



UNIVERSITY OF
BIRMINGHAM

**The Impact of Two Language Learning Methodologies: Technology Enhanced
Language Learning and Paper-Based Learning: An Individual Differences
Approach to Effective Learning and Teaching**

By

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Abstract

The present study has two areas of interest: Technology Enhanced Language Learning (TELL) and Individual Differences (IDs). Research on TELL has reported the positive impact of technology on L2 learning (e.g., Bester & Brand, 2013; Qiao & Zhao, 2023). Most studies targeted adult L2 learners, leaving the effects of TELL at younger ages understudied (e.g., only a fifth of studies has been conducted at secondary educational levels, cf., Chang & Hung, 2019). The present study aimed to examine this under-researched population and determine whether technology is conducive to young teenagers' L2 learning. A variety of language structures (e.g., vocabulary, tenses, and word order in English), language skills (e.g., listening and speaking skills), and factors integral to learning (e.g., in-class attention and motivation in the lesson) were considered. Research on IDs has made contradictory claims about the impact of IDs on language learning. While many studies corroborated their relationship (e.g., Chrysochoou et al., 2013; Schmidt, 2012), many others disputed the importance of such an effect (e.g., Felser & Roberts, 2007). To address this longstanding controversy, the relationship between IDs and language learning was explored, specifically with respect to the teaching methodology. Due to the intricate relationship of IDs with various SLA factors, such attempts are scarce in the literature (Chen et al., 2021; Dewaele, 2012).

A 6-month classroom intervention study was conducted at a Lower Secondary School in Greece with L1 speakers of Greek aged 11-13 who were learning English as a Foreign Language (EFL). A control group (30 students) was taught in the traditional way using textbooks and paper-based materials, and an intervention group (35 students) was taught with digital resources (e.g., online games and videos, websites, Virtual and Augmented Reality, mobile phones) and paper-based teaching materials. Tests assessing the participants' L2 knowledge were conducted before and after the intervention to assess any difference in

linguistic improvement between the two groups. Tests measuring their individual differences were also administered. Questionnaires on their motivation and attention in class were completed at the end of the intervention and in each lesson, respectively.

The results showed that technology improves learners' vocabulary and speaking skills and contributes to their in-class attention and motivation. The other language learning dimensions – tenses, word order, and listening – equally improve in both teaching methodologies. Furthermore, the teaching methodology was found to modulate the relationship of IDs with language learning. The findings revealed that attentional capacities hinder word order acquisition in traditional paper-based classes and impede vocabulary acquisition in TELL classes. Conscientiousness contributed to L2 learners' in-class attention regardless of the teaching methodology. However, the results showed that L2 learners need to be academically motivated to stay attentive in a traditional lesson. Additionally, they need to show conscientiousness traits to stay motivated in a traditionally taught class.

These findings suggest that a) although recent research highlights the effectiveness of TELL, an engaging technology-free L2 environment is still effective, and b) the teaching methodology, language learning, and learners' IDs are intertwined and influence each other. This study contributes to the limited number of TELL studies on younger ages and establishes a framework for exploring the modulating role of the teaching methodology on the IDs-language relationship. Teaching recommendations based on the findings are provided to highlight the research impact of the study.

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1. CHAPTER 1: INTRODUCTION

1.1 Theoretical Background of the Study

The field of Second Language Acquisition (SLA) includes a vast array of critical areas related to how people acquire any language other than their first one. The present study focuses on two of those: Teaching Methodologies and Individual Differences (IDs). A variety of SLA theories (e.g., Behaviourism, Interactionism) have shaped the teaching methodologies that are implemented in language classrooms (VanPatten & Williams, 2015). SLA studies on IDs have corroborated the impact of IDs on language learning (e.g., Chrysochoou et al., 2013; Schmidt, 2012), yet others have disputed the interaction between IDs and language learning (e.g., Felser & Roberts, 2007). These differential, contradictory claims have been explained by how various language acquisition theories interpret the IDs-language interaction (Kidd et al., 2018), leading to a longstanding debate on the role of the IDs-language interaction in the SLA landscape. In English as a Foreign Language (EFL) settings, differentiating instruction influenced by learners' IDs can lead to effective language learning (Tanjung & Ashadi, 2019). The relationship between IDs and language learning outcomes is, therefore, a critical area of research, particularly in the context of how the teaching methodology may influence this dynamic.

1.2 Statement of the Problem

The present study aims to address three issues related to language learning and IDs: a) Greek L2 learners' problematic acquisition of specific language structures and skills in English, b) learners' attention in class and motivation in the English lesson, and c) the relationship between IDs and language learning.

With regard to the first issue, Greek L2 learners' problematic acquisition of specific language structures and skills, during my experience as an English teacher, I identified a series

of language learning challenges frequently encountered by Greek L2 learners of English. Firstly, acquiring word order in English is challenging for Greek L2 learners (Papaefthymiou-Lytra, 2001). English syntax predominately follows a fixed sequence of words (e.g., Subject – Verb – Object). On the contrary, there is no such fixed order of words in Greek. This very frequently results in erroneously structured sentences in English formed by Greek speakers. Additionally, Greek learners struggle with polysemous words in English. Over 80% of words in English are polysemous (Rodd et al., 2004). Greek learners' struggle is attributed to multiple meanings of English polysemous words (e.g., cut, hands) or their translation to a single word in Greek (e.g., *ago* and *before* are both translated as *πριν*[prin] in Greek). Furthermore, two tenses in the English grammar – Present Simple and Present Continuous – are, in most cases, problematic. Greek students face difficulties distinguishing their different uses (Papaefthymiou-Lytra, 2001). This problem is explained by the fact that the Greek language has only tense referring to the present without differentiating a continuous or a simple aspect. Lastly, Greek learners struggle with speaking and understanding spoken English despite having obtained a certificate showing they are proficient in the English language. This has led to difficulties in communication and a fear of orally expressing themselves and engaging in conversation. The reason for this communication barrier experienced by Greek learners of English is the structure of the educational system in Greece, which predominately focuses on theoretical knowledge related to grammar, reading and writing, excluding oral competencies. Section 1.7 **The Educational System in Greece** below offers a more detailed description of the educational system in Greece, with an emphasis on English language education, to further explain the reason for this communication barrier. Taking everything into consideration, word order, polysemous words, two tenses, *Present Simple* and *Present Continuous*, speaking and listening, were selected as this study's targeted language learning dimensions to facilitate their acquisition by Greek L2 learners of English.

Regarding learners' attention and motivation in class, these two constructs have long been established as factors that contribute to effective learning (Gardner, 2007; Gardner, 1983; Olney et al., 2015). Yet again, teachers acknowledge the difficulty of maintaining learners' attention and motivation in class, especially in larger classrooms. Attention and motivation in the classroom were thus selected as research topics of the present study. The aim is to identify factors that influence these two constructs and provide teaching recommendations to support teachers' and students' efforts in class.

Lastly, due to the multifaceted needs and learning goals of L2 learners, a non-adaptable, widely used method of instruction is detrimental to learners' linguistic improvement (Bouguen, 2016; Gerges, 2001; Mercer et al., 1996). A teaching methodology that considers learners' IDs and learning goals should thus be defined to facilitate learners' language acquisition and alleviate teachers' classroom challenges. To achieve this, this study explores whether the teaching methodology influences the relationship between IDs and language learning. Any finding will also contribute to the debate on the IDs-language interaction in the SLA field.

1.3 Objectives of the Study

The present study has a three-fold aim. Firstly, it aims to compare two teaching methodologies that are currently used in language classes, i.e., the TELL and the traditional paper-based teaching methodology, to identify the most efficient one. Their efficiency will be measured based on language knowledge (i.e., L2 learners' speaking and listening skills in English and their knowledge of Present Simple and Present Continuous, word order, and polysemous words) and by examining two factors integral to learning (i.e., attention and motivation in class). The second aim of the study is to investigate IDs, different kinds of linguistic knowledge, and factors integral to learning by considering the impact of the teaching methodology. The two teaching methodologies, i.e., TELL and the traditional paper-based method, were selected for two reasons: Firstly, to mirror the growing trend in educational

practices, which incorporate digital tools for language learning. Secondly, to delineate the prevailing teaching approach in Greece, which is the traditional paper-based method. The goal is to provide educators with suggestions regarding their teaching choices. Research has shown that teachers and educators frequently encounter challenges in transferring research-based insights into practical implementations within the classroom (Chi et al., 2021; Popoola et al., 2012; Warby et al., 1999). Therefore, the final aim of this study is to inform classroom practice and suggest pedagogically viable and effective teaching recommendations shaped by learners' IDs and teaching methodologies.

1.4 Research Questions and Hypothesis

The present study pursues answers to the following research questions at the intersection of emerging language learning technologies and individual factors:

1. Does Technology Enhanced Language Learning (TELL) significantly improve language development, in-class attention, and motivation in the English lesson?
2. Do cognitive capacities and personality moderate the acquisition of word order and polysemy in TELL versus the traditional teaching methodology?
3. a) How do personality and academic motivation correlate with in-class attention in TELL versus the traditional teaching methodology?
b) How does personality correlate with motivation in TELL versus the traditional teaching methodology?

Existing research (e.g., Adair-Hauck et al., 2000; Berns et al., 2016; Bester & Brand, 2013; Marsaulina, 2020; Smith et al., 2013; Tausch, 2012) on the impact of TELL allows us to formulate the following hypotheses about the research question 1:

Young Greek L2 learners of English who are exposed to a TELL teaching methodology improve their knowledge of polysemous words, speaking skills, attention and motivation in

class more than those exposed to the traditional, paper-based teaching methodology. Additionally, there is no significant difference in the improvement of tenses, word order, and listening skills between a TELL teaching methodology and the traditional paper-based one.

Research questions 2 and 3 are exploratory, and formulating research hypotheses presents a challenge. Robinson (2001) stated that individual differences “are important to explaining variation between learners in the effectiveness of second language (L2) instructional treatments” (p. 368). Previous studies have investigated IDs and specific kinds of instruction, e.g., implicit learning (Kaufman et al., 2010), explicit learning (Roehr-Brackin et al., 2021), web-based learning (Grimley & Riding, 2009), etc. However, there is insufficient empirical evidence to determine whether the teaching methodology modulates the relationship between IDs and language learning. This study aims to explore how IDs and language learning interact under two distinct methodologies, i.e., TELL and the traditional paper-based method. The goal is to provide insights into the longstanding contradictory claims related to the IDs-language relationship.

1.5 Overview of the Methodology

The present study is a classroom intervention study conducted at a public secondary school in Greece where students study English as a foreign language. It investigates IDs and two teaching methodologies (i.e., *Technology-Enhanced Language Learning* and the *traditional paper-based teaching methodology*). Specifically, the study was designed as a treatment procedure with a control group that functioned as the baseline and an interventional one that functioned as the treatment line. The control group was taught without any digital learning resources, and the intervention group was taught with the use of digital learning resources. The choice not to use digital tools for the control group was made to reflect the traditional approach to learning, which remains prevalent in Greece. The use of technology for the intervention group was adopted to investigate how technology impacts young Greek

learners' language acquisition, motivation, and attention in class. Questionnaires measuring the participants' cognitive and conative individual differences were employed. Furthermore, pre-, post- and delayed tests assessing their knowledge of word order, tenses, polysemous words, listening and speaking skills in English class were administered. Questionnaires on motivation in the English class were also conducted before and after the intervention. The participants' in-class attention was measured in every lesson.

1.6 Significance of the Study

The present study is significant in both theoretical and practical terms. From a theoretical perspective, it contributes to the advancement of the SLA field. According to Lucas (2022), SLA advances on the condition that a thorough understanding of the most effective teaching practices is explored (p. 50). In addition, it addresses the longstanding debate on the differential impact of IDs on language learning, specifically with respect to the teaching methodology in authentic classroom settings. Due to the intricate relationship of IDs with various SLA factors, such attempts are scarce in the literature (Chen et al., 2021b; Dewaele, 2012a, 2012b). Additionally, studies on the impact of Technology-Enhanced Language Learning on Greek adolescents' linguistic knowledge compared to the traditional paper-based approach are at an early stage. In relation to practice, the authentic classroom environment of the study, instead of a laboratory-based environment with controlled teaching and learning, could facilitate the application of research results to language classes. Meurers et al. (2019) suggested that “conducting more research in regular foreign language classrooms arguably could help increase the impact of SLA on real-life language teaching and learning in school, which so far seems to be rather limited” (p. 162). In that way, the present study will propose pedagogical language learning practices.

1.7 The Educational System in Greece

As mentioned above, Greek L2 learners' communication issues in English stem from the educational system, which is dominated by an exam-centered approach to language learning. For secondary school students, this translates into a focus on grammatical knowledge, exhaustive learning of vocabulary, and numerous reading comprehension activities. Consequently, teachers adopt a traditional teaching approach, predominately incorporating coursebooks, photocopies of learning materials, and other paper-based materials so that learners can excel in their written language examinations. This teaching approach excludes less theoretical knowledge (e.g., problem-solving, collaboration, critical skills, etc.) and an emphasis on students' speaking or listening skills. This approach is also apparent in English language courses and has resulted in learners holding a B2 or higher certificate in the English language but lacking oral production skills consistent with that level of proficiency.

As a compulsory school subject, English is taught at Primary and Secondary schools in Greece. At the time this study was conducted, primary schools, as part of Primary Education, cover six years. Certified teachers of English who hold a BA degree in the English Language issued by a public Greek University teach the English subject to 6–12-year-old students. The students attend two 45-minute English lessons per week in the first two years, while a 3rd teaching hour is added in years 3-6 of Primary School. Lower Secondary Education (called Gymnasium) lasts for three years, and it is the last compulsory educational stage in Greece. Young learners aged 12-15 attend two 45-minute English lessons per week. During the last two years of Primary School and throughout Lower Secondary education, students are also taught a second foreign language (French, German, or Italian) for two 45-minute lessons per week. Outside school contexts, private language schools (called *frontistiria*) offer additional courses in various foreign languages, and they aim to help learners secure a language certificate. Attending a private language school or having private tutoring lessons is a prevailing situation in Greece, and it is highly acclaimed compared to public education. Students spend 7-8 years

to secure a certificate that testifies the test taker's English language knowledge, usually at a B2 level of proficiency. This pursuit of language certificates for professional purposes has affected learning methodologies in terms of adopting exam-driven teaching techniques, and thus, according to Papaefthymiou-Lytra (2012), young learners have grown indifferent to the English courses taught at state schools (p. 25). These exam-oriented practices create a learning environment where enjoyment and curiosity are left aside, which, in turn, impacts language learning motivation (Papaefthymiou-Lytra, 2012, p. 26).

In the case of the participants of the present study, educational settings similar to the ones described above were evident. Except for the same teaching hours, the teachers' qualifications and the learners' attendance at private language schools, the teachers, regardless of their school subject, usually adopted a traditional paper-based approach to teaching. Particularly, they preferred the use of the coursebooks, which were mandated by the Greek government, alongside photocopied materials, which were suggested as additional resources by the Greek Ministry of Education, or they were the teachers' own teaching materials. This kind of adopted teaching methodology was grounded in the familiarity that it entailed following years of service and the need to prepare students for the monthly, semester, and end-of-year exams. Therefore, speaking practice, projects, or other learning activities that aimed to improve learners' soft skills (e.g., critical thinking, collaboration) were less frequently integrated into their lessons. Additionally, the infrastructure of the school premises, where this intervention was conducted, was inadequate for implementing technology-enhanced instruction. This learning condition was due to a lack of Wi-Fi connectivity and classroom equipment, and teachers' insufficient knowledge and training in effectively leveraging technology for learning purposes. It is noteworthy that prior to the pandemic, teachers were unaware of online teaching and how it could be achieved, and after the pandemic, they returned to classroom-based

teaching. In the year when the intervention was conducted, no online teaching was required for the study participants due to COVID-19 issues.

1.8 Structure of the Dissertation

Following the introductory chapter, the dissertation is structured in four sections: Section 1: Literature Review, Section 2: Methodology, Section 3: Data Analysis and Results, Section 4: Discussion, and Conclusion. Each section is divided into the chapters explained below:

Section 1 of the Literature Review includes two chapters:

CHAPTER 2: INDIVIDUAL DIFFERENCES AND LANGUAGE LEARNING PARAMETERS will address the concept of Individual Differences. Out of the extensive pool of cognitive and conative IDs, the ones related to the present study: attention, working memory, personality and academic motivation will be analysed, and their role in language acquisition will be explained based on previous research. Closely related to attention and academic motivation, two learning factors integral to this study, in-class attention and motivation in the lesson, will be examined due to their impact on language learning (Gardner, 2007; Gardner, 1983; Olney et al., 2015).

CHAPTER 3: TECHNOLOGY IN LEARNING will address the other important research area of the study, technology-based learning. The two primary forms of technology-based learning, Computer-Assisted Language Learning (CALL) and Technology-Enhanced Language Learning (TELL), will be analysed. To offer a comprehensive overview of the technology-based language learning field, the findings of recent meta-analyses on the field will be presented. The chapter will proceed with TELL intervention studies on language skills and structures as well as factors integral to learning by presenting their findings and methodological design. The purpose of this chapter is to a) contextualise the present research, b) provide methodological insights to TELL intervention studies, and c) situate the research within the

broader academic discourse. The chapter will conclude with the research gap that this study aimed to fill.

Section 2 on Methodology includes two chapters:

CHAPTER 4: DATA COLLECTION will describe several key aspects of the study (e.g., approvals, participants, research questions, and procedures) and present which research methods (e.g., tests and questionnaires) were employed to address each research question and how this was achieved. Additionally, the tests and questionnaires employed will be analysed with references to their original sources, their design, and any minor changes applied to them for the needs of the present study.

CHAPTER 5: THE CLASSROOM INTERVENTION AND TEACHING MATERIALS will present the main stage of the data collection of this study, which was the classroom intervention study. It will introduce the similarities and the difference between the two groups, which was the means of delivery of the teaching materials: digital vs paper-based. Subsequently, it will present the structure of all lessons covering the general teaching approach, the very first lesson, and feedback – aspects of high importance for a language learning process. Additionally, it will thoroughly describe how various aspects of language learning, e.g., reading, listening, speaking, tenses, word order, and polysemy, were taught by further explaining the reasons behind each teaching strategy. Then, it will explore how language learning games were used in the lessons for both groups. The chapter will proceed by presenting the teaching materials designed and used for the lessons. Initially, the digital teaching resources and how they were adapted for the control group will be presented alongside the reasons for selecting each teaching material. A description of the overlapping teaching materials which were used unchanged for both groups will be presented next. The choice to implement overlapping teaching materials was made to reflect class realities and create an authentic classroom environment, where a combination of digital and paper-based resources is usually

adopted. A detailed presentation of each teaching material and class equipment used for each group will accompany the description of the teaching materials. The chapter will conclude with the role of the researcher. This chapter is essential for presenting how the intervention and the lessons were designed and structured to accurately reflect a technology-enhanced language learning methodology and a traditional paper-based one.

Section 3 on Data Analysis and Results includes two chapters:

CHAPTER 6: DATA PREPARATION AND EXPLORATORY ANALYSIS will provide a description of the data preparation processes which were completed before the statistical analysis. It will start with comparing the pre-tests completed by the participants to establish the baseline conditions. It will proceed with explaining the calculation of the participants' attentional capacity and in-class attention, and the scoring of the linguistic tests. Furthermore, the preparations related to condensing questionnaire items, multicollinearity issues, the review of the distribution of the data, and variable transformation will be analysed in detail. Next, the variable correlations within each group will be examined, and the chapter will conclude with the descriptive statistics of the variables. This chapter is essential for analysing all the necessary cleaning and preparation processes that enabled the subsequent statistical analysis.

CHAPTER 7: LINEAR MODELS will present the statistical analysis of the data. It will start by introducing the reasons and process of using linear models to address each research question. Subsequently, it will present the results of research question 1, "*Does Technology Enhanced Language Learning (TELL) significantly improve language proficiency, in-class attention, and motivation towards the English lesson?*" which were obtained from the ANOVA-like linear models. The results will be presented in three sections: 1. Kinds of linguistic knowledge, 2. Language skills, and 3. Factors integral to learning.

The linear regression models, which were used to examine the study's exploratory questions, will be introduced next, followed by an analysis of how the linear regression models were built. The results of research question 2, “*Do cognitive capacities and personality moderate the acquisition of word order and polysemy in TELL versus the traditional teaching methodology?*” will be presented first. The results will reveal the effect of attention, working memory, and personality on the acquisition of word order structures and polysemous words. Whether the teaching methodology modulates this effect will also be explored. The aim of research question 2 is to identify which teaching methodology is to be adopted when a type of learner, as described by their individual differences, learns word order and polysemous words in English.

The chapter will conclude with the results of research question 3, “*How do personality and academic motivation correlate with in-class attention in TELL versus the traditional teaching methodology?*” and “*How does personality correlate with motivation in TELL versus the traditional teaching methodology?*”. Research question 3 investigates whether personality and academic motivation influence L2 learners' in-class attention and whether personality impacts motivation in the English lesson. Similarly to research question 2, it explores the contribution of the teaching methodology to this relationship. The purpose of research question 3 is to determine which teaching methodology is to be adopted when a type of learner, as described by their conative individual differences, aims at staying attentive or motivated in the lesson.

Section 4 on Discussion includes two chapters:

CHAPTER 8: DISCUSSION OF RESEARCH FINDINGS will provide a comprehensive discussion of the research findings. It will commence with presenting the aims of the study, the research gaps it addressed, and a summary of the methodology. Subsequently, it will focus on interpreting and evaluating the results of research question 1 on the

effectiveness of the two teaching methodologies – i.e., TELL and the traditional, paper-based methodology – on L2 learners' improvement in language proficiency, in-class attention, and motivation towards the English lesson. The results of research question 1 will be compared to previous studies to contribute to the field of SLA by examining the effectiveness of the two teaching methodologies for young Greek L2 learners of English. The chapter will proceed with presenting the findings of research questions 2 and 3. Specifically, the impact of L2 learners' individual differences on word order structures, polysemous words, in-class attention, and motivation in the lesson will be analysed. The discussions in this chapter will also present how the teaching methodology modulates the relationship of IDs with these language learning dimensions. Possible interpretations of the results obtained from the exploratory questions and comparisons with previous studies will be offered. The aim of the chapter is to provide valuable insights into the relationship of individual differences with language learning in different teaching methodologies.

CHAPTER 9: RESEARCH IMPACT will focus on the research impact of the study. This chapter aims to transfer the research results to language classes and provide practical teaching recommendations. This is achieved by merging the findings of the intervention, the learning materials designed for the lessons and previous studies. The chapter will open by providing general teaching recommendations related to the structure and content of a lesson and proceed with analysing effective teaching strategies for instructing word order and polysemous words in English, as advised by the learners' individual differences.

The final chapter, **CHAPTER 10: CONCLUSION**, is the conclusion to the dissertation. It will start with summarising the rationale, methodology, and aims of the study. Subsequently, it will briefly discuss the findings and the pedagogical implications, highlighting the contribution to the field of SLA and the significance of the study. Furthermore, the limitations and possible criticisms of the study covering aspects including the participants, the

teaching components, the marginally statistically significant results, the speaking test, and the questionnaires will be considered. Recommendations for future studies related to the targeted language, teaching methodologies, individual differences, and language learning dimensions will be introduced to propose and explore similar research suggestions.

Section 1 Literature Review: Overview

Section 1 reviews previous findings relating to the research areas upon which this intervention study was built, namely individual differences, attention and motivation in class, and language learning through technology. Chapter 2 presents the theoretical background of individual differences, focusing on cognition and conation as factors which influence language learning and inform language teaching. In terms of cognition, working memory and attention are presented in sections 2.2.1 **Working Memory** and 2.2.2 **Attention**. Regarding conation, personality and academic motivation are examined in sections 2.3.1 **Personality** and 2.3.2 **Academic Motivation** respectively. Within this extensive discussion, special attention is paid to in-class attention and motivation for language learning since these are two parameters integral to this study that affect language learning. Learners' attention in class will be analysed in section 2.2.2.1, while motivation in language learning will be analysed in section 2.3.2.1. Chapter 3 opens with a presentation on the two primary forms of technology-based learning, namely Computer-Assisted Language Learning and Technology-Enhanced Language Learning (TELL). What follows are recent meta-analyses in the field of technology-based learning to draw stronger conclusions pertaining to the field. The chapter concludes with an analysis of intervention studies in TELL by presenting studies which targeted the same research foci as the present intervention.

2. CHAPTER 2: INDIVIDUAL DIFFERENCES AND LANGUAGE LEARNING PARAMETERS

2.1 The Role of Individual Differences in Language Acquisition

Although research in Individual Differences (IDs) dates back to the 19th century highlighting peoples' differences, theories and experimental methods have long downplayed their importance (Lee & Webb, 2005; Rouder & Haaf, 2019). Researchers have explained this downplaying by arguing that IDs prevent generalisations that apply to all individuals and restrict conclusions that universally cover all situations (Kidd et al., 2018; Dörnyei, 2010). A thorough investigation of IDs, however, can explain variations in diverse phenomena, which are otherwise difficult to account for. For instance, IDs can elucidate why L2 acquisition differs in each person, thus offering a better understanding of language learning processes. Studies have reported that IDs affect learning in various ways (Degani & Goldberg, 2019), predict L2 learning success (Dörnyei, 2010, p. 2), and determine how learning and teaching should be undertaken (Oxford & Ehrman, 1992). From a language acquisition perspective, individual differences encompass various facets, such as motivation for language learning, types of intelligence, cognitive capacities, conative types, noticing skills and attention control during language exposure, aptitude while studying a language, implicit and explicit learning abilities, learning styles, external parameters (e.g., type and length of exposure to L2, prior knowledge) (De Raad, 2000a; Dörnyei, 2010). This is not an exhaustive categorisation of all IDs.

