have covered and what they have not covered by showing them with ticks and crosses in MetaS.
***** At the end of each subcategory of metacognitive strategies (global, problem solution and support strategies) the teacher asked them to evaluate their learning and performance on practice parts by asking how many points they would give for how well they understood different parts of strategy knowledge and how well they performed, and whether they reached their purpose.	***** At the end of each subcategory of metacognitive strategies (global, problem solution and support strategies), the coaching avatar asked them to evaluate their learning and performance on practice parts by presenting a Likert scale survey slide. The students gave points from 1 to 5 for how well they understood different parts of strategy knowledge and how well they performed, and whether they

			reached their purpose.
Week 4 (2 Lessons 90 minutes)	Reading text: Food for Thought Exercises from the book: -Quick comprehension check -Exploring vocabulary -Developing reading skills (scanning, main ideas, making inferences, critical thinking discussion)	Reading text: Food for Thought The procedures for practice on global, problem solution and support strategies were the same as the first practice lesson in week 3. The text structure studies were cause-effect and description. The text features studied were em dashes (—) and parentheses (with different functions) ******The teacher showed a video on global inference making and explained and modeled the inference-making process from the animation video.	Reading text: Food for Thought The procedures for practice on global, problem solution and support strategies were the same as the first practice lesson in week 3. The text structure studies were cause-effect and description. The text features studied were em dashes (—) and parentheses (with different functions) ******The link of the video on global inference making became available when students clicked on the Extra Info button and after the video was watched the coaching avatar explained and modeled the inference-making process from the animation video.
Week 5 (2 Lessons 90 minutes)	Post-tests: -PET -MT exam -MARSI -CEI	Post-tests: -PET -MT exam -MARSI -CEI	Post-tests: -PET -MT exam -MARSI -CEI *******User feedback sheet

Note. * symbols show differences of implementation for two experimental groups.

APPENDIX C

STRATEGIES TAUGHT WITH META-S AND TASKS TO PRACTICE THEM

Metacognitive Strategies	Sub-strategies	Tasks
Global Strategies	1) Having a purpose	1) Writing their purpose to *My NotePad*
	2) Predicting the text	2) Looking at the title Skimming the first and the last sentences Looking at pictures and any additional information Finding the topic sentence Writing their prediction
	3) Activating background knowledge on text structure -Description -Compare-contrast -Cause-effect -Problem solution	3) Scanning the text for signal words or sentences for text structure Matching the sentences with correct text structures Filling in graphic organizers for main ideas and details according to text structures
	4) Noticing text features	4) Finding the text feature from a given part Matching the purpose with the text feature
	5) Inference making -Local inferences -Global inferences	5) Answering questions on local and global inferences
	*Monitoring learning **Evaluating learning	*Slide on what has been covered and what has not been covered presented to the users ** 5 point Likert scale to evaluate how well the users performed on learning and practicing the global strategies
Problem solving strategies	1) Guessing unknown vocabulary from the context -Signal words -Words in vicinity -Word classes	-Answering multiple questions on signal words, words in the vicinity and word classes -Matching pictures to the given words -Dragging and dropping pictures

		according to the given word -Writing their guesses about the meaning of a word
	2) Rereading	2) Getting prompted by the coaching avatar when the text is difficult or when the students lose their concentration
	*Monitoring learning **Evaluating learning	*Slide on what has been covered and what has not been covered presented to the users ** 5 point Likert scale to evaluate how well the users performed on learning and practicing the problem solving strategies
Support Strategies	1) Note-taking	1) Answering questions in the *My NotePad*
	*Monitoring learning **Evaluating learning	*Slide on what has been covered and what has not been covered presented to the users ** 5 point Likert scale to evaluate how well the users performed on learning and practicing the support strategies

APPENDIX D

SAMPLE QUESTIONS FROM PET

5

Museum Café
These tables are for customers only.
Follow signs for picnic areas.

A You should take all food to the special picnic area.

B You can eat picnics in this section of the café.

C You may sit here if you buy something from the café.

21 What is the writer trying to do in this text?

A describe how children make friends at a summer camp

B suggest how parents should choose a summer camp for children

C explain what it is like for children at a summer camp

D advise children how to behave at a summer camp

25 Which postcard might a child at the camp send home?

A

I was annoyed when they suggested I put on old jeans, but I guess they were right.

B

It's so unfair that everyone else can use their mobile phone, but they won't let me use mine.

C

I've made some good friends but we're all bored because there isn't much to do here.

D

I was really frightened every time we went rock climbing, so they let me do something else instead.

APPENDIX E

SAMPLE QUESTION FROM MT EXAM

19. What is the main idea of the reading passage?
A) Tourism industries should introduce new trends and themes to tourists.
B) Tourism may cause negative effects on local people and host countries.
C) Tourists should be protected against dangerous situations and realities.
D) Tourists may provide several opportunities to the host countries.

21. In paragraph 2, why does the writer use the words of an African tribesman?
A) To mention the benefits of luxuries.
B) To mention the main point of the text
C) To explain how he feels about local people
D) To explain what are problems with identity.

APPENDIX F

RELIABILITY STATISTICS OF MARSI

Reliability Statistics and Item Means Summary for MARSI

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.868	.874	30

	M	Min	Max	Range	Maximum / Minimum	Variance
Item Means	3.53	2.30	4.24	1.94	1.85	.249

APPENDIX G

RELIABILITY STATISTICS OF CEI

Reliability Statistics and Item Menas Summary for CEI

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.829	.835	23

	M	Min	Max	Range	Maximum / Minimum	Variance
Item Means	3.63	2.10	4.71	2.62	2.25	.412

APPENDIX H

OPEN-ENDED FEEDBACK QUESTIONS

1) What do you think about the strategy study that you have had?

_____
_____
_____.

2) Which strategies helped you the most?

_____
_____
_____.

3) How did these strategies help you?

_____
_____
_____.

4) Which features of the tool did you like the most?

_____
_____
_____.

5) What were the difficulties that you experienced in the tool or in the instruction, if you had any?

_____
_____
_____.

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