The relationship between IDs and language acquisition is distinctively interpreted within different linguistic theories. For instance, the Nativist approach ascribes a minimal role to individual differences in the language acquisition process; instead, it asserts that innate mechanisms facilitate the process. Specifically, Nativists argued that universal grammar rules are represented in a language area of the human brain that is independent of cognitive skills. Chomsky, a leading proponent of this approach, further claimed the existence of a Universal Grammar (UG) in infants' brains when acquiring their first language (Cook, 1985; VanPatten & Benati, 2015; Williams & Gulberg, 2013). Krashen and Terrel (1983) associated UG and SLA by proposing the Natural Order hypothesis. According to this hypothesis, an innate language acquisition faculty facilitates L2 acquisition through input, and there is a specific order of acquiring grammatical morphemes and structures regardless of the native language (L1). Contrary to nativist theories, usage-based theories of language learning highlight that learning is determined by IDs in cognitive capacities without any reliance on a pre-determined mental faculty (VanPatten & Benati, 2015). In hindsight, different approaches to language make different claims about IDs in the contexts of both first and second language acquisition.

Studies on IDs in second language learning have also investigated the impact of procedural and declarative memory in L2 learning (e.g., Ruiz et al., 2019). Ullman (2015) proposed the Declarative/Procedural model (DP) positing the significance of these memory systems for language learning. The DP model suggests that while both types of memory facilitate learning and function together, declarative memory is necessary for explicit knowledge while procedural memory underlies implicit knowledge. Explicit knowledge refers to the conscious acquisition of information and rules while implicit knowledge is unconscious and can be extracted from experience (Ellis, 2008). Ullman (2015; 2020) specified that declarative memory is critical for consolidating new knowledge, and in cases of L2 acquisition, it could support the acquisition of grammatical rules explicitly or implicitly. On the contrary,

procedural memory facilitates learning and processing of new cognitive skills (Ullman, 2015, pp. 137-138). Focusing on L2 knowledge, DeKeyser (2015) proposed the Skill Acquisition Theory highlighting the importance of declarative and procedural knowledge for language learning. The former refers to the knowledge about something – e.g., past tenses of irregular verbs – and the latter corresponds to the knowledge of how to do something, e.g., forming the irregular tense without consciously thinking of the rule. The aim in language learning is turning declarative knowledge into procedural knowledge through trials of using the former to produce the target language (DeKeyser, 2015, p. 95). Following this process, a significant amount of practice is required to establish the automatization of knowledge, which occurs when knowledge is completely procedural.

The various kinds of knowledge and memory systems in L2 and the diversity in claims pertaining to the influence of IDs underscores the significance of the field and necessitates its examination through literature review and empirical research. The literature review focuses on cognitive and conative individual differences, which are relevant to the present thesis.

2.2 Cognitive Individual Differences

Cognition, as a mental activity, relates to people's intellect, but scientists have not provided an all-inclusive definition due to its association with various intricate mental concepts. Cognition constitutes an intricate system encompassing various structures and functions, which are associated with different brain areas and undergo constant changes influenced by both genetics and the environment (Fisher et al., 2019). Cognitive capacities involve a spectrum of functions. The most basic, which can be seen as fundamental cognitive functions, include visual perception and processing, social and emotional processing, language, attention, memory, and executive functions. Apart from these fundamental processes, higher-order cognitive functions include problem-solving, decision-making, remembering, problem-

solving, thinking, reasoning, and learning (Anstey, 2016; Godfrey-Smith, 1996; Singer & Klimecki, 2014).

Language functions in combination with cognitive capacities, including perception, processing of information, and memory (Bourguignon, 2022; Rönnberg, 2003). A significant body of research (e.g., Cirino et al., 2019; De Smet et al., 2013; Khanna & Boland, 2010; Tapia & Duñabeitia, 2021) has identified an association between language and cognitive capacities. This association has rendered cognitive capacities a type of individual differences that affect language acquisition. In what follows, two specific types of cognitive capacities, working memory and attention, are reviewed, and their interaction with language learning is described. Firstly, a detailed presentation of each concept is completed to form the basis for their relationship with language acquisition. Their relationship with language acquisition is analysed next.

2.2.1 Working Memory

Working Memory (WM) is a system of limited capacity responsible for maintaining and cognitively processing information while functioning as an interface between perception, attention, long-term memory, and action (Baddeley, 2003a; 2007). Working memory is an extensively reviewed construct in SLA, and its relationship with bilingualism (Lukasik et al., 2018), language skills (Michel et al., 2019; Swanson & Kong, 2018), and developmental language disorders (Gray et al., 2019) has been widely examined.

Debates of domain-general and domain-specific, multiple, and single resource WM models have been central to the SLA field. For instance, Baddeley (2007) perceived WM as a multiple-resource model comprising four independent systems of limited capacity, each being responsible for different kinds of information processing. According to Just and Carpenter's (1992) domain-specific single-resource WM model, processing and storage simultaneously rely on the same resources during activation, while language comprehension depends on an

individual's WM capacity. Arguing against Baddeley's model, Cowan (2005) associates WM capacity with keeping a specific number of items accessible at any time and correlates WM capacity with controlling attention in distraction tasks. This single or multiple resource pool is still an issue under scrutiny, and some scholars have argued in favour of the dissociation between memory storage and processing (e.g., Logie & Duff, 2007) while others advocate a shared cognitive resource pool (e.g., Barrouillet & Camos, 2007).

In the domain of language research, working memory has been investigated through WM tasks (Vasylets & Marín, 2021), but also through neuroimaging techniques such as fMRI and EEG (e.g., Bae & Luck, 2018; Simmonds et al., 2017). WM tasks vary in complexity based on the stimuli utilised, and they span from simple to more complex tasks, which aim to identify the impact of working memory on language-related tasks. The categorisation of tests into simpler and more complex forms is aimed at mirroring the demands placed on working memory during language processing. Simple tasks are usually word or digit recall exercises, while complex types of WM assessment involve high requirements for memorisation and information processing to increase memory load. Memorisation requires storing verbal or visuospatial stimuli, and information processing tasks include activities such as object categorisation, evaluating sentence veracity, and backward digit recall. Archibald (2018) argued that individuals with an extensive vocabulary perform better in word recall tasks, attributing this phenomenon to the retrieval of words from long-term memory by forming bindings and associations. To mitigate long-term memory retrieval, pseudowords have been employed. However, Munson et al. (2005) argued that despite their contribution to assessment processes, phonotactic probability may facilitate pseudoword recall.

Working memory has also been investigated at a neural level (Smith & Jonides, 1999) and in association with attention. Kane and Engle (2002) reported that the WM requires attention control, and executive attention is a component of the WM system (p. 639). In other

words, working memory capacity reflects individuals' ability to control attention (Wiley & Jarosz, 2012; Redick & Engle, 2006). The relation of WM with attention was also corroborated by Gevins and Smith (2000). They reported that individuals with high general cognitive ability when compared to their low-ability counterparts, demonstrate enhanced brain activity in areas associated with WM and attention control. The relationship between WM and attention was also sought by Mackey et al. (2002), who revealed that learners with high working memory capacity noticed more question forms in English during interactional feedback in comparison to learners with low WM capacity. Adam et al. (2015) delved more into the relationship between WM and attention by measuring EEG activity, and they revealed that attentional lapses alone cannot elucidate individual differences in WM capacity, but rather, graded fluctuations in attentional control explain WM differences better.

Examining WM from a language perspective, the three components of WM, the central executive, the visuospatial sketch pad, and the phonological loop, function together in language comprehension and learning (Baddeley, 1992). Studies have reported a positive relationship between working memory capacity and language acquisition (Swanson et al., 2011) and its effect on language processing in both native and second language learning (Baddeley, 2003b). Additionally, Just and Carpenter (1992) argued that individual differences in WM capacity explain differences in language comprehension, i.e., syntactic modularity, ambiguity, and adaptability. Working Memory also positively predicts accuracy in L2 speech production (Fortkamp & Bergsleithner, 2007), reading comprehension (Alptekin & Erçetin, 2010), syntactic processing (Sagarra & Herschensohn, 2010), writing performance (Bergsleithner, 2010), and sentence processing for native speakers of English (Felser & Roberts, 2007). The most recent meta-analysis on working memory and language acquisition of typically developing adults was conducted by Linck et al. (2014). The authors reviewed studies on WM measured with simple and complex span tasks, including verbal and nonverbal stimuli, and

included data from 79 samples collected until 2012. The findings reported a positive relationship of WM with L2 processing and proficiency outcomes with an estimated population effect size (ρ) of .255. Studies after 2012 also corroborated the positive effect of WM on language acquisition. Chrysochoou et al. (2013) found that WM impacts vocabulary development in early years. Specifically, they reported that WM capacity contributes to L1 vocabulary knowledge of Greek children at 5.5 years, and this contribution declines with age (by 9.5 years). Juffs and Harrington (2011) also reported that the extent of the WM effect is contingent upon the age of L2 learners, the nature of the task, and the linguistic domain. More recent studies have reported that WM capacity positively influences L2 writing and fluency (Zabihi, 2018), improves L2 reading and vocabulary (Swanson et al., 2015), and is associated with phonological processing in L2 (Darcy et al., 2015).

The positive relationship between WM and language is also explained in cases of language disorders. Children diagnosed with language disorder experience impairments in sub-components of working memory. Archibald and Gathercole (2006) documented that children with Specific Language Impairment (SLI) are slower at processing visuospatial and verbal information and recalling verbal materials compared to typically developing children of the same age. In cases of complex memory tasks combining verbal storage with verbal or visuospatial processing, SLI children had lower accuracy rates compared to their typically developing peers. Research has also documented the negative impact of different developmental disorders on WM skills (Alloway et al., 2009). Particularly, children with SLI experience deficits in verbal WM (Montgomery, 2003) and children with general learning difficulties and language problems show impairments in WM capacity (Pickering & Gathercole, 2004). To alleviate the adverse consequences of WM impairments, research has centered on devising methods of remedial support (e.g., Gathercole & Alloway, 2006) and WM training interventions to expand WM capacities in cases of language impairments (e.g.,

Shahmahmood Toktam et al., 2018). Nonetheless, working memory training has accumulated opposing views. Some studies have supported the notion of WM training (e.g., Zhao et al., 2011), whereas others have entirely dismissed the concept (e.g., Watrin et al., 2022) and its effectiveness (e.g., Redick et al., 2013), rendering research on WM a domain characterised by ongoing debates and discussions.

In contrast to the abundance of studies advocating the positive relationship between WM and language, a comparatively smaller number of studies reporting no relation have been published. This can be explained since studies reporting no relation are less frequently published. Initially, Daneman and Tardiff (1987) questioned the influence of WM on explaining individual differences in reading skills, while MacDonald and Christiansen (2002) argued against Just and Carpenter's (1992) and Waters and Caplan's (1996) extensively cited studies. They supported that differences in language comprehension do not stem from working memory capacities but rather from biological factors and language experience. Juffs (2005) expanded the results of the previous studies by including adult L2 learners of English with different L1s. By investigating the processing of wh-movement in English for Japanese, Chinese and Spanish learners and native speakers of English, he found that working memory does not influence reading time either in the first or second language. Building from Juff's (2005) study, Felser and Roberts (2007) investigated the processing of wh-dependencies in English as an L2 by advanced Greek speakers. They documented that, contrary to the native speakers, WM does not affect the processing of complex relative clauses by the Greek L2 learners of English. Taguchi (2008) examined Japanese speakers' comprehension of conversational implicatures in English as an L2. The findings of his study further reported the absence of WM impact on L2 learners' ability to comprehend implied speakers' intentions in English. Mizera's (2006) study targeted native English speakers of Spanish, and he reported no correlations between WM capacity and L2 oral fluency, while Gilabert and Muñoz's (2010)

study targeted Spanish learners of English. Their results revealed that there is no relationship between overall L2 proficiency in English and working memory.

Due to these contrasting findings relating to the impact of working memory on language learning, the interaction of language with working memory remains a domain of active research efforts. The discrepancies in findings highlight the pressing need for further investigation into how working memory interacts, if at all, with language learning.

2.2.2 Attention

Attention is defined as the deliberate or automatic focus on specific information while disregarding other stimuli to achieve a goal imposed by external or internal factors (Nobre & Kastner, 2014; Wu, 2014, as cited in Divjak, 2019). Attention is a highly selective and limited resource (Oberauer, 2019) that requires focalisation, concentration, and consciousness (William James, 1890). Broadbent's (1958) seminal work on attention introduced attention as a selective filter influenced by physical characteristics during sensory processing. Posner and Boies (1971) expanded on this by suggesting that attention arises in response to stimuli and requires alertness, selectivity, and processing capacity. Later, Treisman's Feature Integration Theory (1998), influenced by Broadbent, distinguished between automatic detection of basic features and serial processing for integrated multidimensional features (Treisman, 1998; Treisman & Gelade, 1980).

These developments in the field of attention led to investigating attention through different spectrums. Scholars predominantly focused on scrutinising attention deployment through mechanisms of top-down attention direction based on goals (e.g., Henderson, 2003; Oliva et al., 2003; Rizzo et al., 2002) and bottom-up attention to information contingent on stimulus salience (e.g., Itti et al., 1998). Additionally, research extended to investigating various types of attention, including selective, sustained, divided, and joint attention (Carpenter

et al., 1998; Miller, 2013; Tomasello, 2014), the neural basis of attention (Clayton et al., 2015; Sarter et al., 2001), the association of attention with other cognitive processes (Lavie et al., 2004; Posner et al., 2004), attention training (Murray et al., 2016), attentional deficits and disorders (Faraone & Radonjić, 2023). Examining all aspects of attention research is beyond the scope of the current study. The focus of this literature review is its relationship with language.

Attention and language share a complementary and interdependent relationship. The relationship between attention and language is intricate, and developmental and neurological evidence attests to this relationship (Divjak, 2019, p. 162). Segalowitz and Frenkiel-Fishman (2005) explained that five types of attention are needed in attention-demanding situations, like language use. Specifically, these are a) sustaining attention in gradually changing situations which require vigilance, b) concentrating attention during rapid and demanding activities, and c) sharing attention when cognitive tasks are simultaneously executed. Additionally, speakers inhibit attention in response to inappropriate action schemata, which are automatically activated, and shift their attention when engaged in complex activities of frequently changing demands (Segalowitz & Frenkiel-Fishman, 2005, p. 645).

Slobin (1996) argued that attention control differs in L1 and L2. He proposed that speakers pay attention to linguistic structures more efficiently and effortlessly in their L1 and, therefore, manage to automatically form a mental representation of what they hear. On the contrary, L2 speakers require more conscious attention, thus increasing cognitive load. This differentiating process was explained through the concept of L1-tuned learned attention (Ellis, 2006). Particularly, Ellis (2006) explained that speakers' neural mechanisms are adjusted to L1 and, thus, complicate the detection of cues in L2 and any subsequent intake (i.e., learner's acquired knowledge derived from L2 input). This L1 interference results either in positive correlations or error production. Roberts and Liszka (2013) confirmed this L1 interference by

investigating tense-aspect combinations in English processed by French and German native speakers while reading. Specifically, they documented that French L2 advanced learners of English were sensitive to tense/aspect violations because their L1 had a grammaticalised aspect. On the contrary, German L2 advanced learners could not identify the mismatches between a fronted temporal adverbial and the following inflected verb (e.g., **Last year, Mary has gone shopping every day*). This finding suggests that their L1 characteristics influence access to grammatical knowledge and real-time processing of reading tasks.

Extensive research has explored the relationship between L2 learning and attention. Studies have examined attention through tasks measuring attentional and inhibitory control, selective and sustained attention, noticing skills or, more recently, eye-tracking methods. Attentional control is the "ability to regulate information processing during goal-directed behavior" (von Bastian et al., 2020, p. 3), while inhibitory control refers to the ability to suppress irrelevant information (Nielson et al., 2002, p. 56). Krauzlis et al. (2018) defined selective attention as the ability to restrict neural processing and behavioural responses when exposed to stimuli while disregarding valid stimuli from consideration (p. 161). Lastly, sustained attention refers to response persistence and continuous effort for an extended period (Ko et al., 2017, p. 1).

Segalowitz and Frenkiel-Fishman (2005) identified that learners' attentional control accounts for 59% of the variance of L2 learners' proficiency, and it significantly contributes to L2 proficiency. Additionally, attention control facilitates L2 phonological processing of phonemic stimuli (Darcy et al., 2014), L2 phonological acquisition (Mora & Mora-Plaza, 2019), and L2 phonological processing of vowels without high accuracy rates, though (Mora & Darcy, 2023). The results of Bettoni's (2023) systematic review of the relationship between attention and L2 phonology established that attention plays a significant role in L2 phonological acquisition. The review included studies with adult learners of English which

were conducted from 2010 to 2021. The findings indicated that attention is more critical for L2 speech processing at the beginning of the acquisition process than at higher proficiency levels. The author argued that further research with controlled variables, other L1/L2 combinations and various assessment tools is needed.

Studies have also reported the positive effect of attention on L2 grammar learning (Chen et al., 2022; Issa & Morgan-Short, 2019). For instance, Lee (2021) found that controlling attention to linguistic features facilitates L2 acquisition of French grammatical gender attribution. However, Lee's (2021) findings contradicted Bell's (2009) previous results. Bell (2009) had reported no impact of attention control on L2 learners' noticing of gender distinctions in French. The contradicting results can be explained by the methodological designs of the two studies. Lee (2021) focused on the relationship between attention and grammar from an instructional approach by investigating proactive form-focused instruction. Bell's (2009) study targeted attention and grammar by investigating the role of aptitude in L2 learners' awareness of gender distinctions in French. She also did not incorporate any instructional component in her study. Therefore, the different methodological designs could explain the contradictory findings.

Martínez-Vicente et al. (2023) examined the executive attention profile of EFL Spanish learners by measuring the participants' sustained and selective attention using two visual perception tasks. They measured learners' academic achievement in English as an L2, and the results revealed that those who show greater sustained and selective attention perform better in EFL achievement. Attention, in the form of inhibitory control, is also reported to facilitate L2 vocabulary learning (Lu et al., 2017). Similar results were documented in Ghaffarvand Mokari and Werner's (2019) study, which investigated inhibitory and attention control of EFL learners and their role in L2 phonological learning. The findings highlighted that inhibitory control facilitates L2 learning gains while attention control does not contribute to L2 learning. On the

contrary, Linck and Weiss (2015) found that inhibitory control is not related to L2 proficiency. The contradictory findings can be explained by the L1 interference and the way of measuring L2 learning: some studies have examined general L2 proficiency (e.g., Linck & Weiss, 2015) and others (e.g., Lee 2021; Lu et al., 2017) have focused on a specific kind of linguistic knowledge. These findings suggest that the current stage of research on attention and L2 learning is characterised by significant inconsistencies, some of which can be attributed to the differing methodologies.

Less inconsistent, albeit non-definite, findings have been reported when measuring learners' noticing skills. Noticing is a mechanism which requires attentional mechanisms and memory and helps learners detect linguistic patterns in their language input (i.e., the learner's exposure to L2) before these are processed and converted to intake. In other words, noticing is critical for language acquisition (Ellis, 1995; Robinson, 1995; Schmidt, 2012; 1990).

Learners' noticing skills have been examined by employing input or textual enhancement techniques (e.g., bold formatting, underlying). These techniques draw L2 learners' attention to words or morphemes, which in turn facilitates L2 vocabulary acquisition (Namaziandost et al., 2020) and L2 form recognition (LaBrozzi, 2016). Gass et al. (2003) examined attention control by underlying parts in a sentence that contain lexicon, syntax, and morphosyntax structures. By conducting pre- and post- tests to measure linguistic improvement, they found that English L2 learners of Italian focused their attention on all these components, with syntactic knowledge showing the most significant improvement. These results were compared to those of a baseline group that was exposed to the same sentences without any focused attention treatment. In both groups, morphosyntax and lexicon were improved, but the effect sizes of the focused-attention group were larger compared to the unfocused-attention group. However, these results do not tally with the results of another study investigating the effects of textual enhancement (Kim, 2006). Kim (2006) found that textual

enhancement does not increase vocabulary acquisition among Korean L2 learners of English. The contrasting results can be explained by the targeted L2 (Italian vs English) or participants' L1, which variously impacts L2 vocabulary acquisition. Dolgunsöz (2015) employed eye-tracking methods to assess learners' noticing skills in vocabulary acquisition. The results reported that L2 learners of English spent more time noticing unknown words, which resulted in learning gains. Similar results were documented by Godfroid et al. (2013) while examining English learners' eye fixations on known words and pseudowords. The results of their study revealed that learners spent more time processing the unknown pseudowords. This led them to recognise the pseudowords in an unannounced vocabulary posttest.

Attention has been further investigated in relation to different kinds of feedback. Mackey's (2006) study revealed that language learners reported increased noticing of questions and plural forms when interactional feedback was offered in response to their problematic use of questions and plural forms. The interactional feedback also resulted in greater L2 development. Coyle and DeLarios (2014) investigated noticing in two forms of feedback, i.e., error correction and model texts, provided to L2 learners of English aged 11 to 12. The results revealed that learners mainly notice lexical features and grammar structures in the error correction condition. This resulted in improved writing skills. However, Granena and Yilmaz (2019) investigated explicit or implicit feedback provided to L2 learners of Spanish, and compared to the previous studies, different results were reported. They found that drawing learners' attention to linguistic items through explicit or implicit feedback did not predict grammar acquisition.

Overall, studies on the relationship between attention and L2 learning expanded on different domains and yielded contradictory findings stemming from the ongoing change in the examined methods and constructs. While research evidence indicates that attention facilitates L2 phonology, grammar, syntax, vocabulary, and noticing different kinds of feedback, several

studies have advocated no relationship between attention and L2 performance. The lack of scholars' consensus on their relationship suggests that research on attention is still in progress, and there is a need to clarify these discrepancies.

2.2.2.1 In-class Attention in Learning. Related to the concept of attention presented in 2.2.2 **Attention** above, learners' attention in class is a pivotal parameter in successful language learning (Piontkowski & Calfee, 1979; Rubin, 1975) and involves both teachers and learners (Piontkowski & Calfee, 1979). However, learners' attention during the lesson is a construct that has proven challenging to investigate and measure accurately. In-class attention can be influenced by various parameters related to lesson content and structure, the nature of the activity, learners' individual differences and psychological state, as well as the teacher's methodology and teaching style, etc. (Sharmin, 2023). Any measurements of in-class attention should thus be considered with caution and only as an indicative construct in language learning.

Learners' attention is vital for optimising learning, and teachers' endeavours are centered on maximising the time students pay attention (Olney et al., 2015). Unsurprisingly, students recognise the influence that the teacher, environment, classmates, and themselves have on their attention (Cicekci & Sadik, 2019). Conversely, teachers tend to perceive attention lapses as an issue mainly arising from the students themselves and perceive learners' behaviour and low academic performance as discipline problems (2019). Consequently, teachers propose stricter discipline rules, while students prefer a positive environment and diverse teaching methods. These findings highlight a discrepancy between teachers' and students' perspectives on in-class attention (2019).

Studies exploring the relationship between attention and learning have focused on examining the correlation between attention lapses and time intervals (e.g., Hlas et al., 2019; Johnstone & Percival, 1976; Risko et al., 2012). Initially, Johnstone and Percival (1976)

observed that students' attention declines in the first five minutes of a class for 2-4 minutes, and then, between 10-18 minutes into the class, another lapse occurs. At the end of the lecture, attention lapses occur every 3-4 minutes (as cited in Bradbury, 2016; Bunce et al., 2010). Two years later, Stuart and Rutherford (1978) reported that students' attention rises sharply and reaches a peak after 10-15 minutes and gradually declines after that. Citations of these old findings prevailed for an extended period until Wilson and Korn (2007) and Bunce et al. (2010) conducted a re-evaluation of attention and time. Wilson and Korn (2007) reviewed previous studies measuring attention through a variety of tools (e.g., notetaking, self-reports, physiological measures) and found little support for the 10-15' duration of students' attention in lectures. Bunce et al.'s (2010) later study revealed that students do not consistently maintain attention for 10-20 minutes, and attention lapses occur in ever-shortening cycles throughout a lecture. They have found that attention lapses manifest within the first 30 seconds of a lesson and reoccur approximately 4.5 minutes later. Students reported more frequent lapses of 1 minute or shorter in comparison to medium (2-3 minutes) or longer (5 minutes or more) ones. From a teaching perspective, occurrences of attentional decline were notably scarce in non-lecture segments of a lesson, such as practical activities. Unsurprisingly, students sustained attention during segments of lessons immediately following practical activities (Bunce et al., 2010). De Avila and De França Campos (2019) measured attention through heart rate variability, and the results showed that attention is activated in the first 15-20 minutes of a lesson, in contrast to Johnstone and Percival's (1976) study findings. These time-specific patterns could potentially offer considerable benefits when educators teach challenging linguistic phenomena.

Research efforts have also focused on methods of tracking and measuring attention in learning environments, including EEG, notetaking, external observations, or the use of clickers (Bradbury, 2016; Rebolledo-Mendez et al., 2010; Wilson & Korn, 2007). However, factors like

stamina and lesson content, the constant need to press clickers, and the observer's subjectivity may influence the accuracy of those methods (Bradbury, 2016; Wilson & Korn, 2007). Consequently, the validity of the collected results is questionable, given that attention is a nuanced concept influenced by various parameters mentioned above. Self-reported statements on learners' sustained attention to the lesson have been used as a means to measure attention (Iluzada et al., 2021). Statements or questions on students' attention are answered through a binary choice, e.g., yes or no (Bunce et al., 2010) or using a Likert scale either to grade the level of attention from mind wandering to high attentiveness (Allison, 2020), or to categorise attention as low, moderate, or high (Shah & Saleem, 2015). Furthermore, learners' attention has been tracked at different lesson intervals after prompts (Allison, 2020; Farley et al., 2013) or following a self-monitoring process where students choose when to report their attention (Bunce et al., 2010).

To address the difficulty in measuring attention in class, Bester and Brand (2013) examined attention lapses using questions related to the content of the lesson. They conducted a classroom intervention study that targeted geography, English, and mathematics and involved two different groups, namely a technology-enhanced one and a technology-deprived one. Specifically, they asked 12–13-year-old learners of English to answer questions related to the subject matter and details which were subtly incorporated into the lesson materials of both groups. The questions could only be answered if students had paid attention to the lesson. The results indicated that the average attention and achievement of learners exposed to technology were significantly higher than those following a technology-deprived teaching approach. Zhang et al. (2017) later introduced an alternative approach to measuring attention. They suggested the use of wearable devices (smart glasses or a cap and a smart pen) where cameras, accelerometers, and gyroscopes are integrated. The authors reported that these devices had excellent performance and high accuracy in detecting and measuring attention. Recent studies

have started reporting the efficiency of these devices in tracking learners' attention (Renawi et al., 2022; Trabelsi et al., 2023).

In a nutshell, due to the difficulty of accurate measurement, in-class attention has been examined through a wide variety of tools and processes in learning environments. It should be noted that there is little research on in-class attention in foreign language classes (Allison, 2020; Hlas et al., 2019).

2.3 Conative Individual Differences

Conation, as defined by English and English (1958), represents a mental process which relates to a conscious tendency to act (p. 104). Conation covers the constructs of motivation and volition, which are influential in the study of human learning (Huitt & Cain, 2005). Motivation pertains to individual differences in goals, needs, wishes, and wants, while volition relates to individual differences in intentions, along with the regulation of effort and actions tied to these intentions (Snow & Jackson, 1997, p. 3). From an educational perspective, Snow and Jackson (1997) perceived the conative construct of motivation as learners' predisposition towards goal achievement. They also considered personality as a conative construct. Based on the California Psychological Inventory, a well-known and extensively researched self-report personality questionnaire, they described a high-scoring person as capable, efficient, organised, responsible, and sincere (Snow & Jackson, 1997, p. 14), establishing a correlation between high scores on achievement and motivation through the concept of personality. These assertions attest to the interconnectedness of motivation and personality, which affect learners' predisposition towards their schoolwork and, consequently, their commitment to the learning process. Findings relating to personality and academic motivation will be presented in the subsequent sections. Following the structure of previous sections, the theoretical framework of each concept will precede a presentation of their association with language learning.

2.3.1 Personality

Dörnyei (2005) highlighted that IDs are the most consistent predictors of L2 learning success, with no other SLA phenomenon being so closely correlated with language attainment in instructed settings (p. 2). A type of IDs, i.e., personality traits, have been associated with differences in language acquisition but lack a fixed consensus in their definition due to their associations with diverse aspects of human nature. Personality has been associated with personal traits (Cervone & Pervin, 2015), human actions and nature (Hogan & Sherman, 2020), the study of human behaviour (Phares & Chaplin, 1997), personal experiences (Dörnyei, 2005), or a network of individual attributes (De Raad, 2000b).

Two taxonomies of personality traits dominate research on personality. Firstly, Eysenck and Eysenck (1985) analysed personality as a three-component construct, including 1) extraversion vs introversion, 2) neuroticism and emotionality vs emotional stability, and 3) psychoticism and toughmindedness vs tender-mindedness (as cited in Dörnyei, 2005, p. 13). Secondly, the Big-Five model is the other taxonomy of personality traits, which has gained more widespread acceptance compared to Eysenck and Eysenck's (1985) categorisation of personality, despite their minor differences. According to the Big-Five model, personality traits are categorised into 1) surgency or extraversion, 2) agreeableness or pleasantness, 3) conscientiousness or dependability, 4) emotional stability vs. neuroticism, and 5) intellect or openness to experience (Goldberg, 1992; Schmitt et al., 2007).

The widespread use of the Big Five model for research purposes led Chen et al. (2021b) to conduct a metanalysis covering a 38-year-period (1982-2020) to evaluate the relationship between Big Five personality traits and L2 achievement in different domains (e.g., language skills: speaking, listening, reading, writing) for students at different schooling levels (e.g., elementary, middle, high school, college or equivalent). The results revealed that openness and conscientiousness were stronger correlates, extraversion and agreeableness were moderate

correlates, and neuroticism was effectively unrelated to L2 performance (Chen et al., 2021b, p. 868). However, compared to other SLA constructs (e.g., aptitude, motivation), fewer studies on the effect of personality on SLA have been published (Dewaele, 2012b, p. 42). Dewaele (2012b) argued that the smaller number of published studies can be explained by the difficulty "to isolate the effect of personality among the cognitive, social, and situational variables that contribute to SLA and L2 production" (p. 43).

Delving into the relationship between personality types and language learning utilising the Big-Five model, conscientiousness has been found to relate to academic success (Kaufman et al., 2008), the L2 learning experience (Ghapanchi et al., 2011), achievement, and academic motivation (Komarraju et al., 2009). Additionally, openness to experience has been associated with higher L2 proficiency (Ghapanchi et al., 2011), and both agreeableness and openness correlate with achievement (Komarraju et al., 2009). L2 proficiency and achievement are related topics in language learning. However, the former refers to a learner's overall L2 competence - in all four language skills (speaking, reading, writing, listening) – alongside lexical, grammatical, and pragmatic knowledge (Xiao, 2015, p. 558). L2 achievement is a more practical construct and reflects learners' course grades and their intended learning efforts (Moskovsky et al., 2016).

Research attention has predominantly centered on the correlation of extraversion with successful language acquisition due to the association of extraversion with communication and interaction, which are factors crucial to language use. Dewaele and Furnham (1992) supported that extraversion is a psychological variable that positively influences L2 speech production. Suliman's (2014) study revealed that extrovert L2 learners of English exhibit greater success in language acquisition compared to their introverted peers. Specifically, Suliman (2014) conducted classroom observations and assessed speaking, listening, and reading comprehension while considering factors such as group work, speech rates, pronunciation,

fluency, word choice, confidence in responses, and total talking time. The results revealed that extroverts were more successful in effortless English communication and employed diverse word types with clear pronunciation and high-speed rates. In contrast, the classroom observations showed that introverts avoided interaction. The author claimed that introverts exhibited this lack of interaction due to fear of failure, embarrassment caused by mistakes, or difficulty producing speech. However, when they engaged in speaking, introverts produced well-formed sentences with good pronunciation but lower speech rates due to the time devoted to careful sentence structuring. A comparison of extrovert and introvert L2 learners was conducted by Golaghaei and Sadighi (2011) using the Eysenck extroversion/introversion questionnaire. Her study explicitly focused on L2 vocabulary and personality by examining extrovert and introvert learners pertaining to their active and passive vocabulary knowledge. The participants of the study completed the personality questionnaire and tests measuring their knowledge of content words (e.g., verbs, nouns, adjectives, adverbs) using pictures and complete sentences, their sight vocabulary (i.e., the ability to understand the meaning of words without any contextual cues), and their productive vocabulary size (i.e., eliciting the correct word in short sentences; Golaghaei & Sadighi, 2011, pp. 77-78). The words included in the test to assess sight and productive vocabulary were taken from high-frequency vocabulary lists. The results revealed that extrovert learners had greater both active and passive vocabulary compared to introvert learners.

Suliman (2014) emphasised that the personality type of 65% of adult learners significantly influenced their L2 acquisition, while for 35% of them, personality has no discernible effect on their acquisition. Ghapanchi et al. (2011) compared the impact of personality and motivation on L2 proficiency. Their findings concluded that motivation plays a more prominent role in explaining L2 proficiency compared to personality. Both personality and motivation can influence L2 learning, underscoring the need to take these factors into

account in classroom instruction. Owing to the necessity for a teaching approach that acknowledges learners' IDs in personality and motivation, these two constructs form the focal points of the present research.

2.3.2 Academic Motivation

Academic Motivation refers to learners' perceptions and enjoyment of learning in an educational setting, and it has been shown to correlate with effective learning (Vecchione et al., 2014; Gottfried, 1990). Academic motivation is based on the Self-determination theory (Niemiec & Ryan, 2009). It comprises intrinsic and extrinsic motivation, as well as amotivation. Intrinsic motivation (IM) is innate and creates satisfaction derived from an activity (Deci & Ryan, 1985; Deci, 1975, as cited in Vallerand et al., 1992a). Intrinsic Motivation is classified into *IM-to know* (satisfaction while learning), *IM-toward accomplishments* (satisfaction derived from attempts to accomplish or create something), and *IM-to experience stimulation* (engagement in an exciting activity; Vallerand et al., 1992a). Extrinsic motivation (EM) refers to behaviours which are undertaken as a means to an end (Deci, 1975, as cited in Vallerand et al., 1992a). Extrinsic motivation is classified into *external regulation* (behaviour regulated through rewards and constraints), *introjected regulation* (internalisation of external motives), and *identification or identified regulation* (previously internalised external motives perceived as important and valued by an individual) (Vallerand et al., 1992a). Amotivation is experienced when individuals do not identify any contingencies between their actions and outcomes (Vallerand et al., 1992a). This classification of academic motivation is highly relevant in education and classroom instruction, considering that learners can perceive learning as exciting, are motivated to accomplish goals and score high, or have no interest in class activities. However, the impact of cultural or social backgrounds on perceptions about motivation challenges the validity of scales that measure academic motivation among learners from diverse cultural backgrounds (Guay, 2016; Salili et al., 2001). Consequently, researchers

examined the cross-cultural reliability and validity of Vallerand et al.'s (1992a) well-established Academic Motivation Scale (AMS). Scholars have administered the AMS to students of varying nationalities in English or the participants' native language and completed exploratory and confirmatory factor analyses of its scales alongside examining its reliability via Cronbach's alpha value. The findings of the studies validated the use of the AMS by secondary students of different nationalities to assess their motivational scores (Algharaibeh, 2021; Ardeńska et al., 2019; Barkoulis et al., 2008; Caleon et al., 2015; Osei Akoto, 2014; Zhang et al., 2016).

From a learning viewpoint, academic motivation has been investigated to establish connections with learners' affinity to the educational environment. Research on academic motivation has predominately focused on its association with personality traits (Clark & Schroth, 2010), self-efficacy (Honicke & Broadbent, 2016; Schunk, 1991) and its positive influence on academic achievement (Gupta & Mili, 2017; Taylor et al., 2014).

In terms of personality, in examining the interplay between each personality type and academic motivation, Komarraju and Karau (2005) targeted college students, and they investigated their personality traits through the Big Five model and their academic motivation. After reviewing its reliability, they used the Academic Motivations Inventory (AMI, Moen & Doyle, 1977). They conducted a principal components factor analysis to reduce the initial 16 scales in AMI to three main scales (engagement, achievement, and avoidance). The findings revealed that engagement was related to extraversion and openness to experience. The latter was the stronger predictor. Three personality traits of conscientiousness, openness, and neuroticism were positively related to achievement, with conscientiousness explaining the most variance. Lastly, a positive relationship between avoidance and two personality traits (neuroticism and extraversion) was reported. Neuroticism was the strongest predictor of avoidance whereas conscientiousness and openness were negatively related to avoidance. The

results attest to a positive relationship between personality and academic motivation. The Academic Motivation Scale and the Big Five questionnaire were later used in another study by Komarraju et al. (2009). Again, they targeted college students and observed that students classed as open according to the Big Five model demonstrated high intrinsic motivation, whereas extroverts displayed extrinsic motivation. Additionally, conscientious individuals exhibited high extrinsic and intrinsic motivation and the lowest amotivation. Lastly, neurotic individuals had high amotivation scores, whereas agreeable individuals had low amotivation scores (Komarraju et al., 2009, pp. 49–50).

Clark and Scroth (2010) focused on the relationship between the different types of academic motivation and personality traits. Despite minor differences in the reported relationships between different types of intrinsic/extrinsic motivation and personality traits, their study findings revealed that conscientious, extroverted, and agreeable learners are academically motivated. Specifically, they reported that extroverted and agreeable learners are extrinsically motivated. Additionally, conscientious learners are extrinsically motivated by identified and introjected regulation. However, learners who show signs of neuroticism are extrinsically motivated with introjected regulation. Regarding intrinsic motivation, conscientious, extroverted, and agreeable learners are intrinsically motivated towards knowledge and accomplishments. Furthermore, learners who are open to new experiences are intrinsically motivated towards knowledge and to experience stimulation. Lastly, disagreeable and careless students exhibit signs of amotivation (Clark & Scroth, 2010). It is also interesting to note that the study found that learners (college students) exhibit higher rates of extrinsic compared to intrinsic motivation, which testifies to learners' predominant interest in external rewards.

Regarding the other constructs that academic motivation has been associated with, i.e., achievement and self-efficacy, the latter is a mechanism that affects actions, thought patterns

and emotional arousal (Bandura, 1982, p. 122) and reflects individuals' judgements of their capacities to execute an action (Schunk, 1991). Academic motivation is moderately correlated with academic self-efficacy (Honicke & Broadbent, 2016). Schunk (1991) reported that accomplishments, experiences, teacher feedback, persuasion, and physiological indexes influence learners' self-efficacy and, therefore, their academic motivation. Zimmerman (2000) further reported that beliefs of a person's efficacies are gradually and subtly affected by performance and predict students' motivation and learning. These findings suggest a strong association among self-efficacy, academic motivation, and achievement.

Reviewing academic motivation from a language learning perspective, Zhang (2022) argued that academically motivated learners demonstrate considerable effort to acquire a language. Numerous studies have corroborated the positive impact of academic motivation on language learning achievements (e.g., Cao, 2022; Vecchione et al., 2014). For instance, Omar et al. (2021) investigated undergraduates' English language learning and found that high levels of academic motivation facilitated active participation in online classes. These findings suggest a positive relationship between academic motivation and both language learning accomplishments and participation. However, Martin (2002) claimed that research and theory on motivation have been structured without guiding educators and learners regarding the ways of developing motivation and academic resilience in classroom settings. This observation denotes a gap between theoretical research and the practical application of research findings. Liu (2022) addressed this gap by translating research results on motivation into strategies conducive to English language learning. Aiming at improving learners' motivation and grit (an individual's perseverance in pursuit of long-term, albeit challenging, goals), Liu (2022) recommended the provision of pleasant learning environments, the implementation of interesting and creative learning materials that improve learners' positive attitudes and motivation and heighten their cognitive resources (p. 4). Additionally, she suggested providing

regulatory strategies to learners that facilitate their behaviour towards disturbances, postponement, and motivational challenges. From a teacher training perspective, workshops that highlight the significance of grit in language learning were recommended for teachers (Liu, 2022). However, these recommendations do not offer specific teaching recommendations, pedagogical strategies, or examples related to learning materials.

2.3.2.1 Motivation in Language Learning. Closely linked to academic motivation, motivation in language learning is a sociopsychological factor associated with successful language acquisition (Gardner, 2007; Gardner, 1983; Masgoret & Gardner, 2003). Motivation has been defined in various ways, but they are all centered on learners' willingness to achieve a task. For instance, Zhou (2012) defined motivation as "a student's willingness or desire to be engaged in or commit effort to complete a task, [and it] is an important component of classroom learning that students may self-regulate" (p. 1318).

Motivation in language learning is a complex phenomenon encompassing a) learners' attitudes toward an L2 learning experience and L2 culture, b) beliefs regarding the necessity and reasons for learning an L2, c) positive perceptions of the teacher, the lesson, the teaching materials, and the teaching methodology, and d) their communication with peer groups (Crookes & Schmidt, 1991; Dörnyei, 1994; Tamba, 2021; Williams & Burden, 1997; Zareian & Jodaei, 2015). Motivation in language learning is reflected through learners' willingness to learn a foreign or second language due to the prospects of a better job in the future (i.e., motivation associated with aspirations), fear of failure in progressing to the next level (i.e., motivation associated with negative outcomes), and the necessity for communication with foreigners across diverse situations (i.e., motivation associated with international posture; Pawlak, 2012). Dörnyei (1990) examined learners' motivation in foreign language learning environments and reported that there are different types of motivation, including the instrumental motivational subsystem, an integrative motivational subsystem, the need for

achievement, and attributions about past failures (p. 45). Moreover, Gardner and Smythe (1975) distinguished two types of motivation in second language acquisition, namely language learning motivation and classroom motivation. Other kinds of motivation have also been distinguished, including integrative, instrumental, intrinsic and extrinsic (Thohir, 2017). Alizadeh (2016) reviewed the different types of motivation and found that they play a vital role in successfully learning English as an L2.

Dörnyei's (2009) motivational self-system which examines self-concepts – Ideal L2 Self, Ought-to L2 Self, L2 learning experience – and Gardner's (1985) Attitude/Motivation Test Battery (AMTB), which considers behavioural elements guiding learners' motivation, have been widely used in L2 research. Dörnyei's (2009) motivational self-system addresses learners' personal aspirations, external influences, and the importance of the environment. AMTB offers a more holistic examination of EFL learners' motivation that considers a variety of motivational scales, including integrative and instrumental orientation, interest in foreign languages, parental encouragement, motivational intensity, anxiety, attitudes, and evaluation of the teacher and course. Instrumental and integrative orientation toward learning an L2 are two distinct measuring scales. The former refers to learners' motivation driven by practical benefits, including career advancement, passing an exam, and studying or travelling in the country where the L2 is spoken. The latter, *integrative orientation*, refers to the learners' interest and desire to learn and interact with the L2 culture and its people.

From a theoretical perspective, studies on motivation in SLA have evolved following different approaches (VanPatten & Benati, 2015). Initially, research on motivation followed a static sociopsychological approach, emphasising a learner's perception and level of interaction with the target language and culture. Subsequently, it transitioned to a more cognitive-oriented approach related to the mental self of the learner and eventually culminated in contemporary psychology-based constructs linked to self-regulation, self-esteem, and personality (VanPatten

& Benati, 2015, p. 45). In other words, the initial approach to motivation in language learning considered social and psychological factors related to motivation without attributing any dynamic, changing progress to them. Motivation was established through a cultural perspective, and specifically, it was influenced by learners' perceptions and attitudes towards the culture and their interactions with it. The following phase overlooked the prior attribution of cultural factors to learners' motivation and focused more on cognitive factors, i.e., a learner's thoughts related to learning and their influence on motivation. After this series of developments, motivation in SLA was reviewed from a psychological approach, suggesting that learners' personality traits, perceptions of themselves, and control of behaviour and attitudes affect their motivation towards learning. Wu (2022) conducted a bibliometric analysis of research on motivation in SLA from 2000 to 2021. The results reported that recent research on motivation has implemented more qualitative approaches to data collection, has focused on the development of existing theories/models (e.g., self-determination theory), and has targeted factors related to language anxiety, emotion, mindset, experience, and educational environments which incorporate the rapid advancements in technology.

Given the multifaceted nature of motivation in education, during the extended process of language acquisition, motivation changes since it "is associated with dynamically changing and evolving mental processes, characterised by constant (re)appraisal and balancing of the various internal and external influences that the individual is exposed to" (Dörnyei & Skehan, 2003, p. 617). Pawlak's (2012) classroom-based study examined motivational variation and used a variety of research tools. Specifically, motivational variation was evaluated through a motivation questionnaire intended to gather data on the learners' motivation to learn English, interviews with the learners, and a motivational grid where the learners had to mark their interest and engagement at 5-min intervals during a lesson using a Likert scale. Pawlak (2012) also used an evaluation survey including different adjectives (e.g., interesting vs boring,

pleasant vs unpleasant) based on which students reported their interest to the lesson, a questionnaire administered to the teacher to evaluate learners' behaviour in class, and detailed lesson plans. The findings reported that the secondary school students' reasons for learning English remained relatively stable. However, the intensity of their motivation to learn fluctuated throughout the lessons, which were completed over a period of four weeks. This fluctuation is explained by the type of activities, the specific time of their implementation, or the group dynamics which affect learners' engagement, effort, and interest.

Motivation in language learning has been examined from a point of view that considers learners' personality traits. The relationship between personality and motivation towards foreign language learning is a topic of research which has yielded contradictory findings. For instance, Zhang et al. (2013) examined Chinese EFL learners' personality traits as measured by the Eysenck Personality Questionnaire. Their motivation was measured using the English Learning Motivation Scale, which targets motivation intensity, intrinsic motivation, language requirement, instrumental motivation, integrative motivation, and interest in foreign languages and cultures. The findings reported that a more tough-minded person is generally less motivated in the aspects mentioned above. On the contrary, an extroverted student is motivated intrinsically and integratively, is interested in interaction with people from other cultures, and has stronger motivation intensity (Zhang et al., 2013, p. 63). The Big-Five model was used in Jung Ku et al.'s (2021) study, which investigated motivation towards learning Mandarin. The authors relied on Dörnyei's (1990) study to modify a questionnaire to measure adults' motivation towards learning Mandarin as a foreign language. The results reported that conscientiousness, extraversion and agreeableness positively influence motivation, whereas neuroticism is a negative predictor of motivation. Additionally, no correlation between openness and motivation was found. The same questionnaires were later used in Ku et al.'s (2022) study, which also targeted adult learners' learning of Mandarin as a foreign language

and personality traits. Their study documented that conscientiousness, extraversion, and agreeableness positively influence motivation towards foreign language learning. Contrary to Jung Ku et al.'s (2021) study, openness was also reported as a positive predictor of motivation. No relationship between neuroticism and motivation was found. The results of these studies suggest that motivation towards foreign language learning, as measured by learners' perceptions and attitudes, is variously and, in some cases, contradictorily associated with personality traits.

Judge and Ilies (2002) conducted a meta-analysis on the relationship between personality traits and motivation performance, as described by learners' goal setting, expectancy, and self-efficacy. The inclusion criteria were studies conducted from 1887 until 2000, measured personality using the five-factor model and primary data, computed a correlation between personality and motivation performance, and included direct measures of performance motivation (e.g., goal setting, expectancy, and self-efficacy motivation). The results obtained from 65 studies revealed that neuroticism and conscientiousness were the most consistent and strongest correlates of performance motivation. The former was negatively related to motivation performance, and the latter was positively associated with motivation performance. The remaining Big Five personality traits – Extraversion, Openness to Experience, and Agreeableness – exhibited weaker correlations with motivation performance. The contradictory findings of the above studies and the meta-analysis render motivation towards language learning a field of active research efforts.

Except for the relationship between personality and motivation towards foreign language learning, research on motivation in L2 learning has also targeted a wide range of additional topics including factors affecting language learning motivation, e.g., social economic status and teachers' praises (Aryadoust et al., 2024), Dörnyei's (2009) L2 motivational Self System and its three components, *the ideal L2 self*, *the ought-to L2 self*, and

the L2 learning experience (Al-Hoorie, 2018), the positive impact of emotions on L2 learning motivation (MacIntyre & Vincze, 2017), and the relationship of motivation with resilience (Kim & Kim, 2017), and language teaching (Lamb, 2017). Examining this extensive body of literature on motivation and language learning is beyond the scope of this thesis. Instead, the focus will be drawn on motivation within technology-enhanced language learning environments as it pertains to the current intervention study. The next chapter will analyse motivation, in-class attention, and language learning in digital settings.

3. CHAPTER 3: TECHNOLOGY IN LEARNING

3.1 Introduction

This chapter examines the other aspect integral to this study, i.e., language learning through technology. Following the definition of Educational Technology, which encompasses all aspects of technology-based learning, the two primary methods of technology-based learning, i.e., Computer-Assisted Language Learning and Technology-Enhanced Language Learning (TELL), are reviewed in section 3.2 **Forms of Technology-based Learning**. This section also presents how TELL has influenced language learning. To offer a comprehensive overview of the field, meta-analyses on TELL studies are presented in section 3.3. **Overview of the Field** detailing their findings and inclusion criteria. Furthermore, the importance of intervention studies is examined in section 3.4 **TELL Intervention Studies**. Following this, technology-based intervention studies focusing on language skills and structures, factors integral to learning, and the combination of all those are presented in sections 3.4.1 **Language Structures** – 3.4.5 **Combination of** The literature review concludes by presenting the research gap this intervention study aimed to fill.

In the following pages, when the term ‘traditional paper-based methodology’ is used, it represents a lack of digital tools for the control group to describe the realities of language classes in Greece. The term ‘intervention/treatment group’ indicates the use of technology, which is rarely adopted in the majority of Greek public schools, and in the cases that it is adopted, it is very limited (i.e., a short video or movie).

3.2 Forms of Technology-based Learning

The integration of technology in learning has given rise to the field of Educational Technology, which has been variously defined, among others, as *audio-visual instruction*, *educational communications*, *learning resources*, or *educational media*. The Association for

Educational Communications and Technology (EACT, 1977) reported that *Educational Technology* is a multifaceted integrated process encompassing people, ideas, devices, procedures, and organisation to address issues related to all facets of human learning (p. 19). While other terms, including *Instructional Technology* and *Technology in Education*, have also emerged, they are all viewed as subsets of *Educational Technology* (EACT, 1977). Throughout the developments in the field of Applied Linguistics, technology integration in language learning classrooms has evolved into different forms. Two primary methods, namely *Computer-Assisted Language Learning* (CALL) and *Technology-Enhanced Language Learning* (TELL), have become prominent in the field. These two primary methods are reviewed in turn.

Computer-Assisted Language Learning (CALL), as a subfield within the broader field of Applied Linguistics, continues to evolve, and it was defined by Beatty (2003) as "any process in which a learner uses a computer and, as a result, improves his or her language" (p. 7). Despite its simplicity, this definition broadly encompasses all varieties of computer-based learning, reflecting the ongoing advancements of CALL implementations. Various related terms, such as *Intelligent Computer-Assisted Language Learning* (ICALL), *Computer-Mediated Instruction* (CMI), *Computer-Based Training* (CBT), *Computer-Adaptive Testing* (CAT), *Computer-Assisted Teaching* (CAT), and *Computer-Assisted Learning* (CAL), have emerged, with some scholars (e.g., Beatty, 2003) perceiving them as subsets under the umbrella-term of CALL. The proliferation of such terms is due to the constant advancement of technologies, and their validity requires continuing evaluation and adaptation in light of new technological developments.

Grgurović et al. (2013) conducted a meta-analysis of CALL studies covering 1970 to 2006 with the aim of summarising research on the effectiveness of computer-based language learning. They investigated language outcomes of second and foreign language learning

through computer technology by comparing them with language learning approaches that are not supported by computer technology. The findings favoured the computer-supported pedagogy with small but positive and significant effect sizes. Students in higher education settings were more frequently investigated compared to younger ages, indicating an initial emphasis on adult L2 learners. It is worth mentioning that the results revealed that the proficiency level played a role in the effectiveness of CALL. Grgurović et al. (2013) reported that advanced and intermediate learners performed better when exposed to CALL compared to beginner learners. Lastly, they documented that non-random allocation of participants to conditions was the most common type of participant assignment. Although non-random participant assignment is common, using random assignment of participants in CALL studies was reported to lead to larger effect sizes (Grgurović et al., 2013, p. 191).

Due to recent advancements in technology, there has been a gradual move from CALL to Technology-Enhanced Language Learning (TELL), which utilises any digital learning tool. While CALL primary focused on integrating computers into language learning, TELL involves a broader range of state-of-the-art technologies (e.g., mobile phones, apps and websites, artificial intelligence, augmented reality, etc.). These advanced technological tools reflect the continuous advancement of Information Technologies, rendering TELL a teaching approach that influences learning in both traditional and online language classes by shifting the emphasis from teacher-centered to autonomous learning. It has been reported that autonomous learning creates great benefits for the learner (Dickinson, 1994; Reeve & Cheon, 2021; San Jose et al., 2020).

TELL has an impact on the methods of technological integration in classrooms, shaping the content of a lesson. Notably, it has influenced syllabus and instructional design, assessment, feedback, communication, and the development of higher-order skills (Albinson et al., 2020; Chander & Arora, 2020; Kessler, 2018; Nguyen, 2008; Kern, 2006). With regard to syllabus

and instructional design, multimedia materials, online resources, and platforms have been employed in technology-supported lessons to fulfil learning objectives. Regarding assessment methodologies, rather than relying solely on paper-based formats, learners' evaluations now comprise a range of online techniques, including quizzes, presentations, and projects. Unsurprisingly, this array of online modalities includes the provision of feedback in a digital format, consequently expediting the feedback process completed by the teacher within the classroom. This efficiency allows teachers to allocate additional teaching time to other learning objectives. TELL has also enhanced learners' opportunities for communication with their peers and other language speakers. For instance, online multiplayer games, virtual platforms, discussion forums, and social networking sites are used for language learning to facilitate different ways of communication, which are usually constrained in traditional classrooms. Finally, TELL has fostered the development of higher-order cognitive abilities through the use of digital tools for in-class research and projects or online games that require analytical and problem-solving skills.

3.3. Overview of the Field

The aforementioned technology-based resources for learning purposes led to a wide variety of studies investigating their efficiency. To offer a comprehensive overview of the field of TELL, recent meta-analyses on the field will be examined by presenting their various inclusion criteria and findings. TELL intervention studies examining the efficiency of technology-based learning resources are described next.

The most recent meta-analysis written in English on technology-based learning and its effect on language learning was conducted by Fajaruddin et al. (2024), who reviewed studies published between 2012 and 2021. The inclusion criteria were studies that a) were conducted with participants from primary school to college level, b) evaluated the relationship between

technology use and language learning and documented the outcomes, c) described how technology was used, d) reported Pearson's r correlation and the sample size, and d) were written in English. The findings reported a mean effect size of 0.562, which testified to the significant impact of technology on language learning compared to traditional, technology-free learning. The authors additionally reported that the majority of studies (approximately 40%) were conducted at primary or university levels, 18% were conducted with senior high school students, and only 5% were conducted at junior high schools. The most frequent language skills under measurement were vocabulary (26%) and writing (23%) followed by reading (12%) and listening (7%), for which two technology was proven ineffective. The meta-analysis findings revealed that technology contributes to vocabulary and writing more compared to traditional methodologies.

Prior to Fajaruddin et al. (2024), Shadiev and Yang (2020) conducted a meta-analysis on technology-enhanced language learning and teaching reviewing studies written in English and completed from 2014 to 2019. Their meta-analysis was not as thorough as Fajaruddin et al.'s one since they only focused on the number of articles published by journals each year, the targeted languages and skills, and the type of technology used. They also provided some possible explanations for use and effectiveness of digital resources. The findings reported that the CALL and English Language and Technology journals published the most articles, revealing that researchers mainly focused on investigating writing, vocabulary, and speaking in TELL contexts. Furthermore, the authors specified that the most frequent types of technology used were games, online videos, and collaborative writing tools (e.g., Google Docs). Two years later, Shadiev and Wang (2022) completed a meta-analysis on studies that simultaneously investigated learners' improvement of language skills and 21st century skills, e.g., critical thinking, creativity, communication, digital literacy, or collaboration skills. The need to investigate 21st century skills originated from their importance to learning, which was

overlooked in CALL settings. Moreover, the authors aimed to examine the effect that the use of technology has both on language learning and 21st century skills. Their study reviewed previous research published in English from 2011 to 2022 (February) on technology-supported language learning. Following the screening process, which aimed at identifying studies on technology-supported language learning and 21st century skills, thirty-four articles were included in the review. The review focused on the reported findings, research questions, technologies employed, and methodology utilised, among other factors not central to the present study. By presenting previous studies, the findings revealed that technology-supported learning improves learners' language skills and the above mentioned 21st century skills and leads to an increase in motivation and self-confidence (Shadiev & Wang, 2022). No effect size was reported.

Shadiev and Wang (2022) also reported that the reviewed studies targeted a variety of language skills and kinds of linguistic knowledge. Specifically, speaking skills were extensively examined by 27.40% of studies, followed by writing (26.03%), vocabulary (17.81%), grammar (12.33%), listening (9.59%) and reading (6.85%). Regarding the targeted 21st century skills, oral competencies were primarily examined. Specifically, 20.83% of studies investigated communication and collaboration skills, and 13.89% examined skills in critical thinking and social and cross-cultural interaction. These were followed by studies on creativity and innovation (11.11%) and other 21st century skills (with a percentage of less than 10).

To provide a comprehensive description of the field, Shadiev and Wang's (2022) meta-analysis also examined the research design of the reviewed studies by reporting details related to a) the type of research and its duration, b) the participants, c) the data collection methods, and d) the types of technological resources. Specifically, most of the studies (41.18%) employed a quasi-experimental research design, which involves the non-random allocation of participants in control and experimental groups and compares pre- and post-test results between

groups. The remaining studies were categorised as case studies (35.29%) or action research (23.53%). Shadiev and Wang's (2022) meta-analysis also documented that the majority of the studies (29.41%) lasted for 3-6 months, followed by 20.59% of studies which lasted for 1-3 months, and 8.82% of studies with a duration of 6-12 months. Only 5.88% of studies lasted more than a year, while 35.29% did not report their duration. Although these categorisations describe the duration of technology-based studies, they do not offer comprehensive insights into the details and intricacies of the language learning process. In other words, this categorisation does not specify the total number of instructional hours which the participants attended, hindering a more precise and accurate description of the interventional methodology.

Regarding the participants, the majority of the technology-targeted studies (i.e., 32.35%) involved 11-30 participants, 23.53% of studies were conducted with 61-90 participants, and 20.59% included 31-60 participants. A very small number of studies included a higher number of participants or less than 10. Shadiev and Wang (2022) reported that undergraduates were the most commonly targeted learner group, with half of the studies being conducted with this age group. Junior high school students were the next most frequently targeted age group (14.71% of studies). A significantly smaller number of studies (i.e., 5.88%) included senior high school students, while primary school students were very rarely targeted (i.e., 2.94% of studies). A considerable number of studies (26.47%) did not report the targeted age group of participants. These findings suggest that more technology-based research on underage learners is required as the effects of technology on this age group's language learning are not widely examined.

Regarding data collection, half of the studies used questionnaires to probe learners' perceptions of technology-enhanced language learning in relation to their development of communicative competencies and language skills. The next two most frequent data collection methods were tests and interviews, which were used by 44.12% and 38.4% of studies,

respectively. Tests targeted both linguistic knowledge and 21st century skills, and interviews were conducted with learners to uncover their learning experiences, attitudes, motivations, and challenges encountered in the learning process (Shadiev & Wang, 2022, p. 15). In terms of technologies implemented, more than half of the studies utilised social media websites (e.g., Facebook, Skype, YouTube) and creative digital apps (e.g., Windows Movie Maker, iMovie). Conversely, less frequently implemented technologies included collaboration tools (e.g., Google Docs), learning management systems (e.g., Google Classroom, Edpuzzle), multimedia materials (e.g., films, multimedia textbooks), classroom interactive tools (e.g., Kahoot, cram), and presentation software (e.g., PowerPoint Presentations). Despite their widespread popularity and use, only one study (i.e., Chen et al., 2021a) involved Virtual Reality (VR) technology by implementing a VR production tool (i.e., *EduVenture*) and a VR wearable device (i.e., *Google Cardboard*) (Shadiev & Wang, 2022, pp. 6-7).

On the contrary to Shadiev and Wang's (2022) study, a recent meta-analysis covering a more extended period from 1990-2015 was conducted by Chang and Hung (2019) and examined studies on technology-enhanced language learning. The inclusion criteria were a) the study's statistical information for calculating effect size, b) the use of tests for measuring L2 learning achievement, c) all educational levels from primary school to post-secondary education, d) the study employing a (quasi) experimental design with technology being the only difference between the control and the experimental group, and e) English was the language the article's language. An average large effect size ($g = 0.993$) was reported for the technology interventions. Additionally, the results documented that 66.7% of studies included post-secondary school participants, while 17.9% and 15.5% of them were completed with participants in secondary and primary schools, respectively. Additionally, the effectiveness of technology on language learning was higher in post-secondary levels ($g = 1.143$) compared to secondary levels ($g = 0.598$). These findings suggest that research has predominately focused

on adult L2 learners, leaving the effects of TELL on younger ages understudied, similar to the findings of Fajaruddin et al.'s (2024) and Shadiev and Wang's (2022) meta-analyses.

Chang and Hung's (2019) meta-analysis examined the treatment duration and reported that more than half of the studies (i.e., 52.4%) lasted for 5-16 weeks and were classified as short in terms of their duration. Twenty studies (i.e., 23.8%) were considered brief as their duration was four weeks or less, whereas eight studies (i.e., 9.5%) lasted for 17-24 weeks and were classified as having an intermediate duration. Only 1 study had a long duration of more than 24 weeks. The same meta-analysis also reported that among the pool of 84 technology-based studies reviewed, 47.6% of them comprised sample sizes ranging from 51 to 100 participants. Additionally, 38.1% of the studies included 1 to 50 participants, and 14.3% of the studies enlisted more than 100. The mean effect sizes were all positive, irrespective of the sample size and number of participants (Chang & Hung, 2019, p. 9).

Chang and Hung (2019) also reported that the majority of studies (82.2%) addressed only one aspect of language acquisition (e.g., listening, speaking, grammar, etc.). In contrast, a limited number of studies (17.9%) simultaneously investigated various language learning dimensions. Chang and Hung (2019) found that the most frequently targeted linguistic knowledge was vocabulary (47.6% of all studies), whereas a smaller number of studies examined listening (4.8%), grammar (4.8%), and pronunciation (2.4%). Additionally, only one study addressed speaking as a learning objective in a digital context. Chang and Hung (2019) did not offer more information (e.g., authors, year, etc.) on this study or any other included in the analysis. By calculating the effect sizes for each language skill, the authors reported the beneficial effect of technology on language skills. Specifically, the findings revealed that the technology-based interventions were most effective in improving pronunciation ($g = 2.620$), followed by writing ($g = 1.152$) and vocabulary ($g = 1.024$). A moderate impact of technology

on grammar was reported ($g = 0.459$), while technology was found to be the least effective for speaking ($g = 0.253$, Chang & Hung, 2019, p. 10).

The proliferation of studies on vocabulary led to meta-analyses solely focusing on vocabulary improvement with the use of digital tools and reported the positive effect of technology use on vocabulary (e.g., Hao et al., 2021; Yu & Trainin, 2022). In recent years, TELL research has shifted its focus more towards speaking (Shadiev & Yang, 2020). Grammar has also started receiving more research interest. Specifically, until 2015, only 5% of studies – i.e., four studies – investigated grammatical structures in a technologically enhanced learning environment (Chang & Hung, 2019), but by 2019, this number increased to almost 10% (Shadiev & Yang, 2020).

Finally, the widespread use of mobile applications for educational purposes over the past decades motivated a meta-analysis conducted by Mihaylova and her colleagues (2022). Owing to insufficient evidence regarding the effectiveness of mobile language learning applications (Mihaylova et al., 2022), the authors aimed to investigate whether these applications positively influence L2 proficiency achievement. Their meta-analysis focused on comparative studies employing both a control group instructed through the traditional pen-and-paper method and a treatment group utilising either a mobile learning system or mobile language learning application for foreign language acquisition. Other inclusion criteria included a) the use of post-tests measuring L2 achievement, b) the presentation of enough statistical information to obtain the effect size, c) English as the language of the article, and d) the article being published in a peer-reviewed journal. Specifically, they conducted a systematic review of studies from 2007 to 2019, which examined various mobile learning systems and applications, e.g., mobile dictionaries and flashcards, as well as applications targeting various language skills such as grammar, writing, reading, listening, and vocabulary. Moreover, the review encompassed studies which implemented mobile applications tailored for exam

preparation (e.g., TOIEC and IELTS) alongside platforms like Duolingo. The findings revealed that mobile-assisted language learning applications facilitate L2 learning achievement compared to the traditional pen and paper learning approach. The findings revealed a moderate-to-strong overall effect ($g = 0.88$) for mobile language applications compared to traditional methods. Consistent positive effects of Mobile Assisted Language Learning (MALL) applications were observed across all levels of learners (primary, middle, and secondary school and university). Additionally, the authors reported that the beneficial impact of mobile applications remained consistent irrespective of the language learning focus (vocabulary acquisition, reading comprehension, writing proficiency, grammar skills, or a combination thereof), the duration of the intervention, and the types of applications employed. The findings also documented the sustained positive effects of MALL on L2 learning over a more extended period. However, due to the small number of studies that included delayed post-tests, a consensus on the long-term effectiveness of MALL is still to be confirmed. In addition to the research recommendation for including delayed post-tests, several potential risks were mentioned. These included the lack of proper randomisation procedures when assigning groups to experimental and control groups and the lack of transparency pertaining to how the outcome variables were assessed. These potential risks elucidate recommendations for future studies.

The results of the above meta-analyses suggest the positive impact of technology on language learning depending on the examined kind of linguistic knowledge. They also offer a presentation of the targeted population and kinds of linguistic knowledge, the employed data collection instruments and digital materials, and the duration of the studies. Following the overview of the TELL field based on the recent meta-analyses, the next section will focus on intervention studies in TELL, presenting their findings and methodology employed to examine language-related knowledge and factors.

3.4 TELL Intervention Studies

Intervention studies in education are a type of research that “experimentally manipulates an independent variable and measures an authentic educational outcome within an ecologically valid educational context” (Lazowski & Hulleman, 2016, p. 602). Meurers et al. (2019) assert that intervention studies typically focus on a specific aspect of language learning within a controlled environment with a limited number of participants. Such a structured setting enhances the ecological validity of the study findings and the transfer of results to real-world language learning environments.

Intervention studies compare the effectiveness of teaching approaches (e.g., Majidi et al., 2020) and are designed, among others, as feedback interventions (e.g., Sato, 2013), input manipulation interventions (e.g., Lee, 2007), or technology-based ones (e.g., Yelia & Efriza, 2021). Intervention studies in technology-enhanced learning have targeted several key areas in learning. For instance, they have documented the positive impact of a technology-enhanced learning methodology over a traditional paper-based one on learners’ improvement of reading skills (Tanyeli, 2009), learning skills (Nomass, 2013), self-esteem and the development of a student-centered learning environment (Page, 2002). On the contrary, studies have also favoured the traditional face-to-face method over the digital one in cases of feedback provision, specifically recasts, regarding learners' successful uptake and L2 gains (Kourтали, 2022). These contradictory study findings render TELL a field of active research efforts. Reviewing the wide variety of learning components examined in TELL interventions is beyond the scope of this thesis. Instead, the following section focuses on TELL intervention studies on language structures and skills (3.4.1 Language **Structures** 3.4.2), integral factors of language learning (3.4.2 Language Skills and the combination of these (3.4.5 Combination **of** These sub-sections aim to describe the methodological design and findings of studies that examined the same research topics as the present study.

3.4.1 Language Structures

The language structures which are analysed below include vocabulary, syntax, and tenses targeted in TELL intervention studies. In these studies, technology was implemented for the treatment/intervention group and its efficiency was measured through various methods, which are described in detail.

3.4.1.1 Vocabulary. Regarding vocabulary knowledge, Cobb and Horst's (2011) intervention study targeted sixth-grade Francophone learners of English as a second language and used a video game for vocabulary learning. They employed a treatment group that used the vocabulary training game on Nintendo consoles and a control group that received the traditional classroom vocabulary instruction. The game exposed learners to the most frequent word families in English taken from the Cambridge Advanced Learner's dictionary and provided their definitions and polysemous senses. The participants had to complete different vocabulary activities on different levels, and both groups were at the same level before the experiment. The results documented that the vocabulary training game led to gains in vocabulary recognition, longer oral productions, reduced code-switching, and increased speed of lexical access. Additionally, compared to the control group, the treatment participants showed better lexical access and word recall. Cobb and Horst (2011) conducted their study at a middle-class suburban school, which created experimental conditions that were far from laboratory-like. Conducting their study at a school offered access to an authentic learning environment, which enhanced the validity of their results.

Smith et al.'s (2013) subsequent study compared adult Chinese EFL learners' vocabulary learning through the use of e-books and inference-based computer games on vocabulary to a control group that was taught using the traditional method. Smith et al. (2013), citing Wittrock (1974), specified that the control condition in their study resembled the traditional approach to learning where language learners used books with texts containing

vocabulary items, a list of words alongside their translation in the learners' native language, English definitions, and their parts of speech. Additionally, the L2 learners' vocabulary practice in the control group was accomplished by answering multiple-choice comprehension questions. The treatment participants read texts online with unknown words appearing through hyperlinks with definitions and Chinese translations. Subsequently, they played computer games where they had to make inferences using the new vocabulary words. Both groups were at the same level of vocabulary knowledge before the experiment. The results revealed that although both groups improved their vocabulary knowledge, the treatment group achieved greater gains compared to the control group. Overall, Smith et al. (2013) explicitly compared the traditional paper-based method adopted in China with a technology-enhanced one, and the findings suggested that technology contributes to L2 vocabulary acquisition more than the traditional method.

Vocabulary acquisition through a vocabulary app was also examined by Berns et al. (2016) with L2 German learners of Spanish. The participants were asked to play with the app individually and complete game tasks on vocabulary, grammar, reading, and writing over a 2-week period. Subsequently, they participated in an online collaborative game task where they had to apply the previously acquired knowledge in real-life communication. The results showed that the learners improved their vocabulary knowledge after the intervention. The documented results were based on qualitative and quantitative measures reviewing the efficiency of the app. Berns et al. (2016) asked the participants to evaluate their linguistic improvement by completing questionnaires and engaging in focus group interviews after using the app, and they subsequently reported the beneficial outcomes. In the present study, there was no control group. However, the authors employed a vocabulary post-test and compared its results with the scores of a writing task completed in the semester prior to the experiment as a measure of their relative

learning gain. Based on the comparison between the writing scores and the vocabulary post-test, they documented learners' vocabulary improvement.

A recent intervention study on the effectiveness of "*Quizziz*", a web 2.0 application, was conducted by Kazu and Kuvvetli (2023). The authors selected the web-based version of the application to assess EFL learners' vocabulary learning. As a game-based language learning activity, *Quizziz* was used by treatment students aged 12 to 14 to learn vocabulary in a digital game-based format. The control group learned the same words through rote learning to resemble a traditional, technology-free learning approach. The rote learning involved memorisation of words in the participants' mother tongue. Tests assessing their vocabulary knowledge were administered before and after the intervention. The findings reported that the participants practising words through the *Quizziz* web application outperformed the control group in vocabulary retention. Furthermore, the learners exposed to the application reported that the digital game-based vocabulary learning contributed to their academic achievement in terms of longer vocabulary retention. It also excited and motivated them due to the integration of game-like features, which offered opportunities to compete with their peers and reduced their fear of failure. The above study findings related to vocabulary acquisition report the positive impact of technology use on L2 learners' vocabulary gains based on the inclusion of a control group and identical pre- and post- linguistic tests administered to both groups.

4.4.1.2 Syntax. To investigate syntactic skills, Tang et al. (2011) targeted adult Chinese learners of English and examined a Wiki-based collaborative writing environment for 15 weeks, with the course running twice a week for two hours each. The participants were asked to engage with the online writing environment, write paragraphs on a specific topic and link them with the rest of the paragraphs on the same topic by using the correct linking expressions and adapting them to the rest of the text. Then, they read and discussed each other's texts to write comments, review and correct them. Questionnaires on the learners' perceptions of the

online writing environment were administered. The questionnaire results reported that engaging with the Wiki-based software improved peer collaboration and attention to integral aspects of writing, e.g., grammar, spelling, sentence structure, and paragraph organisation.

Later, Tausch (2012) conducted a syntax-based intervention for English as second-language learners by comparing a paper-based learning method and a technology-based one in a primary school. Her study investigated school learners' potential improvements in syntactic knowledge after a six-week teaching period of 35-minute which was carried out three times per week. To investigate their syntactic knowledge, the authors examined the participants' reading skills. The treatment group was exposed to scaffolded animated PowerPoint presentations and visual cards. The PowerPoints included stories that participants were asked to read, and the teacher provided grammar explanations on the content. The visual cards included explanations of various grammar structures. The group engaged in reading practice after the digital-based treatment. The control group was exposed to a paper-based phonemic awareness intervention. Tausch (2012) adopted a phonemic awareness baseline condition for the control group considering that phonemic decoding is the primary skill required to learn how to read (Tausch, 2012, p. 78). The control group used paper-based learning materials including phonic faces (i.e., visual cards with letters and sounds printed on characters' faces), phonemic awareness stories, consonant production charts, and word trains, which are a visual tool depicting the sound structure of words. After the phonemic-focused activities, they read short stories. Both groups were assessed in terms of their oral syntax, written syntax, and sentence combining skills. The findings revealed that both groups improved their performance in word order, word reading in context, and comprehension. The treatment group exhibited higher scores in sentence combining skills. These results suggest the positive effect of the use of PowerPoint presentations over printed, paper-based materials on sentence combining while

knowledge of word order structures is improved regardless of the paper-based or digital materials.

Syntactic skills, specifically clause combining through parataxis or subordination, were later probed in an intervention study conducted with adult Jordanian L2 learners of English by Zibin and Altakhaine (2019). The study included a treatment group that adopted a technology-enhanced learning approach and a control group that followed the traditional face-to-face method. Both groups were homogenous in terms of their academic level. The treatment group was exposed to YouTube videos or read information on E-learning systems. They were then asked to complete online exercises, activities and discussions on clause combining in English. During class time, they were asked to engage in discussions reflecting on the online materials and activities which they had previously completed. Following the in-class discussion, they were given online assignments that they had to upload to the E-learning system, and they subsequently received online feedback from the teacher. The control group was exposed to the same materials, which were uploaded online for the treatment group. Mainly, the teacher explained the same materials in class, and they completed the same exercises, activities, and assignments on paper, adhering to a traditional approach. This process ensured exposure to identical materials between the two groups. The control group also engaged in discussions on the materials. Contrary to the online feedback of the treatment group, they received feedback on their paper assignments in class by hand. The findings reported that the treatment group instructed through online writing activities outperformed the control group taught via the traditional face-to-face method in clause combining.

4.4.1.3 Tenses. In terms of grammar, and specifically tenses, AbuSeileek and Rabab'ah (2007) investigated Arabic L2 adult learners' knowledge of specific English tenses (simple present, simple past, present perfect, present continuous, and simple future). The study included a treatment group, which was taught the English tenses through computer software offering

activities and rules on the tenses, and a control group, which was taught based on a teacher-driven approach with printed materials. The materials of both groups included the same verbs, sentences, and dialogues, ensuring exposure to identical materials, with the means of delivery being the differentiating factor. The study also compared two teaching approaches: a) a structure-guessing deductive approach and b) a rule-oriented deductive approach. The former refers to presenting grammar in context using dialogues, and learners are asked to decipher the rules before moving to activities. The latter refers to presenting the grammatical rules first, followed by grammar items in context (e.g., sentences, dialogues) and then, learners are asked to complete exercises (AbuSeileek & Rabab'ah, 2007, p. 70). Additionally, the feedback provided to the two groups was different due to the nature of the instruction, i.e., printed versus digital materials. Specifically, in the control group, the teacher provided feedback to the learners, whereas in the treatment condition, feedback was offered by the computer programme. Both groups received the same feedback about rules and correct answers. In the treatment group, this was provided in written form on the computer screen. However, in the control group, the authors did not specify whether feedback was provided on the printed materials or orally. It is assumed that feedback was provided orally due to the teacher-led instruction. The administered pre-test on English tenses with multiple choice questions ensured that both groups were at the same level at the beginning of the intervention. The results documented that the participants in the computer-based instruction achieved a higher mean score in the post-test on tenses than the control group. The post-test was completed four weeks after the experiment and was identical to the pre-test. These findings suggest that compared to a teacher-driven approach that incorporates printed materials, a digital kind of instruction that offers online materials enhanced with sound, graphics, and animations is more beneficial. Furthermore, results favoured the structure-guessing deductive approach over the rule-oriented one. Considering the design of the study, the overlapping materials of the two groups in terms

of their content highlight that the means of delivery – the digital version of the learning materials – is the contributory factor to language learning.

Marsaulina (2020) reported contradictory results in her study investigating grammatical knowledge in technology-enhanced language learning environments. The kinds of grammatical knowledge investigated were tenses, articles, nouns, pronouns, adjectives, adverbs, prepositions, particles, phrasal verbs, types of sentences, and question forms. The participants were adult L2 learners of English, and their nationality was not specified. The participants were divided into one control group, which was taught using a grammar coursebook. They completed manual grammar homework and were offered additional instructional time outside of regular class each week. During the lessons, they used their smartphones to access online dictionaries. The lecturer used technology to deliver presentations and upload materials for the participants to consult before the classes. The treatment group was exposed to internet resources on grammar theories and activities completed in class and independently by the learners. The internet resources included songs and a grammar checker application. They also engaged in role play and gave presentations explaining their answers. The authors did not provide a meticulous presentation of how the digital materials were used and the reason for their selection. At the beginning of the experiment, the two groups' participants had similar English proficiency. At the end of the experiment, tests assessing the grammar structures, which were previously taught, were administered. The results reported no significant difference between the two groups' knowledge of English grammar. The author argued that the lack of positive outcomes in the technology-based group was due to the students' low motivation to complete drills, the complexity of the assessment tests, and the lecturer's pedagogy skills.

3.4.2 Language Skills

In addition to language structures, TELL intervention studies have also examined language skills. Listening and speaking are two language skills crucial for addressing learners' communication problems. They are presented below by analysing the methodology and findings of studies that investigated them in technology-enhanced environments.

3.4.2.1 Listening. Focusing on listening skills, Chang and Chang's (2014) study investigated adult Taiwanese L2 learners of English. They used YouTube videos as a tool for EFL listening instruction to examine listening skills and strategies adopted by the participants while watching advertisement videos. The participants watched YouTube videos, created dictation tests with fill-in-the-gaps activities based on the video, and commented on their listening strategies in an online space. The pre- and post- listening achievement tests indicated that learners improved their listening skills and developed metacognitive strategies in L2 listening. This study did not include a control group to accurately propose the efficiency of YouTube videos for listening improvement.

Using multimedia learning materials, Sejdiu (2017) examined primary school EFL learners' listening comprehension skills. Contrary to Chang and Chang's (2014) study, a group was exposed to multimedia materials and another group, serving as the control, received regular listening instruction. Tests assessing the participants' listening skills through activities on the overall idea, details, and making inferences were administered to both groups. All participants had similar listening skills at the beginning of the intervention. The findings revealed that the multimedia group improved their listening skills more compared to the control group. It should be highlighted that the methodological design of this study included two different teachers, one assigned to the control group and another one assigned to the treatment one. Such a methodological design establishes an intervention where the two independent variables are the

teaching methodology, i.e., *multimedia materials vs. traditional learning*, and the different teachers. Therefore, the reported results may differ in the two groups because of the two teachers because a teacher's teaching style affects learning achievement (Conti, 1985).

Hsu et al. (2023) recently reviewed the impact of Amazon Alexa on adult L2 learners of English listening and speaking skills. Their study included a control group and a treatment group taught by the same teacher, unlike Sejdiu's (2017) study. Both groups had the same B1 (intermediate) proficiency level. The control group attended a vocabulary lesson that included text reading, vocabulary instruction, and exercises. The treatment group attended the same vocabulary lessons alongside Amazon smart speakers and sessions to interact with Alexa by asking questions, receiving answers and taking notes. Due to the integration of the Alexa sessions, two reading texts were used for the treatment group, and four were implemented for the control group. This suggests that the control group was exposed to double the number of reading texts and practised reading while the treatment group engaged in speaking practice. TOEIC tests assessing the participants' listening and speaking skills were administered before and after the intervention. The post-test results reported no difference in listening skills between the two groups. However, the treatment group outperformed the control group in speaking. The different practice of skills explains why the treatment group outperformed the control group in speaking.

3.4.2.2 Speaking. Studies on L2 learners' speaking performance employ standardised tests (e.g., IELTS) or localised tests (e.g., tests designed by researchers or teachers to align with the learning aims of interventions, Chang & Hung, 2019, p. 4). These tests often examine general proficiency, accuracy, fluency, syntactic complexity, average sentence length, or total number of produced words.

Akkara et al. (2020) employed a mobile application to investigate L2 learners' English-speaking skills in online settings. The study aimed to examine the impact of informal learning and interaction in a *WhatsApp* group on improving speaking fluency and coherence, lexical resource, grammatical range and accuracy, and pronunciation, which are the assessment criteria of the IELTS speaking exam. The adult participants engaged in a variety of collaborative and individual activities, including texting and voice responses, videos, and different activities on grammar, vocabulary, and syntax. There was no control group in this study. The scores given based on the four speaking criteria of IELTS revealed that the participants improved their CEFR level in speaking skills. These findings suggest that the interaction and various activities completed through the application enhanced L2 learners' speaking skills.

Later, Abedi (2022) investigated Iranian EFL learners' speaking improvement by comparing two homogenous groups of the same B1 level and speaking abilities. The treatment group used a social networking application through which teaching was implemented. In the application, the participants practised all four skills, with a specific focus on speaking. They were provided with materials to listen to and read, and they spoke about different topics and received feedback and support from the teacher. The control group followed the structure of an English Language Teaching (ELT) coursebook. Both groups had the same hours of instruction, practice, and teacher and completed pre- and post- tests. Adopting a pre-post test design (i.e., a treatment effect study) and the same learning conditions in terms of hours of instruction and practice alongside the same teacher highlight a robust research design. The findings revealed that the treatment group outperformed the control group in terms of fluency, coherence, and lexical resource in their speaking. The results of this study suggest the effectiveness of digital tools over the traditional approach.

Qiao and Zhao's (2023) recent study examined the use of artificial intelligence (AI) to improve the speaking skills of adult Chinese EFL learners. The authors used a randomised

controlled trial with repeated measures. A control group was taught using the traditional approach, and the treatment group followed AI-based language instruction. There was no difference between the two groups in their initial speaking skills. Both groups received equal instruction time and comparable learning contexts. The differentiating parameter was the method of instruction, i.e., AI and traditional teaching. The treatment group engaged in speaking activities on the Duolingo app, which provided personalised feedback in response to the participants' utterances. The control group engaged in discussions, activities, role plays, and presentations, which is a learning environment that corresponds to the traditional method of instruction. The IELTS speaking skill exam was used to measure the participants' speaking skills post-intervention. The IELTS speaking test assessed participants' fluency, vocabulary, accuracy, and pronunciation of their speaking productions. The findings of the multiple linear regression employed revealed that the Duolingo application had a statistically positive effect on all the IELTS speaking criteria. These findings propose the positive impact of the use of technology on L2 learners' speaking skills compared to the traditional approach. The authors explained this positive impact on the grounds of the provided personalised feedback and the opportunities for communication without the limits of time and location, which are apparent in traditional classroom settings.

Wang and Han (2021) examined the development of adult Chinese L2 learners' speaking skills in English after engaging with a game-based language learning mobile application for 30 minutes twice a week for five months. In the application, while learners practised speaking in English about different topics, their speech was recorded, and immediate feedback and rewards were provided. The identical pre- and post- tests involved a story narration using pictures and were completed individually by each participant. The authors assessed learners' fluency by calculating the speech rate and mean length of pauses. They also assessed the syntactic complexity of the produced utterances by measuring lexical density (the

ratio of lexical words to the total number of produced words) and the average number of words within independent and dependent clauses. Their accuracy was also examined by measuring errors and repairs (i.e., reformulation and substitution of words or phrases, repetitions, false start, and repetition of phonemes or syllables). The findings showed that there was no difference between the pre- and post- tests in terms of repairs and pauses. However, learners improved their speech rate and lexical density, made fewer errors, and the average number of words in their oral productions increased.

Lys (2013) reviewed the use of iPads and various applications by adult B1-B2 learners of German whose first language was English. Before class, the participants watched a news segment and discussed it during class through collaborative work on an iPad app. They engaged with the Face-Time chat app outside class time to practise speaking, recording, and listening with their peers. The learning process occurred twice a week for one hour and twenty minutes over nine weeks. The pre- and post- recordings were used to assess different speaking criteria, including the total number of individual words and the mean length of each sentence. The findings revealed significant differences between the pre- and post- recording. After the intervention, the participants produced a higher number of total words, and the average sentence length of their oral productions was increased.

The above studies investigating language skills in TELL intervention studies adopted different methodological designs to report the impact of technology. While some studies employed only a group exposed to technology, others have incorporated a technology-based group and a control one following the traditional paper-based approach. Additionally, studies that have employed the same pre- and post- tests, learning time, content of materials, and teacher between the two groups rendered a methodology where the only difference was the teaching method, i.e., digital vs traditional. Overall, a study methodology designed with a control and a treatment group and the teaching method as the only differentiating factor while

accounting for other variables (e.g., tests, duration, etc.) can potentially yield precise results pertaining to the effectiveness of TELL.

3.4.3 Factors Integral to Learning

Other than language structures and skills, TELL intervention studies have also examined the impact of technology use on L2 learners' attention and motivation in class. The importance of these two factors for learning was discussed in the previous chapter. Briefly, in-class attention is a decisive component of a learning process since it positively influences language learning (Olney et al., 2015; Piontkowski & Calfee, 1979; Rubin, 1975), yet measuring it has been proven challenging. Motivation is positively related to successful language learning (Gardner, 2007), and its relationship with various contexts, e.g., personality, emotions, etc., has been examined. This subsection focuses explicitly on in-class attention and motivation in learning in TELL studies.

3.4.2.1 In-class Attention. Bester and Brand's (2013) study investigated learners' attention in an EFL class. They compared a technologically enhanced lesson with a technology-free one attended by 12–13-year-old students with various L1s used at home (i.e., English, Afrikaans, or another African language). The participants were randomly assigned to a control and a treatment group, and the groups were analogous in every aspect. In the technologically enhanced lesson, the treatment participants were exposed to an auditory recording of an unknown English poem while expressive images illustrating the poem were displayed on the interactive whiteboard. In the technologically free lesson, the control participants were exposed to a verbal teaching methodology without any use of digital tools. The teacher recited the poem and provided the same explanations as in the treatment group. Questionnaires on attention and tests on achievement were administered at the end of each lesson. The authors reported that technological tools captured and maintained learners' attention and led to higher achievement

scores compared to traditional verbal teaching. These results propose the positive impact of TELL on learners' attention in an English language class.

Hung's (2016) study examined EFL learners' attention, focusing on speaking through multimodal videos, which they created for feedback provision. Specifically, 60 adult learners participated in a semester-long project on video feedback using *Facebook*. Each participant produced three 3-minute video clips responding to questions related to discussions that had occurred in class. They also produced six 2-minute oral feedback video clips where they provided feedback on their classmates' video clips by commenting on their strengths, weaknesses, and areas of improvement. The results taken from questionnaires completed by the participants on their perceptions of video-mediated oral feedback reported learners' engagement and easier understanding of the feedback content compared to conventional written feedback. Specifically, the participants documented their attentive engagement, opportunities for personalised learning when engaged in video-based feedback and their positive attitude towards digital feedback compared to conventional written feedback.

3.4.2.2 Motivation in the Lesson. Motivation is a construct that has been widely examined in TELL studies to identify the potential effect of digital recourses on learners' motivation. Reviews of the literature reveal that the use of technology enhances L2 learners' motivation in language classes (Shadiev & Wang, 2022; Wei, 2022).

Berns et al.'s study (2016) examined L2 learners' motivation in a digital learning environment, and except for the positive impact of the game-based app on vocabulary improvement described above, the questionnaires revealed that the app motivated learners and was perceived as engaging and entertaining compared to conventional learning tools (e.g., flashcards, wordlists). While German L2 learners of Spanish were included in Berns et al.'s study (2016), Berns et al.'s (2013) previous study targeted Spanish L2 learners of German.

Their study examined the impact of Virtual World (VW) environments with game-like features on the participants' motivation and learning. In this study, there was not a control group, and the treatment participants were asked to connect to a VW game on their own time and complete vocabulary, listening and reading activities individually or in collaboration with other game users. After the completion of the study, the learners answered a motivation questionnaire evaluating the game, and the findings revealed that it had a positive impact on their motivation. Furthermore, post-linguistic tests reported their improvement in vocabulary acquisition, listening and writing skills. The authors mentioned that the competitive features explain the favourable effect of the VW game since learning is embedded in a game-based environment (Berns et al., 2013, p. 216). The results of these two studies suggest that integrating technology for language learning purposes is effective regardless of the targeted L2 and learners' first language.

Similar favourable results were documented in James and Mayer's (2018) study, which investigated English adult L2 learners studying Italian via the Duolingo app. The treatment group engaged with the Duolingo app for language learning and was compared to a control group that followed the traditional approach. The control participants were also exposed to online slides presenting grammar rules and equivalent examples. The same materials in terms of words and phrases were employed for both groups. The participants had no knowledge of Italian at the beginning of the study and did not differ in basic characteristics (e.g., gender, age). The post-questionnaire on learners' perceptions of the lessons they attended revealed that the treatment participants reported more motivational and affective benefits compared to traditional learning methods. However, the post-tests showed no difference in language acquisition between the two groups.

Perry (2015) scrutinised adult students' motivation using a quest-based Augmented Reality (AR) learning game. Her study sought to combine gaming and language education by

extending language learning beyond the classroom. The AR learning game transformed a university campus into a virtual world using GPS, where students interacted with other characters and completed quests while improving their French language skills. The post-questionnaires on participants' evaluations of the game and the learning experience documented their increased engagement and motivation and enhanced peer-to-peer interaction. Perry (2015) specified that the critical factor in this mobile augmented reality learning game was the combination of sufficient language learning and adequate game-play scaffolding.

Younger learners were included in Bautista-Vallejo et al.'s (2020) intervention study. Their study addressed sixth graders' motivation for learning English as a foreign language through a gaming computer application with vocabulary cards and videos as visual stimuli. The treatment group was engaged with the application for 15 minutes to learn vocabulary, and the control group learned the same vocabulary items in the conventional way for the same duration. The authors did not assess the homogeneity of the two groups but reported that they had the same characteristics. No details on the conventional method were provided. The findings revealed that the majority of participants (70.88%) in the treatment group exhibited enhanced motivation and enjoyment compared to a smaller number of control participants (27.65%) engaged in traditional lessons. Similarly, 70.25% of the intervention students reported that they were not at all distracted while performing the computer task. Most importantly, although the control group slightly outperformed the treatment group in immediate vocabulary memory tasks, the delayed post-test revealed that the intervention group improved their word memorisation, as shown by a 20-percentage increase. In contrast, memory retention dropped in the control group's follow-up evaluation. These findings suggest that computer applications contribute to motivation and memory improvement for vocabulary through gamification. They also lead to longer retention in comparison to traditional teaching methods. Bautista-Vallejo et al. (2020) interpreted the effectiveness of technological tools based on the motivation

experienced by learners during exposure to them on account of their enjoyment and concentration, as well as the enhancement of executive functions while learning English through the gaming application (p. 12).

A relationship between higher scores in motivation and vocabulary acquisition was observed in the treatment participants of Chen et al.'s (2021a) study, who explored virtual reality and problem-based learning (PBL) in English language learners. Specifically, the treatment participants were exposed to a problem-solving scenario in a VR environment, in which a 3D avatar narrated the situation/problem. Subsequently, the study participants created VR problem-solving videos where they role-played their proposed solutions to the problems and, finally, composed a PBL analysis in writing. The control group was exposed to the same problem-solving scenario in printed form and wrote their PBL analyses without creating videos. Both groups were homogenous, had the same instructor, used the same teaching materials and participated in identical PBL contexts. The only differentiating factor was the integration of VR technology. Virtual reality technology proved conducive to learners' motivation and vocabulary acquisition since VR enables learners to interact with diverse modalities of information (Chen et al., 2021a), which cater to variations in individual preferences. Furthermore, it was also observed that VR did not influence learners' problem-solving performance since there was no significant difference between the treatment and the control group, even though the control participants did not engage in video creation.

By and large, the above studies investigated and reported the positive impact of digital learning tools on L2 learners' attention and motivation in the lesson – alongside linguistic improvement – with the documented positive results applying to both adults and young learners. The authors compared their findings to a language learning environment that disregarded any use of technology by keeping consistent other variables (e.g., duration, content

of materials, teacher, etc). Such a methodological design asserted the favourable impact of technology on learners' attention and motivation.

3.4.5 Combination of Learning Dimensions

The studies above focused on linguistic structures, skills, or factors integral to learning. Chang & Hung (2019) reported that the majority of studies (82.1%) have targeted one language learning dimension. A broader combination of language learning dimensions within an authentic language learning environment has been examined by a smaller number of TELL intervention studies.

Adair-Hauck et al.'s (2000) study is the first study that investigated the impact of TELL on a variety of language-learning areas during a semester-long course on French as an L2. Their study evaluated the balanced integration and effectiveness of TELL in a university's language learning curriculum. This intervention study employed a control and a treatment group and utilised compatible teaching materials for both groups. In particular, they examined university learners' performance in French listening, speaking, reading, and writing skills, as well as their cultural knowledge, motivation, anxiety, and perceptions of their achievements on language learning goals. Both groups had the same instructor, textbook, and materials. Each group participated in four weekly learning sessions, with three sessions being identical for both groups. The differentiating parameter was established in the fourth learning session, wherein the treatment participants autonomously chose when and where to complete the TELL activities. Conversely, the control group met at a specific time for their fourth session and was exposed to the same multimedia activities on paper or watched a video as a group. The findings revealed that both groups performed equally well in listening and speaking, whereas the treatment group outperformed the control group in reading, writing, and cultural knowledge. Additionally, no difference was reported between the two groups regarding their motivation and anxiety in learning French as an L2. The authors argued that the duration of the intervention

could explain this lack of difference, as a 15-week learning time is insufficient to affect those language learning parameters. Lastly, the participants exposed to both teaching methodologies reported their progress towards their language learning goals.

Undoubtedly, Adair-Hauck et al.'s intervention study set the basis for the methodological design of future studies in evaluating the TELL impact on a combination of learning dimensions in authentic language environments. Nonetheless, greater autonomy was assigned to the treatment group, letting the treatment participants choose when to engage in TELL activities and complete homework assignments. Studies have reported that learners' autonomy is a crucial factor which contributes to performance and language proficiency (Cotterall, 2000; Langfred & Moye, 2004; Little, 2007); therefore, Adair-Hauck et al.'s study results reporting a positive impact of TELL on cultural knowledge, reading and writing skills should be interpreted with caution. Alternatively, adopting a methodological approach that ensures both groups are not subjected to additional influential factors and instead centres on comparing the delivery methods of the learning materials has the potential to yield more reliable findings.

Shifting the focus to the understudied group of young learners (Shadiev & Wang, 2022; Chang & Hung, 2019), Alvarez-Marínelli et al.'s (2016) study adopted a treatment effect design with intervention and control groups of young learners, scrutinising a range of learning objectives (i.e., listening and speaking skills, vocabulary, and language literacy). The authors reported that their research on evaluating the effectiveness of technology-based EFL learning for elementary grade levels over a long period was the first one to be conducted with L1 Spanish speakers in Latin America. Their randomised trial study included a control group and two treatment groups examining participants' oral development over a 25-week project. The control group was taught following the typical English instruction model adopted by teachers in Costa Rica, where the study was conducted. The teaching methodology of the control group

focused on cultural awareness, listening and speaking. Although the authors described the types of activities implemented for the control group, they did not specify whether the method of delivery followed a paper-based approach. One treatment group was exposed to a computer-assisted English language learning programme whose aim was the "synchronised activation of the auditory, phonological, and visual systems in the brain" through activities on various topics, assessment, and feedback (Alvarez-Marinelli et al., 2016, p. 108). Another treatment group adopted a more technology-based teaching approach focusing on listening, speaking, and vocabulary development through listening and responding to stories, watching video clips, producing conversational phrases, and completing activities on phonemic awareness, literacy-based learning strategies, and academic and basic vocabulary. It is suggested that the three groups were exposed to different content and input in their learning materials, which can affect learning. The authors did not offer a detailed description of the software, the technology-based methodology of the treatment groups, or the control group's teaching methodology. The results from the pre- and post- tests documented that the first treatment group outperformed the control group and the second treatment group in their vocabulary knowledge and listening skills. Additionally, the second treatment group outperformed the control group in oral proficiency. It should be noted that a study like Alvarez-Marinelli et al.'s (2016) and Adair-Hauck et al.'s (2000) ones have not been conducted with either adult or young Greek L2 learners of English.

Wei's (2023) recent intervention study investigated a combination of types of linguistic knowledge by further attributing great importance to the use of AI educational technologies for language learning purposes. Wei (2023) examined the efficiency of AI-mediated instruction using the Duolingo language learning app, which was utilised by the treatment group of adult EFL learners for 10 weeks. The Duolingo app provided treatment participants with personalised lessons in English, including interactive activities, online quizzes, language games, and real-time, tailored-to-the-user feedback. The control adult EFL learners received traditional

language instruction, which implemented textbooks, lectures, and classroom activities of grammar drills, writing exercises, reading passages, and teacher-led discussions. The results reported that the participants engaged in AI-mediated instruction improved their performance in grammar, vocabulary, reading comprehension, and writing to a greater extent than those exposed to a traditional teaching methodology. Additionally, the self-reported questionnaires documented that the treatment group exhibited greater motivation compared to the control group. The semi-structured interviews revealed treatment participants' active engagement in the interactive language learning activities. The positive impact of AI on linguistic achievement and motivation was explained by the offered personalised learning experience and the learners' increased sense of curiosity and enthusiasm for further learning beyond the classroom (Wei, 2023).

3.5 The Research Gap

The aforementioned intervention studies reported the effect of digital resources for language learning purposes on learners' L2 improvement, motivation, and attention compared to the traditional approach that predominantly employs a pen-and-paper learning method with textbooks and paper-based learning materials. Meta-analyses have revealed that research has primarily focused on adult L2 learners, leaving the effects of TELL on younger ages understudied (Chang & Hung, 2019; Fajaruiddin et al., 2024; Shadiev & Wang, 2022). The methodological design of intervention studies aimed at examining some aspects of linguistic knowledge or factors integral to learning. However, language teachers target a variety of linguistic features and factors in authentic L2 classrooms. This necessitates the review of a range of linguistic skills and structures in future intervention studies that aim to create an authentic language environment. Based on the methodological designs described above, a control and an intervention group with compatible teaching materials are recommended for a robust methodology. Such a methodological design will enable the transfer of research findings

into language classes, enhance the accuracy of TELL research, and by targeting the younger population, expand and generalise the findings.

Regarding the present thesis, no study has been conducted with young Greek L2 learners of English comparing the impact of a TELL methodology and the traditional paper-based one on a variety of language skills, structures, and integral factors to learning. In fact, studies with Greek L2 learners predominately propose new websites for independent language learning (Λεονταρίδη & López, 2018), review the impact of digital learning tools – e.g., podcasts – on L2 learners’ motivation and linguistic improvement outside classroom settings (Nikolou & Darra, 2018), or examine the use of web applications (Πανταζή & Γεωργιάδη, 2015). They also review a teaching method, i.e., CLIL, in combination with digital tools (Χασιλτζόγλου, 2022; Μαρτινοπούλου, 2019), examine Greek EFL learners’ perceptions of language learning digital tools (Vekopoulou, 2023), and investigate the efficiency of e-learning platforms, or websites predominately without the use of a control group (Θεμιστοκλέους, 2021; Kontogeorgi, 2014).

However, in the case of Vasileiadou and Makrina’s (2017) study, the authors compared the efficiency of computer games for L2 English vocabulary learning with the traditional book-based approach. The results taken from the pre- and post- tests reported that the online computer games were only effective for low achievers. The semi-structured interviews conducted only with the treatment participants revealed that they perceived the computer games as entertaining and acknowledged that they helped improve their vocabulary. The participants were primary school students learning English as a foreign language, but Greek was their second language, and they had different L1s. Young and Greek L1 learners constitute an understudied group, and more research is needed on this population.

The present study aimed to address this research gap by comparing the efficiency of technology integration in an EFL class with the traditional paper-based teaching methodology for Greek adolescent learners, which is an under-studied group. A combination of language learning dimensions was examined in an authentic language learning environment.

Section 1 Summary

This section provided an overview of the literature in the scientific fields pertinent to the present study: individual differences, motivation and in-class attention in SLA, and technology-based language learning. Individual differences were examined through the lenses of cognition and conation, explicitly focusing on attention, working memory, academic motivation, and personality as factors influencing language acquisition. Two additional factors related to attention and motivation, i.e., in-class attention and motivation in language learning, were presented as they impact in-class language learning. Their theoretical background, research within various fields and domains, and relationship with language were described.

The section concluded with **CHAPTER 3: TECHNOLOGY IN LEARNING** introducing the final research area of the study, technology-based language learning, by delineating its two primary forms, CALL and TELL. Subsequently, to provide a comprehensive overview of the field of TELL, the findings of meta-analyses were analysed. The chapter proceeded with the findings of intervention studies on TELL that examined the same language learning dimensions as the current study. Their methodological design was presented to inform the methodology of the current study. The literature review concluded by presenting the research gap that this study aimed to address.

Section 2 Methodology: Overview

Section 2 analyses the methodology of the current study by focusing on the data collection and the classroom intervention study. **CHAPTER 4: DATA COLLECTION** describes the study design by presenting information related to the approvals, participants, research questions, and procedures. A description of the tests and questionnaires with references to their original versions and any minor changes is provided. **CHAPTER 5: THE CLASSROOM INTERVENTION AND TEACHING MATERIALS** focuses on the classroom intervention of the study. After presenting the general teaching approach of the lessons, the strategies for teaching language skills (e.g., reading, listening, speaking), kinds of linguistic knowledge (e.g., tenses, word order, polysemy), and language learning games are described. These strategies were employed for both groups. The materials used to teach the above language skills and structures are analysed next. This section starts with an overview of how the intervention materials were adapted to a paper-based methodology for the control group and the reasons for their selection. The overlapping materials used for both groups are presented next, followed by the teaching materials for each group. The chapter concludes with the role of the researcher in the classroom intervention.

4. CHAPTER 4: DATA COLLECTION

4.1 Approvals

The current classroom intervention study was approved by the ethics committee of the University of Birmingham, UK and the Institute of Educational Policy, which is under the jurisdiction of the Ministry of Education and Religious Affairs in Greece. An additional approval was granted by the headteacher of the secondary school where the field experiment was conducted.

4.2 The Participants

The participants of the classroom intervention study were L2 learners of Greek nationality aged 11 to 13 years (mean age: 12.1). They attended the first grade of a public secondary school, which is located in a suburban area in Thessaloniki, Greece, and they were randomly allocated to a control and an intervention group. The initial number of participants was ninety-two (41 males, 50 females, 1 non-binary). The exclusion criteria were a) any kind of atypical development (e.g., autism), b) a non-Greek nationality, c) bilingualism, and d) a proficiency level higher than B2. Based on the exclusion criteria, twenty-one young teenagers were excluded from the data analysis process. Due to school policy, they attended the lessons and completed all the tests and questionnaires since no student should have been excluded from their classes. Four participants had a proficiency level of B2 or higher. They all belonged to the control group and were excluded to establish comparable baseline conditions between the two groups. Additionally, six participants were excluded from the statistical models due to their low extreme scores. Owing to the exclusion criteria and the extreme scores in the variables, the final number of participants was sixty-five. Twenty-five were males, thirty-nine were females, and one was non-binary. Thirty participants were in the control group, and thirty-five participants were in the intervention group. There were twelve males, seventeen females, and

one non-binary in the control group. Thirteen males and twenty-two females were in the intervention group.

The participants had been learning English for one to five years or more at public or private language schools alongside their public school language education. Specifically, six participants had been learning English for 1-2 years. Three were in the control group, and the other three were in the intervention group. Thirty-five participants had been learning English for 3-4 years. Sixteen were in the control group, and nineteen belonged to the intervention group. Lastly, twenty-four participants had been learning English for five years or more. Eleven participants were in the control group, and thirteen were in the intervention group.

Based on the placement test that the learners took before the beginning of the intervention, their proficiency level in the English language ranged from Beginner to Intermediate. Specifically, eleven students were classified as *Beginners* (A1) according to the Common European Framework of Reference for Languages (CEFR) categorisation. Four of them were in the control and seven in the intervention group. Forty-four learners were classified in the *Elementary* CEFR level (A2). Twenty of them were in the control group, and twenty-four were in the intervention group. The remaining ten participants were *Intermediate* (B1) users of English, six of whom were in the control group and four of them were in the intervention group. The similar number of elementary and intermediate students in the control and the intervention group was coincidental. The coincidence can be justified by the fact that learners of this age group (mean age: 12.1) have not yet reached a higher proficiency level. The decision to include both elementary and intermediate learners was made to reflect the learning conditions in secondary schools, where proficiency levels typically range from A1 to B1 and to ensure a sufficient number of participants for the intervention study. The exclusion of one of the two proficiency levels (i.e., elementary or intermediate) was not necessary since previous

research has revealed that the effectiveness of TELL or paper-based teaching methodologies does not change according to learners' proficiency levels (Chang & Hung, 2019).

4.3 Data Collection

The data collection was divided into four stages, which were run by the author of the thesis. The first included the pre-intervention stage, where all the necessary tests and questionnaires were administered to the participants; the second was the classroom intervention study, where the lessons were conducted. The third and the fourth stage corresponded to the post-intervention process. Specifically, the third stage included the administration of post-tests and questionnaires, and the delayed post-tests were completed in the fourth stage.

4.4 Procedure

According to the legal requirements in Greece, the participants' parents or guardians provided their consent (see Appendix 1), and the young teenagers' assent (see Appendix 2) was also received before initiating data collection. Before the classroom intervention study was launched, the pre-intervention process lasted one month (December 2021). It included the administration of tests and questionnaires via Qualtrics, which is an authenticated online tool for surveys. All questionnaires were first piloted (see section 4.6 **Introduction to Data Collection Instruments** below for details on the piloting stage), and they were completed in the IT classroom of the school one or two at a time to minimise young teenagers' cognitive load and collect accurate results. The tests assessing the participants' knowledge of English were completed on paper in the main classroom. The participants were also voice-recorded in a quiet classroom while engaging in a speaking test. One participant did not provide their consent to be audio recorded in the pre-intervention stage and was removed from the equivalent data analysis. All participants' responses to the questionnaires and tests were anonymised.

Upon completing the pre-intervention stage, the classroom intervention was launched and lasted three months (11 January 2022 - 06 April 2022). As part of the intervention study, the participants attended two 30-minute per week lessons in the English language for a total of three months. The official duration of each teaching hour in Greek public schools is 45 minutes. Fifteen minutes of each lesson were allocated to completing in-class attention and mood questionnaires, which reduced the duration of each lesson to 30 minutes. Five lessons were lost due to COVID-19-related issues or school trips and activities, and thus, the final number of conducted lessons was nineteen. The total duration of the intervention study was 9.5 hours. No emergency remote teaching was required due to COVID-19 during the intervention, and all lessons for both groups were conducted in person in the school classrooms. However, the participants' educational experience prior to the intervention had been conducted remotely. Specifically, they completed their final year of primary school – i.e., the school year immediately before the intervention – online owing to the COVID-19 pandemic. This lack of in-person education resulted in some classroom management issues at the beginning of the intervention. These challenges stemmed from the learners' first exposure to a secondary school environment and their need to readjust to in-person classroom rules. The classroom rules were established before the intervention lessons started, and any classroom management issues were addressed during the intervention.

Psychometric tests were completed from January to March 2022. The author conducted them in a quiet room at the school on a one-on-one basis. Specifically, the attention tests were conducted on the author's personal computer, and the working memory tests were conducted after the author had received training from a licensed psychologist about the procedures, guidelines, assessment, and verbal instructions suitable for young students when administering the working memory test. During the main intervention stage, interim testing was also

completed. The author was also observed by school-allocated teachers each month while teaching both groups.

At the end of the intervention, another round of speaking recordings, tests, and questionnaires assessing the participants' language proficiency, motivation, and technology enjoyment were administered to the participants in the IT and the main classrooms, similarly to the pre-intervention stage. One and a half months after the end of the intervention, the last post-intervention stage included the delayed post-tests, which re-assessed the participants' language proficiency.

4.5 Matching Research Questions with Methods

The tests and questionnaires which were used in the current study are presented for each research question. Table 1 below provides an overview of the research questions and the data collection methods.

Table 1

Tests & Questionnaires Used to Address Each Research Question

Research Question	Tests and/or Questionnaires
1. Does Technology Enhanced Language Learning (TELL) significantly improve language development, in-class attention, and motivation in the English lesson?	<ul style="list-style-type: none"> • Linguistic tests on tenses, word order, polysemy, listening, speaking • Questionnaire on attention in class • Questionnaire on motivation in the English class
2. Do cognitive capacities and personality moderate the acquisition of word order and polysemy in TELL versus the traditional teaching methodology?	<ul style="list-style-type: none"> • Attention tests • Working Memory test • Big Five personality test • Linguistic tests on word order & polysemy
3a) How do personality and academic motivation correlate with in-class attention in TELL versus the traditional teaching methodology?	<ul style="list-style-type: none"> • Big Five personality test • Questionnaire on academic motivation • Questionnaire on attention in class • Questionnaire on motivation in the English class

3b) How does personality correlate with motivation in TELL versus the traditional teaching methodology?	
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Research Question 1 *“Does Technology Enhanced Language Learning (TELL) significantly improve language development, in-class attention, and motivation in the English lesson?”*

To address the first research question, the participants in both groups (i.e., a group taught with the aid of digital resources and a group taught traditionally without the use of technology) were evaluated with regard to their language development, attention, and motivation in class. Specifically, the participants' language development was measured with tests on tenses (i.e., Present Simple and Present Continuous), word order in English, and polysemous vocabulary before the intervention, at the end of it, and 1.5 months later. Language development was further tested through listening and speaking activities, which were administered before and right after the intervention. As a process of interim testing, the participants' oral comprehension was further reviewed every month using multiple-choice listening exercises. Their attention in class was measured using a self-report questionnaire at the end of every lesson. Lastly, their motivation was evaluated via a questionnaire which addressed the participants' views on learning English before and right after the intervention. The scores/results taken from these tests and questionnaires were used to investigate the impact of technology-enhanced language learning.

Research Question 2 *“Do cognitive capacities and personality moderate the acquisition of word order and polysemy in TELL versus the traditional teaching methodology?”*

To address the second research question, participants' individual differences in cognitive and conative dimensions were measured and used as the independent variables in the statistical analysis. Particularly, their different cognitive types were defined through a working

memory test and a series of attention tests. Their conative types were indicated using the Big Five personality questionnaire. The results taken from the tests and questionnaire were used to predict the participants' scores in the tests on word order and polysemy. This procedure aimed to establish any relationship of these two kinds of linguistic knowledge with both cognitive and conative individual differences. This relationship was also examined in relation to the group to which the participants belonged. Word order and polysemy were selected because they exhibited distinct relationships with cognitive and conative variables in each group, as shown by the correlation plots. Section 6.3.7 Group Correlations below offers more detailed information on this selection.

Research Question 3a) *“How do personality and academic motivation correlate with in-class attention in TELL versus the traditional teaching methodology? 3b) How does personality correlate with motivation in TELL versus the traditional teaching methodology?”*

The third research question has a two-fold aim. The first part seeks to identify any relationship of in-class attention with both personality and academic motivation. The second part explores any possible relationship between personality and motivation in learning English. Any difference in this relationship attributed to the group was also explored. The Big Five Personality questionnaire and a questionnaire on academic motivation were utilised to address the third research question. The questionnaires of in-class attention and motivation in the English lesson explained previously in research question 1 were employed. The tests and questionnaires are presented in more detail in sections 4.7 **Questionnaires and Tests on Individual Differences**– 4.10.3 **Teacher's Questionnaires** below.

4.6 Introduction to Data Collection Instruments

The original versions of the questionnaires used for the needs of the present study were in English, and due to the learners' low proficiency level in the English language, they were

translated into Greek by the author, who is a native speaker of Greek. Before translating the questionnaires into Greek, minor changes (presented below for each questionnaire) were made to the English version to simplify some of the statements without changing the meaning or, hence, affecting their validity. The choice of slightly changing some statements was made because their direct translation into Greek would be too lengthy or, in some cases, would not make sense. Therefore, the translated version would be too difficult for young learners to comprehend. The versions used, the original versions, and their translation in Greek are included in the appendices of each questionnaire. At the end of the questionnaire administration, the author translated the participants' answers to the open-ended questions from Greek to English.

To ascertain young teenagers' understanding of the translated questions, all questionnaires were first piloted to five learners who were asked to answer the questions and judge the comprehensibility of the statements. The five learners were students in the same school grade and age as the participants of the study and shared similar social and educational backgrounds. Further questions were made to them by the author during the piloting stage to ensure their comprehension of specific words or questions and their attention to the process. During the pre- and post- intervention stages, where the participants completed the questionnaires, they were informed that their answers would not affect their school grades and assessment to ascertain the truthfulness of their answers. In what follows, the questionnaires and tests on individual differences are analysed first. Specifically, the questionnaires on qualitative data (e.g., personality traits and academic motivation) are presented and followed by the psychometric tests, which were used to measure cognitive individual differences. Questionnaires on students' motivation, attention, and mood in class, as factors integral to learning, are presented next. Following this, the tests which were utilised for collecting quantitative data are introduced. Particularly, the language proficiency tests that assessed

participants' different kinds of linguistic knowledge are described and are followed by the tests for interim testing. The chapter proceeds with a description of other questionnaires used in this study (e.g., questionnaires on participants' demographics, technology enjoyment, and teacher's questionnaires). Progress Tables 1 – 4, like the following one, are included throughout this chapter as a helpful point of reference to its contents.

Progress Table 1

Questionnaires and Tests on Individual Differences
Questionnaires on Factors Integral to Learning
Tests on Linguistic Knowledge
Other Questionnaires

4.7 Questionnaires and Tests on Individual Differences

4.7.1 Personality Questionnaire

The Personality questionnaire used for the needs of the present intervention study was designed by Markos and Kokkinos (2017) as an adaptation of the Big Five Questionnaire for Children (BFQ-C). It is a validated self-report instrument with a good reliability rate (Markos & Kokkinos, 2017), and it is addressed to children aged 8 to 16 years. The abbreviated form of the questionnaire includes 30 items measuring the participants' Conscientiousness, Intellect/Openness, Agreeableness, Emotional Instability, and Energy/ Extraversion. Except for the translation into Greek, the only change made to the original questionnaire was the addition of some emojis to each answer to keep the participants' attention intact (see Appendix 3). The questionnaire was administered at the pre-intervention stage.

4.7.2 Academic Motivation Questionnaire

The High School version of the Academic Motivation Scale (AMS-HS 28) developed by Vallerand et al., known for its high reliability (1992a), was used to measure learners' academic motivation, mainly their reasons for attending school. The academic motivation questionnaire was integrated with the questionnaire on motivation (see section 4.8.1 **Motivation Questionnaire** below) and was administered before the intervention only. The decision not to administer the AMS questionnaire after the intervention was based on the understanding that changes in a single subject (English) are unlikely to significantly alter students' perceptions of the overall school curriculum and academic experience. The questionnaire assessed seven types of academic motivation: intrinsic motivation – to know, intrinsic motivation – towards accomplishments, intrinsic motivation – to experience stimulation, extrinsic motivation – identified, extrinsic motivation – introjected, external motivation – external regulation, and amotivation. Intrinsic academic motivation evaluates learners' pleasure and satisfaction while learning, and extrinsic academic motivation refers to behaviours which learners adopt to achieve a goal. Amotivation is learners' lack of associations between actions and outcomes (Deci, 1975; Deci & Ryan, 1985, as cited in Vallerand et al., 1992a).

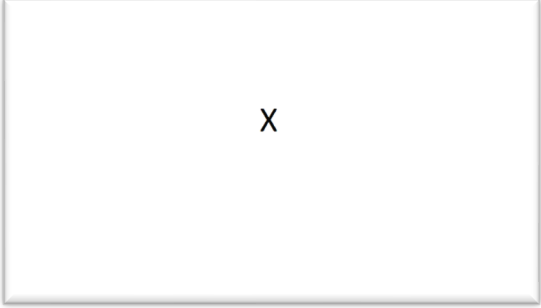
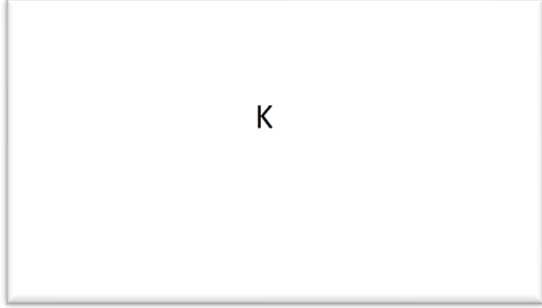
Minor adaptations were applied to the original format of Vallerand et al.'s (1992b) questionnaire (see Appendix 4 for the original version). Specifically, the questionnaire was initially designed on a 7-point Likert scale ranging from *Does not correspond at all* to *Corresponds exactly*. For the needs of the present study, it was adjusted to a 5-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree" for easier understanding by young teenagers. The questionnaire included both positively and negatively worded statements (Appendix 4).

4.7.3 Attention Tests

A Go-NoGo inhibition task, the Eriksen Flanker Test, and a visual search task are standardly used tests and were utilised in the present study to measure the participants' attentional capacities. Each of these psychometric tests was administered via the desktop version of OpenSesame. Each participant took all three tests on a computer with a 1366 x 768 screen resolution, and a short break was provided to each participant before proceeding to the next attention test. Each test had a trial part before the main stage. The instructions were written in English at the beginning of each task, and for accuracy reasons, they were also explained to the participants in Greek by the author. All subjects reported normal or corrected-to-normal vision.

The participants were exposed to two conditions in the single response Go/No-Go task. In the first condition, i.e., the Go Condition, they had to use the index of their dominant hand and press the spacebar button on the computer's keyboard every time they saw a letter on the computer screen. They were asked to do that as fast and accurately as possible. In the second condition, i.e., the Go/No-Go Condition, they had to follow the same procedure as the Go Condition, but they were asked to refrain from pressing the spacebar button when they saw the letter X (see Table 2 below). They thus had to provide a single answer so that their capacity not to respond was measured. The paradigm started with a practice phase, which included five trials of the Go Condition and five trials of the No-Go Condition. After the practice trials, the main task included six trials of the No-Go Condition (i.e., the experimental one) and six trials of the Go Condition (i.e., the control one), which were presented interchangeably. Each trial was comprised of 13 letters in random order. In the experimental condition, the times that the letter X appeared varied, and in the Go Condition phase, the letter X was never presented. The whole experiment lasted about six minutes.

Table 2*The Go/No-Go Task*

	
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In the arrow Eriksen Flanker task used for the present study, the participants had to press a key that matched the arrow at the centre of the computer screen as fast and accurately as possible while ignoring the rest of the arrows. Specifically, the central arrow was surrounded by two arrows on each side, which were headed in the same direction (i.e., congruent flankers) as the central arrow or towards a different one (i.e., incongruent flankers) (see Table 3 below). In the beginning, there was a practice phase of four trials where the participants practised the correspondence between the central arrow and the equivalent key, and the main task included 64 target trials. Thirty-two of those were congruent distractors, and the remaining thirty-two were incongruent with the target stimulus. The whole experiment lasted about five minutes.

Table 3*The Eriksen Flanker Task*

In the visual search task used in this study, the participants had to locate a specific geometrical figure – a circle or square in blue or yellow – on the screen among other geometrical figures of different colours, shapes, and combinations. The target shape was placed in different positions each time, and it was either the only stimulus presented or a varied number of other stimuli in each trial surrounded it. The two primary colours of the shapes were blue and yellow, and they appeared in combination or only one at each trial. The participants were asked to press the right arrow on the standard keyboard if they had found the target stimulus or the left arrow if they had not, and they could see the display for as long as they needed. The whole experiment lasted approximately three minutes per participant.

4.7.3 Working Memory Test

The participants' working memory was measured to serve as a basis for learners' cognitive individual differences similar to the attention tests explained above. At the beginning of the intervention study, the Digit Span task of the Wechsler Intelligence Scale for Children (aged 6-17) Third Edition (WISC-III) was used to measure the participants' working memory scores (see Appendix 5). The WISC-III Digit Span task has been widely used in previous studies involving Greek learners (e.g., Alevriadou et al., 2018; Efstathiadi, 2013; Efstathiadi,

2016; Gkountakou & Talli, 2024; Rotsika et al., 2009) as it is the only standardised test available for assessing different intelligence scales, including working memory, in Greek children (Georgas et al., 1997). The Digit Span task is based on the working memory model proposed by Baddeley and Hitch (1974), which states that the WM system comprises the central executive, the phonological loop, the visuospatial sketchpad, and the episodic buffer (Baddeley, 2000; 2007). The central executive is an attentional control system, responsible for high-level executive functions and overseeing the other three subsystems. The phonological loop is responsible for storing and processing any speech-based information, while the visuospatial sketchpad manages visual and spatial information. The episodic buffer integrates visual and verbal information with long-term memory (Baddeley, 2000; 2007).

The author administered the working memory test to each participant in a quiet classroom since test-takers need to be calm and concentrated during the test without any disruption deriving from the environment. The participants were asked to repeat different sets of numbers from the beginning to the end (i.e., forward digit recall) or from the end to the beginning (i.e., backward digit recall). The forward digit span task primarily engages the phonological loop, as learners were required to repeat verbal information, i.e., numbers. The backward digit recall task involves the central executive executive since learners had to process the verbal information and recall them in reverse order, which imposes additional cognitive load (Gathercole, 1999; Efstathiadi, 2013). The forwards digit recall task included two trials of 2 to 9 numbers, and the backwards digit recall included two trials of 2 to 8 numbers (see Appendix 5). The author orally reported each number in a calm way and at a balanced speed, allocating a time gap of one Mississippi between two numbers. These testing conditions were adopted based on the training received from a licenced psychologist, as explained in section 4.4 **Procedure** above. There was no time limit for task completion, and the test was terminated when two mistakes in each trial were made. At the end of the WM test, the total number of

each participant's correct answers was associated with a scaled score (Μόττη-Στεφανίδη, 1999¹). This scaled score is a default one contingent on the test taker's age and shows their working memory capacity.

Progress Table 2

Questionnaires and Tests on Individual Differences
Questionnaires on Factors Integral to Learning
Tests on Linguistic Knowledge
Other Questionnaires

4.8 Questionnaires on Factors Integral to Learning

4.8.1 Motivation Questionnaire

The Motivation Questionnaire included three sections. The statements in sections A and B were taken from Gardner's Attitude/Motivation Test Battery (AMTB), known for its high reliability (Gardner, 1985). Gardner's Attitude/Motivation Test Battery (AMTB) was selected a) to align with research designs in Greek EFL contexts, where the AMTB has been more extensively utilised compared to Dörnyei's (2005) motivational self-system (e.g., Grigoriadis, 1989; Kofou, 2015; Nikolaou, 2010), b) to enable the examination of learners' motivation in English lessons by focusing on how they evaluate the lessons attended as part of the intervention – which was measured using Gardner's (2004) *English Course Evaluation* scale – and c) to prioritise integrative motivation over learners' self-concepts, reflecting the current role of English as a gateway to global communication in EFL contexts.

¹ The original source is in Greek, and it was translated by the author. The reference can be found under the Greek References section.

These sections were administered before and after the intervention to detect any changes. Section A addressed English course evaluation and motivational intensity, and section B covered various motivational aspects, including the desire to learn English, interest in foreign languages, parental and teacher involvement, attitudes toward learning English, free-time activities and English, and integrative and instrumental orientations. The test was expanded by adding eleven statements to section B to agree with the context of English language education in Greece (e.g., *I learn English because I want to get an English certificate*). Section C focused on learners' academic motivation, as mentioned in section 4.7.2 **Academic Motivation Questionnaire** above.

Gardner's (1985) original questionnaire was slightly adapted (see Appendix 4 for the original version). The 6-point Likert scale was adapted to a 5-point Likert scale by altering two response points to enhance clarity for young teenagers. Specifically, Gardner's two intermediate options, "Slightly Disagree" and "Slightly Agree", were combined into "Neither Agree nor Disagree", and the options of "Moderately Disagree" and "Moderately Agree" were changed to "Disagree" and "Agree", respectively. Statements related to foreign languages were adjusted to focus on English (e.g., *I wish I could speak many foreign languages perfectly* was changed to *I wish I could speak English perfectly*). Some words were omitted or replaced with synonyms, and sentences were rephrased without altering their meaning. For instance, the original statement, *I don't pay much attention to the feedback I receive in my English class* was changed to *In the English class, I don't pay much attention to the teacher's comments that I receive on my exercises* since the word *feedback* when translated into Greek is unknown to young teenagers (see Appendix 4 for more examples). An open-ended question was added at the end of the motivation questionnaire to capture any additional intervention-related views from the participants. To enhance engagement, various pictures and emojis were incorporated into the questionnaire to make it more student-friendly and retain the young participants'

attention. The questionnaire included both positively and negatively worded statements (Appendix 4).

4.8.2 Mood Questionnaire

The participants' mood was assessed at the beginning and the end of every lesson to investigate whether their mood changed based on the content of the lesson. Mayer and Gashke's (1988) Brief Mood Inspection Scale (BMIS), which has good metric characteristics, was used for this purpose. BMIS includes eight different mood states of two adjectives each: (a) happy (*happy, lively*), (b) loving (*loving, caring*), (c) calm (*calm, content*), d) energetic (*active, peppy*), (e) fearful/anxious (*jittery, nervous*), (f) angry (*grouchy, fed up*), (g) tired (*tired, drowsy*), and (h) sad (*gloomy, sad*). This list of adjectives (Appendix 6) was given to the participants, and they had to respond to each adjective using a four-point Likert scale ranging from *Definitely not feel* to *Definitely feel*. Then, they were given a question in which they were asked to rate their general mood. Mayer and Gashke's original design of this question included a 20-point scale ranging from -10: *Very unpleasant* to +10: *Very pleasant* (see Appendix 6). Due to the wide range of this 20-point Likert scale, a 10-point scale ranging from 1: *Very unpleasant* to 10: *Very pleasant* was included instead to be more easily understood by young learners. Similar to the rest of the questionnaires, the mood survey was translated into Greek and then piloted to five 13-year-old teenagers to ascertain their correct understanding of the adjectives since the ones used in the original scale by Mayer and Gashke (1988) were unknown to the young population.

4.8.3 In-class Attention Questions

A newly developed questionnaire was designed by the author of this study to assess learners' attention in the class. The questionnaire was administered to the participants at the end of each lesson. The first question was used to judge whether their attention was affected throughout the lesson. If they had answered positively to that initial question, they were then

asked to identify at which stage of the lesson (i.e., the beginning, the middle, or at the end) and for how long their attention was unfocused (five, ten, or fifteen minutes) as well as the cause of lack of attention. The questionnaire was provided in Greek (see Appendix 7).

Progress Table 3

Questionnaires and Tests on Individual Differences
Questionnaires on Factors Integral to Learning
Tests on Linguistic Knowledge
Other Questionnaires

4.9 Tests on Linguistic Knowledge

The quantitative data collection methods of the study involved a placement test assessing the proficiency level of the participants, and pre- and post- tests on different kinds of linguistic knowledge, including listening, speaking, English tenses, word order, and polysemy. The speaking test assessed the participants' procedural knowledge of a variety of language structures by requiring them to engage in free, unguided oral practice. The listening test measured the participants' declarative knowledge of vocabulary, grammar, sounds, and intonation during oral input. The other linguistic tests (i.e., English tenses, word order, polysemy) measured learners' declarative knowledge in these kinds of linguistic knowledge. Specifically, participants were required to consciously apply grammatical rules – for example, producing or choosing the present simple tense in the tenses test – identify and choose the correct word meaning, such as distinguishing between *house* and *home* in the polysemy test, or assess whether the syntax in a sentence was correct, such as inversion in questions in the word order test. Finally, the placement test measured their declarative knowledge of a variety

of language structures by requiring participants to select the correct answers in multiple-choice questions on grammar, vocabulary, and reading comprehension.

Interim testing of the participants' listening skills was also conducted every month of the intervention. Delayed post-tests on word order, tenses and polysemy were also administered, and they were different from the pre- and post- tests. The choice to use a different version was made due to the condition of their administration. Particularly, the delayed post-tests were administered as the end-of-year exams in English, which are mandatory for Greek secondary school students. Therefore, they needed to be a version to which students had not been exposed before. The delayed post-tests evaluated the same kinds of knowledge and had a similar structure as the pre- and post- tests. The instructions for the pre- and post- tests were given in Greek to secure participants' understanding, and after the intervention, the instructions for the delayed post-test were provided in English. Standardised tests were used where possible, and in cases where there was no standardised or previously published test as a good alternative, the author designed the tests. The speaking, listening, and interim testing were designed using sample papers of English proficiency exams. The tests on word order and tenses were designed using insights from previous studies and sample papers, respectively. The first activity in the pre- and post- polysemy test and the delayed polysemy test were designed using the British National Corpus. The specifics of each linguistic test are explained in sections 4.9.1 Placement **Test 4.9.7 Interim Testing** below, including their content and assessment criteria, to detail how the participants' linguistic knowledge was assessed. All tests were evaluated and scored by the author.

4.9.1 Placement Test

To assess learners' proficiency level in the English Language, the Placement Test (quick version 2, 2001), which is issued by Oxford University Press and the University of Cambridge Local Examinations Syndicate (UCLES), was used (see Appendix 8). The placement test is

developed by UCLES, which is a constituent part of the University of Cambridge and an assessment organisation that provides academic and vocational qualifications (The UCLES Group Annual Report, 2004-2005). The test includes a range of questions which correspond to a specific level (A1-C2) according to CEFR. Since its 2001 official launch, CEFR has served as a basis for language teachers' methodologies, textbooks, types of assessment, and curriculum design, aiming at enhancing learners' cognitive development and communication strategies. CEFR includes three main categories, and each category is further divided into two different levels: Basic User (A1-A2), Independent User (B1-B2), and Proficient User (C1-C2) (see Table 4 below). Each level corresponds to a speaker's ability in a language, which is different from one's native language, and that ability is depicted through can-do statements. For instance, speakers at an A2 level can understand sentences related to very basic personal information. In contrast, speakers at a C2 level can express themselves very fluently, immediately, and accurately in any given context (CEFR, Levels, levels & Europe, 2021. For a complete description of each level, see Appendix 8).

Table 4

The Breakdown of CEFR Levels

Categories	Levels
Basic User	A1 Beginner
	A2 Elementary
Independent User	B1 Intermediate
	B2 Upper Intermediate
Proficient User	C1 Advanced
	C2 Proficiency

The placement test included 60 multiple-choice questions, which assessed the participants' ability to understand texts, grammar, and syntax in the English language. The questions were of tiered difficulty ranging from Beginner to Proficiency levels. According to the published marking scheme, points are awarded for each correct answer. The total number of correct answers yields the participants' specific CEFR level.

4.9.2 Listening Test

The test used to assess the participants' listening comprehension skills included four activities of tiered difficulty ranging from an A1 to a B2 CEFR level (see Appendix 9). The activities were taken from sample papers of the English language examinations issued by Cambridge Assessment. The test was administered before and after the intervention.

Specifically, the A1 Movers listening test was used for the first activity. The participants had to listen to a dialogue between a teacher and a student and fill in the provided gaps with one word, which was either a noun or a number. This part lasted 5.15 minutes and assessed the test takers' ability to extract information from a simple dialogue and correctly spell words. The A2 Key for Schools (KET) listening test was used for the second activity. The participants had to listen to a dialogue between two speakers and match a person's name with an activity based on the information provided in the dialogue. There were five people in total and eight activities, and this part lasted 3.17 minutes. The B1 Preliminary for Schools (PET) listening test was used for the third activity, which lasted 9.02 minutes. The participants had to listen to six different dialogues between two different people in each case and choose one answer from three different choices which were related to the content of the dialogue, e.g.,

You will hear two friends talking about a campsite they have been to. What did the boy like best about it?

A. It was very close to the beach.

B. There were lots of people his age.

C. The activities were free.

Lastly, the B2 First for Schools (FCE) listening test was used for the last listening activity. This part included seven questions, and the aim was to listen to a lengthy interview between a reporter and a teenager and choose one answer from three different lengthy choices which were relevant to the content of the interview, e.g.,

What was the aim of Luke's work at the radio station?

A. to encourage teenagers to have a media career

B. to help teenagers find out about well-known people

C. to make teenagers realise how interesting their lives are

This part lasted 9.47 minutes. Each part was played twice, and the total duration of the listening task was 27.24 minutes. According to the Cambridge Assessment marking scheme, each question carried one point, and the total number of correct answers yielded each participant's final score.

4.9.3 Speaking Test

The participants' speaking skills were assessed through the speaking section of the IELTS exam before and after the intervention. The speaking test used for the needs of this study was the sample IELTS speaking exam (2021) published by the British Council. The choice of not using a specific speaking test from the English language examinations mentioned above was made due to the participants' different proficiency levels in the English language. The speaking test included a prompt card (see Appendix 10). The speaking task card prompted the participants to describe something they owned which was very important to them. They were asked to say a) where they got it from, b) how long they have had it, c) what they use it for, and explain why it is important to them. There were no rounding-off questions asked. Following the structure and procedure of the IELTS speaking exam, the participants were asked to read and process the information on the prompt card without a time limit, and they were

allowed to take notes and ask any clarification questions if they preferred to before initiating their speech. Their oral production was not time limited. Each speaking test was conducted individually and was recorded.

The following criteria were employed to assess the speaking test: fluency and coherence, lexical resource, grammatical range and accuracy, and pronunciation. These marking criteria are published by the British Council, IDP: IELTS Australia and Cambridge Assessment English (2021) and are the standardised way of assessing the IELTS speaking test. According to the assessment specifications, each criterion is marked with a score ranging from 1 to 9. The scores are awarded based on statements describing the test taker's speaking performance (see Appendix 10). Upon the completion of the oral production, the scores awarded for each criterion are calculated, and one main score is yielded that shows the test taker's overall speaking ability based on a CEFR level. The participants' speaking skills were also assessed by calculating the total number of words and the average sentence length of their produced utterances. The average sentence length was calculated by the number of words on the *textinspector.com* website. This website is a widely used web-based language analysis tool to retrieve detailed information on different text criteria. The total score, the number of words, and the average sentence length were calculated for the pre- and post- speaking tests.

4.9.4 Polysemy Test

The polysemy test assessed participants' language development in polysemous words, which are considered demanding for Greek speakers of English with low language proficiency levels since they have either one Greek equivalent or multiple equivalent terms depending on the context and the word.

The pre- and post- test included one activity on English polysemous words that have one Greek equivalent and a second activity examining test takers' knowledge of different meanings of English polysemous words which correspond to only one Greek word (see

Appendix 11). All polysemous words included in the test were listed in the New General Service List of the 2000 High-Frequency Words (Browne et al., 2013) except for ‘*annoy*’ and ‘*excuse*’, which are explained below. According to Maby (2016), selecting words based on their frequency, as shown in the *New General Service List* (Browne et al., 2013), minimises the chances of a floor effect (i.e., lack of familiarity with a word form). The New General Service List provides high-frequency English words for L2 learners of English retrieved from the multi-sourced Cambridge English Corpus (CEC).

The first activity comprised ten fill-in-the-gap statements, which were retrieved from the British National Corpus (BNC) to provide the participants with words in their authentic context. For instance, test takers read the following sentence: ‘*I read this in a book a night or two...*’, and they had to complete the sentence by choosing between ‘*ago*’ and ‘*before*’. This design of a sentence-level context assigns more ecological validity to the test in comparison to providing a definition or gloss to the test takers (Maby, 2016, p. 105). The two given choices were English words whose translation corresponded to the same Greek word and could only be distinguished on the condition that speakers were familiar with the grammatical and syntactic context of each word. As mentioned above, all the choices were listed in the New General Service List except for ‘*annoy*’ and ‘*excuse*’. These two words were listed in the General Service List (GSL) previously published by West (1953). The words ‘*annoy*’ and ‘*excuse*’ were given as the alternative option to ‘*bother*’ and ‘*sorry*’, respectively. Each set of these words corresponds to only one equivalent term in Greek. After deciding on the correct word choice, the test takers had to judge their confidence in their response by answering the question ‘*How sure are you about your answer?*’ by selecting their response on a four-point Likert scale (i.e., Not Sure at All - A Bit Sure- Very Sure - Completely Sure). The instructions, confidence-rating questions, and the Likert scale were written in Greek to ascertain the low-proficient participants' understanding.

The second activity was a semantic acceptability task based on Maby's (2016) study and included words with many Greek equivalent terms. The second activity aimed to assess participants' knowledge of the different senses of polysemous words and their knowledge of not using a word in a context. The participants had to read a list of different declarative sentences of ten polysemous words and judge whether the meaning of the word in the given sentence was correct or wrong. A third choice of '*don't know*' was also provided to them. The declarative sentences were retrieved from the Longman Dictionary of Contemporary English (LDOCE), and the different word senses were of varied frequency to minimise the chances of a ceiling effect (i.e., complete knowledge of all senses of a word). The selected words had a minimum of five different meanings, which were listed in the Longman dictionary based on intra-word meaning frequency by presenting the most frequent ones first (Maby, 2016, p. 117). Thus, the word senses were selected among the most frequent ones, the middle-frequency ones, and the low-frequency ones. The different word senses were consistent or inconsistent with the core sense, a metonym extension, or a metaphor extension (for a complete list of the different frequencies and semantic categories, see Appendix 12). For instance, the target word '*heart*' was given in the following sentences:

- a) *Edith loved her boy with all her HEART and soul.*
- b) *Regular exercise is good for the HEART.*
- c) *The centre part of an apple is called its HEART.*

The test takers were asked to decipher which sentence(s) included the target word correctly. There were no idiomatic phrases included in the text, with the only exception of 'in order to' due to its high frequency across different contexts. At the beginning of the activity, an example was provided. The instructions and the three possible answer choices (*correct*, *wrong*, *don't know*) were written in Greek. Maby's original version included the following, speculative

instruction ‘*You can make a guess*’ which was changed to ‘*You may select the correct option(s)*’ in order not to prompt learners to make a guess.

In Maby’s (2016) original task, there were three correct senses and two incorrect ones. However, the test design was simplified for the present study by including three sentences - two correct polysemous senses and an incorrect one – to establish a less demanding test version. This choice was made considering that the participants in Maby’s study had a higher proficiency level compared to the participants of this study. The incorrect sentence included either a logical or an illogical distractor, which was reviewed by native speakers in Maby’s (2016) study. The logical distractor portrayed a semantically acceptable but wrong use of the word, while the illogical distractor portrayed a semantically unacceptable use of the target word (Maby, 2016, p. 119). For instance, in the *heart* statements mentioned above, the logical distractor was the sentence: *The centre part of an apple is called its HEART*, and the sentence with the illogical distractor was: *HEARTS were parked on both sides* (for a complete list of the distractors, see Appendix 12). The distractors were incorporated into the testing process to establish whether test takers resort to semantic similarity when assessing a word sense or to word translation. The logical distractors were identified using the closest equivalent meaning to the core sense of each target word. They were retrieved from Oxford foreign language dictionaries for languages with historic similarities to English. The illogical distractors were selected from LDOCE, and they were words that were meaningfully different from the target word (Maby, 2016).

The delayed post-test on polysemy included two activities. It followed the design of the pre- and post- tests and included English polysemous words that had one Greek equivalent term and polysemous words that corresponded to many Greek terms (Appendix 11). The first fill-in-the-gap activity included five sentences. The test takers were asked to complete them with

the correct word. The five polysemous words of many Greek meanings were given to them, and they had to select the one that fitted each sentence:

e.g., *order, point, face*

1. *For parents, a big smile on their child's.....is the best holiday treat of all.*
2. *You just repeat it in a different.....*
3. *It was a general....., we were not arguing.*

All the sentences were taken from the British National Corpus (BNC) to expose participants to an authentic context of word use. There were no changes made in the retrieved sentences apart from one which was slightly altered to be more applicable to the participants' age (i.e., the original sentence was '*A big smile on your child's face is the best holiday treat of all*' and it was altered to '*For parents, a big smile on their child's face is the best holiday treat of all*').

The second activity included polysemous words that had one Greek equivalent term, and test takers had to distinguish which English word fitted into the context. Similar to the other tests, sentences instead of definitions or glosses were selected to provide the learners with authentic context. The sentences were extracted from BNC without making any changes, and test takers received five sets of two sentences. Each set of sentences included two polysemous words, and the test takers were asked to distinguish which word best completed each sentence. For instance, the words '*ago*' and '*before*' were provided, and they were asked to complete the following sentences:

1. *Your child was born ten years.....*
2. *She spent a lot of time on the beach.....she became ill.*

Each correct answer carried one point in all activities, and the total number of correct answers yielded each participant's final score. No points were awarded when the '*don't know*' option was selected.

4.9.5 Tenses Test

Two different tests were also utilised to assess the participants' language development in tenses in English. One version was used for the pre- and post- testing, and the other one was used for the delayed one.

In the pre- and post- test, the participants' knowledge of Present Simple and Present Continuous tense was assessed through three different activities (see Appendix 13). In the first activity, the participants were asked to produce the Present Simple in all three forms (affirmative, interrogative, negation). This activity included eight fill-in-the-gap statements with the verbs given in brackets – e.g., *Jason.....(like) playing Minecraft alone*. The participants had to produce the correct form of the tense orthographically, and an example was provided to them at the beginning of the activity.

The second activity followed the same structure as the first one, but the participants were asked to produce the Present Continuous tense – e.g., *I.....(plan) to leave on the 8th*. The third activity was a combination of the two tenses and included ten fill-in-the-gap statements with the verbs given in brackets. The participants were asked to distinguish between the tenses, choose the correct one, and correctly write their form and orthography – e.g., *.....Tom to school on foot every morning? (go)*. The activities were designed to reflect frequently encountered errors in the two tenses made by Greek L2 learners of English. To avoid a random choice of words, the verbs and phrases included in the activities were selected from Romain et al.'s (2022) study, which reported the words usually found in these two tenses.

The delayed post-test had the same structure as the pre- and post- tests (see Appendix 13). The first activity on Present Simple included six fill-in-the-gap statements, and the second one on Present Continuous also included the same number of statements with the verbs given in brackets. The participants were asked to produce the correct form and orthography of each

tense. The last activity included ten fill-in-the-gap statements with the verbs given in brackets, and the participants had to distinguish between the tenses, choose the correct one, and correctly write their form and orthography. All the statements in the test were of graded difficulty (A1-B1 CEFR level) taken from equivalent English coursebooks and English Assessment Practice Tests (Cambridge University Press, UCLES, 2019; Cambridge Assessment, 2018). Their content was related to teenagers' preferences and knowledge. Each correct answer carried one point, and the total number of points yielded the final score.

4.9.6 Word Order Test

Similar to the tests on polysemy and tenses, there were two different versions of tests for word order. One was used as the pre- and post- test, and the other one was used as the delayed post-test (see Appendix 14) to measure the participants' language development in English word order.

The pre- and post- test included twenty statements. The participants were asked to read them and judge whether the word order was right or wrong. In case they considered it correct, they were asked to move on to the following statement, while on the occasion that they considered it false, they were asked to re-write the sentence by using the correct word order. There were six syntactically correct sentences and twelve incorrect ones. Scores were awarded on the condition that the participants had successfully judged whether the word order in each statement was correct or wrong. This marking criterion was selected since the binary choice allows for accurate assessment in comparison to evaluating the re-writing of a sentence. The sentences included a variety of word order rules which are usually demanding for Greek speakers of English since word order in Greek is less fixed than in English (Papaefthymiou-Lytra, 2001, p. 133). Therefore, the test included sentences a) in interrogative form since the auxiliary *do* and the inversion is not applicable in the Greek language, b) with direct and

indirect objects, c) adverbs, c) complements, d) relative clauses, e) indirect questions, and f) order of adjectives (Papaefthymiou-Lytra, 2001).

The delayed post-test in word order included eight statements of the demanding, syntactic structures mentioned above. The words were divided into separate units, and the participants were asked to write them down in the correct order (see Appendix 14). The same assessment criteria of one point for every correct answer as the previous tests were employed.

4.9.7 Interim Testing

During the classroom intervention, a listening test was administered to the participants at specific periods to identify any differences between the two groups. The participants completed the test one month after the intervention began (February 2022), at two (March 2022) and then three months (April 2022) after that. Both the intervention and control groups were randomly divided into three sub-groups to ensure variation in test versions. Each participant took a different version of the standardised A2 Key for Schools listening test each month, sourced from the A2 Key for Schools Trainer book (Cambridge University Press & UCLES, 2019, 2nd edition, tests 3,5,6: listening parts 4 and 5). The interim assessment test included two oral comprehension activities. The first activity was a multiple-choice exercise. The participants listened to five dialogues and had to answer a question on the content of the dialogue. Three possible answers were given, and they had to choose one of them, e.g.,

You will hear a girl talking about a video. Which part of the video didn't she understand?

A. the beginning

B. the middle

C. the end

The second activity was a matching exercise where the participants were required to match different kinds of information by listening to an extended dialogue between two

individuals (see Appendix 15). This activity was similar to the A2 Key for Schools (KET) exercise of the pre- and post- listening test. Each interim test lasted nine minutes, with the first activity taking six minutes and the second activity lasting three minutes. Following the Cambridge Assessment criteria, the total number of correct answers yielded each participant's final score.

Progress Table 4

Questionnaires and Tests on Individual Differences
Questionnaires on Factors Integral to Learning
Tests on Linguistic Knowledge
Other Questionnaires

4.10 Other Questionnaires

4.10.1 Demographics Questionnaire

The participants were asked to complete a demographics questionnaire designed by the author. The questionnaire was written in Greek and included questions about their grade, age, gender, native language(s), English language education, other foreign languages learnt, their free-time activities that include exposure to English, and their exposure to English in an English-speaking environment (see Appendix 16).

4.10.2 Technology Enjoyment Questionnaire

The questionnaire measuring learners' technology enjoyment addressed their preference to use technological devices on a general basis and any potential enjoyment deriving from technology integration in the English class (see Appendix 17). The first part, investigating the learners' general technology enjoyment, was administered to them before and at the end of the intervention to pinpoint whether technology integration in class could affect their general

attitude towards technology use. It was adapted from Knezek's (1997) Computer Attitude questionnaire using the Computer Enjoyment subscale, which was designed in a four-point Likert scale ranging from Strongly Disagree to Strongly Agree, and it is recommended for children aged 9-14. The Computer Attitude questionnaire has good reliability rates across all subscales (Knezek & Christensen, 1996). The changes made to the original questionnaire reflected the current technological advancements. For instance, the original statement '*I feel comfortable working with a computer*' was changed to '*I feel comfortable working with a computer (or a laptop, tablet, mobile phone)*'. Four out of nine statements in the first part had negative wording.

The second part of the questionnaire was administered at the end of the study, and it was designed based on two different original questionnaires to effectively measure the learners' perceptions of technology use in class. Specifically, seven questions were adapted from Ryan's (1982) Intrinsic Motivation Inventory using the *Interest/Enjoyment* subscale. Ryan's original questionnaire was designed in a seven-point Likert scale ranging from Not at all True to Very True, and it was condensed into a five-point Likert scale ranging from Strongly Disagree to Strongly Agree to be more easily comprehensible by young teenagers. Additionally, while the original questionnaire included statements on assessing enjoyment in general circumstances, it was adjusted to technology use in class. For instance, the original statement '*I enjoyed doing this activity very much*' was changed to '*I enjoyed using technology in the English class very much*'. Two of the six statements used were negatively cued. McAuley et al. (1989) examined the reliability of Ryan's (1982) Intrinsic Motivation Inventory and reported its good reliability rates.

The Students' Attitudes Toward and Knowledge of Technology questionnaire designed by Incantalupo et al. (2014) was the other questionnaire which was used for the 2nd part and included nine questions on Teaching with Technology. All questionnaire scales, including the

Teaching with Technology subscale, have high reliability rates (Incantalupo et al., 2014). The changes made to it reflected the use of technology in the English course. For instance, the original statement '*Technology improves my understanding of science*' was adapted to '*Technology improves my understanding of English*'. Similarly, Incantalupo et al.'s Likert scale (i.e., Agree, Tend to agree, Neutral, Tend to disagree, Disagree) was changed to a five-point Likert scale ranging from Strongly Disagree to Strongly Agree. This adaptation was made for clarity reasons, considering that the participants in Incantalupo et al.'s study were older (14 - 18 years old) than those in the present study. The remaining eight questions in this section were added by the author to further reflect learners' perceptions of technology usage in class. Three of these statements had a negative connotation (i.e., *I was nervous while using technology in the English class*).

4.10.3 Teacher's Questionnaires

Aiming to review the teacher's equal behaviour and effort in both groups, she was observed by two different teachers during the main intervention stage. Specifically, her mood while teaching the intervention and the control group was assessed by the English Teacher of the school, who acted as an observer throughout the lessons and was informed about the content of the study. A teacher's mood in the lesson is crucial as it affects the quality of classroom instruction (Frenzel et al., 2015). The English teacher was a 38-year-old female with 19 years of teaching experience who assessed the teacher's mood in the classroom at the end of every month of the intervention. The observations were performed on the same day for both groups while teaching the same lesson to ensure consistency and minimise interference of other parameters (e.g., different teaching content). The tool used for evaluating the teacher's mood was the original English version of the Brief Mood Introspection Scale (Mayer & Gashke, 1988; see Appendix 18). The first part included the same adjectives and Likert scale presented in section 4.8.2 **Mood Questionnaire** above. The observer was asked to characterise the

teacher's mood using the provided list of adjectives. The observer also evaluated the teacher's overall mood using a 20-point Likert scale ranging from -10: *Very Unpleasant* to +10: *Very Pleasant* with a 0-option included. A final open-ended question was also included for any additional comments.

The second type of observation was conducted by another teacher who had no insights into the study. The second observer was allocated to the school as a Classics Teacher and was a 52-year-old female with 17 years of teaching experience. She was asked to observe the teacher teaching the same lesson to both groups on the same day and complete a questionnaire on the teaching methodology during her observation (Appendix 19). The first part of the questionnaire focused on the learners, and the observer judged their enjoyment, encouragement, interest, engagement, anxiety, and boredom during the lesson. A five-point Likert scale anchored by 1- Not at all, 2- Slightly, 3- Moderately, 4- Very, 5- Extremely was used. The second part included the same questions using the same Likert scale, but, in this case, the observer focused on the teacher. Three questions on the teaching strategies used in the lesson were added in the second part. Specifically, the observer was asked to judge whether the researcher a) fully addressed the questions of all students in both groups, b) explained carefully, and c) prepared for the lesson. The observer assessed the general atmosphere of the lesson and the teacher's and the learners' moods using a five-point Likert scale ranging from Very Unpleasant to Very Pleasant. The last part included an open-ended question used for any additional comments. The questionnaire for the second type of observation was designed and translated by the author and was distributed in Greek.

5. CHAPTER 5: THE CLASSROOM INTERVENTION AND TEACHING MATERIALS

5.1 Introduction

This chapter describes how the classroom intervention was conducted and the teaching materials used for the lessons. It begins by describing an overview of the intervention. Section 5.2.1 **Teaching Approach, First Lesson, and Feedback** below presents the structure of the lessons, covering the teaching approach, the very first lesson, and feedback. This section aims to introduce the teacher's general teaching approach used in all lessons in both groups. Sections 5.2.2 **Reading**– 5.2.4 **Speaking** focus on the teaching methodology of the targeted language skills (i.e., reading, listening, speaking), and sections 5.2.5 **Tenses**– 5.2.7 **Polysemy** analyse the teaching methodology of the kinds of linguistic knowledge (i.e., tenses, word order, polysemy). Section 5.2.8 **Games for language learning** describes the role of games that were conducted in class for language learning purposes. After explaining how the targeted language skills and kinds of knowledge were taught, the teaching materials used for teaching both groups are described next in section 5.3 **The Teaching Materials** below. The role of the researcher in the intervention is presented in section 5.4 **The Role of the Researcher**.

5.2 The Classroom Intervention

The classroom intervention was the main stage of the present study and focused on technology-enhanced language learning and traditional paper-based language learning. Before the beginning of the data collection, all lesson plans (see Appendices 20, 21) were designed, and all the materials were created to address the learning needs of the control and the

intervention group (see appendix 22 for the control group and appendix 23 for the intervention group). The important elements of any lesson (i.e., the main aim and duration of the lesson, the sub-aims, the order and content of the activities, the skills practised, the interactional focus, and the teacher) were the same across all lessons for both groups. The difference between the two groups was the means of delivery of the teaching materials. The control group was taught with the use of paper-based teaching materials to follow a traditional language learning method, and the intervention group was taught with a combination of digital and paper-based teaching materials to follow a technology-enhanced language learning method. The similarities and the difference in the methodology design for both groups are presented in Table 6 below.

Table 5

Similarities and the Difference Between the Groups

Similarities Between The Two Groups	Difference Between The Two Groups
Content of teaching materials	Means of delivery of the teaching materials: Technological materials vs. paper-based materials
Duration of each lesson	
Duration of total intervention	
Interaction focus among students and teacher	
Learning aims of class activities	
Main lesson aim	
Order of Activities	
Skills practised in class	
Teacher	
Teaching Approach	

The methodologies employed in both groups included: a) a Presentation-Practice-Production (PPP) methodology, b) inductive/deductive learning, and c) a Communicative Language Teaching (CLT) methodology due to their widespread use and effectiveness in ELT contexts.

The lessons followed a Presentation-Practice-Production (PPP) methodology. Initially, the targeted structure was presented, the students were then asked to practise it, and ultimately, they engaged in producing it. A PPP methodology leads to improved L2 performance (Jones & Carter, 2014) and was implemented through contextualised presentations of the targeted structure, multiple-choice exercises, gap-fill tasks, and free-production activities (Anderson, 2017). The presentation stage was structured by following an inductive/deductive learning approach. Studies have either favoured the deductive approach to language learning (e.g., Erlam, 2003), the inductive approach (e.g., Haight et al., 2007), or both of them (e.g., Tammenga-Helmantel et al., 2016; Takimoto, 2008). Addressing these contradictory findings was beyond the scope of the thesis, and a combination of inductive/deductive learning methodologies was employed. An inductive learning methodology proceeded the deductive one in the presentation stage to engage learners in the learning process and prompt them to reflect on and expand their current knowledge before presenting the rules. Inductive learning was achieved by focusing learners' attention on the targeted structure and asking them to understand and explain the underlying rule or the word's meaning. In contrast, deductive learning was achieved by presenting the rule or the explanation of the word's meaning (Shaffer, 1989, p. 396).

The Presentation-Practice-Production methodology and the inductive/deductive learning were employed in both groups by only altering the environment of the teaching materials. Specifically, during the presentation stage, the participants were exposed to identical sentences and pictures. The sentences and pictures were provided through PowerPoint Presentations for the intervention group, while the control group received the same sentences

handwritten on the whiteboard with printed pictures attached. Additionally, for the acquisition of the present simple tense, the intervention group watched a YouTube story, whereas the control group was provided with a printed version of the same story, maintaining all pictures and sentences. In the practice stage, fill-in-the-gaps or multiple-choice activities were used as online quizzes for the intervention group, while the control group worked on the same type of activities with identical sentences using photocopies. Finally, during the production stage, the intervention group used a website to create cartoons using the present continuous tense, while the control group created their cartoons manually in their notebooks. This process ensured that regardless of the lesson aim – e.g., present simple, present continuous, etc. – both groups completed the same kind of activities with identical sentences and the only differentiating factor was the environment of the materials, paper-based vs digital.

The combination of PPP and inductive/deductive learning was further supported by a Communicative Language Teaching (CLT) methodology. All the lessons of both groups were designed following CLT which highlights “the importance of active, communicative involvement in language learning (Oxford et al., 2008, p. 30). A communicative approach to learning fosters competence in all four skills, and enables L2 learners to take an active role in their learning and leads to L2 improvement (Cao, 2023; Oxford et al., 2008). In the present study, a communicative approach to learning was achieved by asking students to engage in the lessons through collaborative work, peer-checking, and offering opportunities for oral expression. These teaching strategies align with Ellis’ (1982) recommendations for effective approaches to communicative language teaching.

5.2.1 Teaching Approach, First Lesson, and Feedback

The control and the intervention groups shared the same teaching approach delivered by the same teacher. The English language was used as a means of communication in every situation, including greetings, discussions, instructions, classroom management, and any kind

of speaking undertaken in class. The English language was used both by the teacher and the learners. The only cases when Greek – which was the participants' and the teachers' native language – was used were instances of learners' difficulty in expressing complex matters in English, severe cases of classroom disruption, and interruptions caused by external factors (another teacher or the head teacher coming to class for announcements). The desks were placed in a horseshoe arrangement, but this was subject to change depending on the type of activity undertaken. For instance, the desks were rearranged in group activities based on the number of students in each group. Learners had pre-assigned desks and seats and were advised to change their seats depending on their needs, the type of activity, and if they were absent.

The teaching approaches followed were based upon communicative methods where students express themselves and are at the centre of the learning process. The general aim was to create a relaxing and engaging atmosphere where everybody contributed to the lesson. The goal was to make learners part of the learning process by prompting them to be independent and autonomous. The general teaching strategy was set on the teacher not being involved in an activity learners could perform independently. Group work and pair work were thus standard practices to shift the attention from the teacher to the learners so that the latter could communicate more and rely less on the teacher. In those cases, the teacher acted as a facilitator when comprehension or collaboration issues emerged. With regards to how lessons unfolded, the topic of each lesson was introduced in the first minutes by letting students speculate on it or by presenting its different stages. The same order of activities was followed in every lesson so that learners were calm and familiar with how the lesson would unfold. At the end of each lesson, students were asked to ask questions on the topics covered and to reflect on their own learning.

The first lesson for both groups was an introductory one to inform learners about the structure of the upcoming lessons, the questionnaires to be completed each time, and classroom

management rules. The first lesson was important to establish the rules of the classroom and make students aware of how the lessons would continue. Icebreakers were completed to acquaint learners with the course content and the teacher and to establish peer-to-peer and peer-to-teacher interaction. After this initial interaction, every lesson started with greetings and news exchange to smoothly reintroduce students to the learning process after recess. Completing exercises in class followed a fixed structure; first, the instructions, which were simple, brief, concise, and in English, were given to the learners by the teacher; secondly, the first question of each exercise was always answered jointly as a class; and then, learners were asked to proceed individually or in pairs/groups. In the end, activities were reviewed by sharing answers with the whole class, in pairs or groups, and feedback was provided in different forms (e.g., recast, elicitation of the correct form) by the teacher and students.

Positive feedback was a prevalent technique throughout the lessons to prompt learners to participate in the learning process. Learners' praise was expressed in English and occurred in cases of good class behaviour, effort, and participation. There were also cases of reprimanding when learners misbehaved in terms of disrespect or inappropriate language use towards their classmates and lack of acting by classroom rules. As a classroom management technique adopted by the teacher of the lessons, an assigned student was partly responsible for class-related issues, e.g., deciding on the order of speakers, writing on the board, distributing photocopies and questionnaires, or noticing and commenting on classmates' behaviour when they did not follow classroom rules. In what follows, a detailed explanation of the methodological steps of teaching different language skills and kinds of linguistic knowledge is presented. The teaching steps explained below cover both groups as a general teaching approach.

5.2.2 Reading

The texts available in students' coursebooks were used to practise reading by modifying the activities proposed by the coursebook authors. In other words, a more structured approach to reading was adopted as an alternative to the coursebook's simple reading comprehension activities to enhance learners' procedural knowledge of reading comprehension strategies e.g., skimming, scanning, detailed reading. A more structured approach was adopted based on Sweller's (1988) Cognitive Load Theory (CLT), which emphasises the critical role of working memory in information processing. To prevent overloading learners' working memory and to enhance their information processing, the reading practice was organised into three stages: a pre-reading stage, a while-reading stage, and a post-reading stage. Specifically, the learners first identified the reading topic by examining the title and adjoining pictures. In cases where they could not identify the topic, guidelines on how to scan and skim the text were given to facilitate the process. Depending on the lesson aims, reading comprehension activities were completed, or the texts were used to teach grammatical knowledge. Reading comprehension was first accomplished by introducing related vocabulary and then by detailed reading, during which students wrote subheadings to each paragraph and answered content comprehension questions. Any unknown vocabulary was explained at the end or on the spot when learners could not decipher the meaning based on the context. In cases of defining an unknown word, classmates were first asked to explain it, and feedback or further explanations were subsequently presented by the teacher if needed.

5.2.3 Listening

The listening practice followed specific steps to gradually introduce learners to the topic of the listening activity and familiarise themselves with the vocabulary. Listening practice was structured in three stages – a pre-listening stage, a while- listening stage, and a post- listening stage – following the premise of CLT (Sweller, 1988) outlined above. Specifically, learners

were first asked a personalised question related to the topic. Then, they brainstormed words which were related to the topic and were expected to be heard in the audio files. A student wrote the words on the whiteboard to check spelling, and ample time was allocated for learners to take notes and ask any questions. When the learners completed the listening activity, they were asked to share their answers among themselves (i.e., collaborative checking) or in class (i.e., class checking). They gave their answers to the questions, and the whole class gave feedback by replying to the teachers' questions on whether they agreed with the answers proposed by the students. In case of problematic replies, the audio was re-played to distinguish the part where the answers were mentioned and identify the correct answer over the other ones. When these listening stages were completed, the audio was used to practise pronunciation and intonation by repeating certain parts. This process tapped into learners' declarative knowledge of vocabulary, grammar, sounds, and intonation during oral input and was selected to facilitate listening comprehension during both the pre/post listening tests and the interim testing.

5.2.4 Speaking

Regarding speaking, learners' speaking skills were practised in different ways, either by free discussion or guided discussion using speaking materials. In relation to free discussion, a topic was chosen, and students were asked to engage with it in pairs/groups while the teacher supervised the process. In the case of guided practice, the teacher used speaking materials to set an example of a) what was expected from learners to produce, b) the structure they needed to follow, and any keywords or phrases essential and related to the topic. Learners were then asked to present their speaking part, and feedback was given at the end. Specifically, the rest of the students were asked to take notes of any grammatical, syntactical, and pronunciation mistakes made by the speaker and share them afterwards. The teacher facilitated this process by commenting on or adding to the erroneous statements. The student who practised speaking was never interrupted unless the speech was incomprehensible to the audience, or the meaning

was ambiguous. Free discussion measured learners' procedural knowledge of a variety of language structures while guided practice measured their declarative knowledge of the targeted structures. The two types of speaking practice were grounded in the scaffolding approach to learning, which is based on Vygotsky's (1978) sociocultural theory of cognitive development and the concept of the Zone of Proximal Development (ZPD). Specifically, through guided speaking practice, learners received the necessary support – e.g., grammar, vocabulary, syntax – to engage in oral production. This support aimed at providing them with the necessary language skills to participate in free speaking, which was required for the pre- and post-speaking test.

5.2.5 Tenses

As described in section 5.2 The Classroom Intervention above, the targeted language structures of the intervention – i.e., tenses, word order, polysemous words – were taught using a PPP methodology. The strategies used to these structures are presented in sections 5.2.5 Tenses), 5.2.6 Word *Order*), and 5.2.7 Polysemy), and were chosen to enhance learners' declarative knowledge of these structures. Section 5.3 The Teaching Materials below provides a comprehensive description of each teaching activity implemented to enhance learners' declarative knowledge of the structures and presents their connections to the tests. The pre- and post- tests assessed learners' declarative knowledge of the language structures.

Tenses were first introduced via elicitation by exposing students to them through sentences and examples. Students were then prompted to produce their own sentences in Present Simple and Present Continuous. Following this process of inductive learning where learners understand the grammar rule through sentences without the teacher's explanation of the rule (Shaffer, 1989), concept-checking questions were integrated into the learning process. Concept-checking questions were an essential part of grammar teaching to ensure learners' understanding of the rules of the tenses. Particularly, learners were asked binary questions (e.g.,

yes or no, this or that) related to the distinct uses of the tenses, e.g. “*Is Present Continuous used for actions that happen regularly or now?*” The choice of asking concept-checking questions after inductive learning lies in the fact that some learners benefit from explicit exposure to grammatical explanations.

Following these two stages, the grammar practice stage was implemented using different techniques, including a) activities and quizzes, b) teamwork where students collaborate and produce the tense forms or c) class presentation of the student's work. For more demanding grammatical points (i.e., auxiliary verbs, distinguishing Present Simple vs Present Continuous), the exposure was gradual by breaking the grammatical information into chunks (e.g., affirmative form before auxiliary verbs) to ascertain learners' understanding before moving to the practice stage.

Furthermore, before introducing new rules on how the tenses are formed, any rules covered in the previous lessons were revised. The strategy of revising before introducing new grammatical knowledge was adopted to ascertain their comprehension and refresh their memory of previously acquired grammatical forms. Notably, in the grammar revision stage of a lesson, students were first asked to produce sentences in a tense, review spelling irregularities, and then reflect on their uses by answering concept-checking questions.

In terms of the teaching materials used to teach grammatical structures, reading texts were implemented to make learners aware of the tenses and their keywords. Specifically, they were asked to read through a text, notice, and underline the verb phrases which contained the two tenses along with any keyword available. This process was followed to form an association between forms and keywords and distinguish when each tense is used. The learners completed exercises to consolidate their grammar knowledge. These exercises included word order of the tenses, completing sentences with keywords (e.g., every day, at the moment), distinguishing and forming one of the two tenses in fill-in-the-gap statements, and forming wh-questions on

the condition that they had understood which tense should be used based on the provided answer. The coursebook activities were slightly altered by adding extra sentences to fully cover the different tense uses.

5.2.6 Word Order

With regards to the other targeted kind of linguistic knowledge, word order, learners were first exposed to it implicitly by asking them to put the words of a sentence in the correct order without introducing them to any syntactical rules. The syntactical rules on word order were afterwards analysed using acronyms (e.g., Subject, Verb, Object: SVO) to make them memorable. Exposing learners to word order structures without explaining any rule, followed by the explanation of syntactical rules through acronyms, aligned with the inductive/deductive learning approach explained in 5.2 The Classroom Intervention above. Each word order rule was accompanied by sentences to present rules in context. Learners were asked to read the sentence and decipher the word order rule. In cases where this was too cognitively demanding or unsuccessful, the rule was explained. The practice stage proceeded with a variety of activities, which were a) multiple-choice ones where learners had to select the syntactically correct sentence, b) fill-in-the-gap ones where learners had to distinguish adverbs' place in a sentence, and c) open-ended ones where they had to write a sentence following a specific word order rule. The activities were completed individually or in pairs; in the first case of individual work, the answers were checked collaboratively between two learners and then shared with the whole class for feedback and any follow-up questions or clarifications. In the second case of pair work, the teacher provided feedback on the spot while invigilating and guiding the whole process. Any frequently noticed mistakes were then shared with the whole class.

5.2.7 Polysemy

The other linguistic focus of the study, polysemous vocabulary, was taught using different materials (e.g., pictures, definitions, sentences) so that learners were presented with

multimodal learning materials to facilitate all learning types – visual, auditory, kinaesthetic, or a combination of those. This merging of various techniques and approaches lies in the learners' individual differences so that they can benefit from their preferred and effective way of learning and not erroneously compel them to adapt to the lesson plan and structure.

Similar to the process of teaching tenses and word order described above, a PPP methodology for polysemous words was adopted. In the presentation stage, polysemous words were taught using pictures to refrain from using Greek in class. Specifically, pictures were shown to the learners, and the term depicted was first elicited and then written on the board. Students were asked to spell the word, and in the cases where they were not familiar with the term or its spelling, the teacher gave the first syllables until the word was fully spelled. Upon completing this familiarisation stage, the teacher or a student showed the pictures, and the rest of the class had to recall and correctly pronounce the word. The next stage incorporated a mnemonics technique where students were asked to cite the words on the pictures in reverse order to further practice word recall and recognition. Alternatively, flashcards were utilised to elicit the polysemous terms, and then the practice techniques mentioned above were followed.

Polysemous words were also taught using sentences containing each word and their various meanings to expose students to the word context. Particularly, learners were asked to read sentences and guess the meaning of the polysemous word. When they had accurately interpreted the meaning, they were asked to compare the general meaning of the word with the polysemous meaning (e.g., *hand* as the body part vs. help or workers as the polysemous meaning). This process was adopted to identify the divergence of the two meanings and whether there is a similarity with the word's core sense or if it is an example of metonymy or metaphor. Students also practised their knowledge of polysemy by reading sentences and matching them with a picture. Specifically, pictures and pairs of sentences of the different senses of a polysemous word were given to the learners. They were asked to decipher the

meaning of the polysemous word as shown in a sentence and then match it with the equivalent picture. This activity aimed to distinguish the different meanings by correlating them with a picture to expose learners to a more memorable learning technique.

Practising polysemous words was accomplished by orally forming sentences upon the first exposure to the target word, solving fill-in-the-gap exercises, and providing their definition. Fill-in-the-gap exercises included sentences which needed to be completed with one correct word out of four possible choices. The choices included a) the target polysemous word, b) its equivalent term, which is demanding to be distinguished (e.g., miss vs lose), c) another irrelevant-to-the-context polysemous word, and d) a completely random word. Definitions offered students an alternative way of practising the senses of polysemous words and familiarising themselves with English-to-English translation. In particular, words were divided into groups of sentences accompanied by dictionary definitions. Learners were asked to read the sentences, decipher the meaning, and match it with the equivalent definition. The teacher asked supplementary clarification questions on the differences in word meanings to ascertain learners' understanding and accurate comprehension of the definitions. Any unknown word was explained by providing synonyms, sentences, drawings on the whiteboard, or class objects. In the event that those techniques were not conducive to their vocabulary learning, keywords and sentences of personalised context or illogical/surprising connotations were written on the board to facilitate learners' recall of the definition. The only case where a Greek translation was provided was when the meaning of the target word was too complex to be understood by young teenagers, for instance, in the case of abstract concepts. Ample time was provided for the students to take down notes, ask questions or clarifications, and share their concerns or instances of misunderstanding.

Vocabulary revision occurred frequently to maximise exposure to words. Reviewing learners' vocabulary acquisition was accomplished by brainstorming previously learnt words,

asking for their definitions, and producing sentences that effectively portrayed their different senses. To facilitate vocabulary acquisition, students were also asked to reflect on their vocabulary learning by sharing their vocabulary learning techniques before the teacher presented alternative ways of studying vocabulary.

5.2.8 Games for language learning

Game-based learning suggests that players acquire new knowledge while trying to succeed in a game (Gee, 2008). Games were frequently included in the lessons as a teaching technique of letting learners practise a language structure or skill while interacting with each other without explicitly realising that they are taking part in the process of learning. Games created a competitive atmosphere and were carried out at the end of the lesson as a follow-up exercise to the skills or language structures taught. Quizzes, realia and in-class objects were used as part of the games played individually, in pairs, or in teams (for a detailed analysis of the games, see the Lesson Plans in Appendices 20 for the control group and 21 for the intervention group).

5.3 The Teaching Materials

A variety of teaching materials accompanied the teaching strategies explained above. This section describes the teaching materials used for each activity, the kind of knowledge they measured, their connections with the tests and the theoretical background of each activity. The teaching materials were designed to mirror an authentic language classroom environment and were selected to address the lessons' learning aim and create variety and engagement in the lesson. To ensure that all participants were exposed to the same linguistic contents, overlapping teaching materials were used for both groups. An array of digital materials was used for the intervention group and was transformed into paper-based ones for the control group. Table 6 below presents an overview of how the intervention group's teaching materials were transformed into paper-based ones and the pedagogical reasons for their selection.

Table 6

Correspondence of Teaching Materials in Both Groups and the Reason for Selection

Intervention Group	Control Group	Reason for Selection
www.storyboardthat.com	Cartoon story on notebook	<i>A personalised way to practise tenses in an entertaining way through cartoon creation</i>
Online games	Classroom games	<i>Practising linguistic knowledge in an inductive and entertaining way</i>
Online quizzes (mentimeter.com, kahoot.com, wordwall.net)	Photocopied quizzes	<i>Practicing each lesson's learning aim</i>
Online flashcards (cram.com)	Printed flashcards	<i>Learning and practising vocabulary</i>
Pictures on the Interactive Whiteboard	Printed pictures	<i>Explanation of word meanings without the use of the native language</i>
VR and augmented reality activities	Printed pictures from the VR and augmented reality activities	<i>Practising listening, speaking, pronunciation</i>
Stories on YouTube videos	Printed YouTube stories	<i>Implicit exposure to tenses</i>
QR codes	Slips of paper	<i>Drawing students' attention to auxiliary verbs</i>
The Speaking Wheel on wordwall.net	Speaking topics printed on a sheet of paper	<i>Practising speaking</i>
PowerPoint Presentation (PowerPoint, quizizz.com)	Whiteboard use	<i>Elicitation and explanation of linguistic knowledge. Brainstorming.</i>

As shown in Table 5 Table 6 above, the difference between the two groups was the means of delivery of the teaching materials. Specifically, the intervention group was taught with digital learning materials, whereas the control group was taught with paper-based ones. The control group's teaching materials included the use of the whiteboard, learners' notebooks, realia, texts, short stories, slips of paper, photocopies, pictures, and flashcards, which are materials employed by teachers adhering to a traditional, paper-based teaching approach. Correspondingly, the Interactive Whiteboard, PowerPoint Presentations, online games and quizzes, educational websites, apps, and augmented and virtual reality activities were used for the intervention group to reflect teachers' choices when opting for a technologically enhanced teaching methodology. The content and learning aim of each lesson specified when and how technology would be incorporated. Constant exposure to digital materials for the intervention group was not adopted as this would not resemble actual teaching practices and would be beyond the scope of the present research. This is the reason why there were some overlapping teaching materials, and are explained in the following section.

5.3.1 Overlapping Teaching Materials

Overlapping teaching materials were included for both the intervention and control groups to create an authentic language-learning experience. No teacher relies solely on digital materials in class; instead, a combination of paper-based materials and digital resources is employed. Paper-based overlapping teaching materials were hence used for both groups, and included English coursebooks, listening activities, and photocopies with sentences with polysemous words. The remaining teaching materials were delivered in a digital format suitable for the intervention group (see section 5.3.2 The Intervention Group below) or in paper form and on the whiteboard for the control group (see section 5.3.3 The Control Group below).

Firstly, the school's English coursebooks were used in both groups. Specifically, coursebook exercises were selected according to the lesson aims. They were used to practise a) the spelling rules and form of Present Simple and Present Continuous, b) the word order of the tenses, and c) to distinguish the tense needed and then conjugate the verb in the correct form. These activities measured learners' declarative knowledge of English tenses and followed the structure of the tests on tenses. Both in the tests and the activities, learners were asked to accurately form each tense, produce its correct orthography, and identify the appropriate tense based on the given context. Teaching the accurate form and orthography, and distinguishing the correct tense based on the context was structured in chunks, aligning with Sweller's (1988) Cognitive Load Theory. The coursebook also provided texts which were employed for reading comprehension activities, e.g., skimming, scanning, and understanding the general theme of each paragraph, as explained in section 5.2.2 Reading above.

In addition to the coursebook, both groups had the same oral comprehension practice using listening activities from the A2 Key for Schools English proficiency exam (Cambridge University Press & UCLES, 2019). The first activity involved a multiple-choice exercise where learners listened to a short dialogue and answered a question. The possible answers were provided in the form of pictures, and the students selected the picture that accurately represented the answer to the question. Subsequent, more demanding listening comprehension activities, structured similarly to the interim testing, involved a) short dialogues followed by multiple-choice questions and b) a more extended dialogue where students distinguished oral information and matched a person's name with an appropriate activity. The same types of activities were included in both the pre- and post- listening tests. In-class exposure to similar listening activities aimed to enhance learners' declarative knowledge in listening and help them become familiar with answering multiple-choice questions while listening to dialogues. The decision to gradually expose learners to more demanding activities was based on the principles

of scaffolding learning and Krashen's (1982) concept of comprehensible input. These approaches suggest that learners expand their existing knowledge by being incrementally exposed to oral information slightly beyond their current proficiency level.

Regarding polysemy, all participants received photocopies containing sentences with polysemous vocabulary. They were asked to decipher the meanings of the words based on the context of the sentences. Then, they matched the words with their definitions or pictures which were displayed on the whiteboard or the interactive whiteboard for the control and the intervention group, respectively. The definitions and sentences were written in English and were extracted from the Longman Dictionary. The pictures illustrated the different meanings of the polysemous words. This activity aimed to enhance learners' declarative knowledge of polysemous words. The focus on distinguishing contextual cues in vocabulary learning is grounded in Sternberg's (2014) proposition that context facilitates vocabulary acquisition. By exposing learners to the contexts in which each polysemous word is used, they became familiar with the type of activities in the pre- and post- tests on polysemy where they had to determine whether a word was used correctly in a sentence.

Table 7 below provides an overview of the overlapping teaching materials and the pedagogical reasons for selecting each material. Concisely, the A2 Key for Schools listening activities were used to expose learners to different types of oral interactions. The coursebooks set for secondary school students by the Greek curriculum were employed to practise English tenses and improve reading comprehension skills. Finally, sentences from the Longman Dictionary were extracted to introduce students to words in context and provide precise definitions of polysemous words during vocabulary activities. The complete version of the overlapping teaching materials can be found in Appendix 27.

Table 7*Overlapping Materials and Reasons for Selection*

Teaching Materials of Both Groups	Reason for Selection
A2 Key for School listening part	<i>Practising listening via shorter and longer dialogues, multiple-choice & matching activities</i>
Coursebooks	<i>Recommended by the Greek curriculum Distinguishing Present Simple & Present Continuous Correct formulation of the tenses Reading Comprehension (e.g., skimming, scanning, writing subheadings to each paragraph, answering comprehension questions)</i>
Photocopies with sentences with polysemous words from the Longman dictionary	<i>Deciphering word meanings based on context Matching polysemous words with pictures Matching polysemous words with their definitions</i>

5.3.2 The Intervention Group

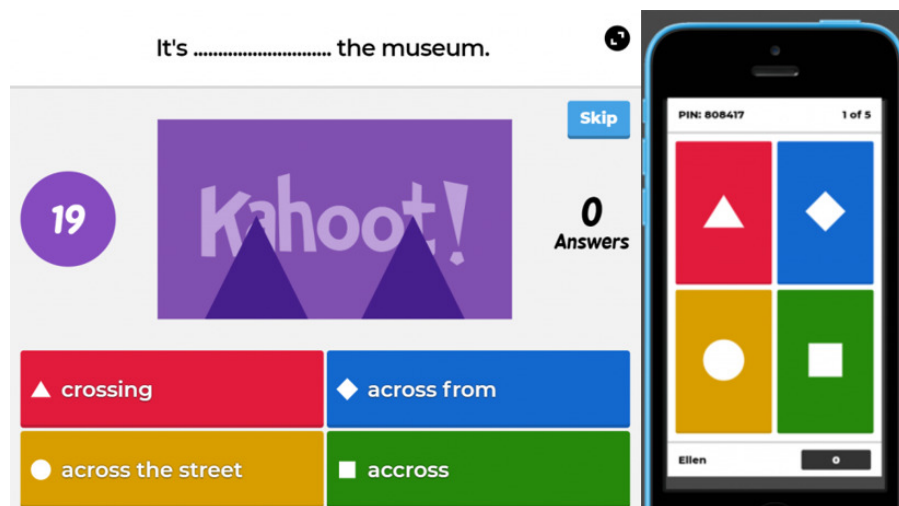
The intervention group was gradually introduced to technology to teach the language structures and skills examined in the present intervention (i.e., tenses, word order, polysemous vocabulary, listening and speaking). Initially, the Interactive Whiteboard (IW), PowerPoint presentations, and Google images were used in the primary classroom to familiarise students with the lesson structure and to practise the Present Continuous tense. This first technology-based learning experience was followed by using computers in the IT classroom. The participants created an online comic book on storyboard.that by producing statements in Present Continuous according to comic writing guidelines. This process of inductive learning of the Present Continuous tense transitioned to using YouTube videos to expose students to the Present Simple tense and practise its affirmative form. The PowerPoint presentations with the relevant images and the YouTube videos helped familiarise learners with the form and use of

the tenses. The activities measured their declarative knowledge in a manner similar to the tests on tenses, where learners were tasked with correctly forming tenses and identifying the appropriate tense based on context. In line with Schmidt's (2012) noticing hypothesis, learners were required to notice how each tense was formed and understand when it is used. Regarding the activity of creating a cartoon, this measured their procedural knowledge since learners were asked to produce sentences in Present Continuous, similarly to the test on tenses. A comic book creation is an example of Task Based Language Teaching (TBLT) where learners use their own linguistic resources to engage in meaningful authentic language learning (Ellis, 2021).

QR codes were introduced next. Learners used their mobile phones to scan them and reveal auxiliary verbs aligning with Bruner's (1961) discovery learning which emphasised the importance of learners' active role and discovering to build new knowledge. The auxiliary verbs were used to elicit and teach the interrogative and negative forms of the Present Simple tense, and were used to improve learners' declarative knowledge for the tests on tenses. To practise what they had learned, learners participated in online quizzes using their mobile phones. For instance, the *kahoot.com* website was used to access a quiz. Learners entered a code and their selected names on kahoot.it, read questions and chose the correct answers. Each question was accompanied by musical elements and a timer countdown lasting from 5 seconds to 4 minutes, depending on the type of question. A specific colour (e.g., red, blue, yellow, or green) was assigned to each answer, and students had to press the equivalent-coloured bar on their phones (Figure 1 below). Points were awarded based on the speed and accuracy of responses. After each question, the correct answers, the points accumulated, and feedback were displayed on the IW and their mobile phones.

Figure 1

The Kahoot.com Website²

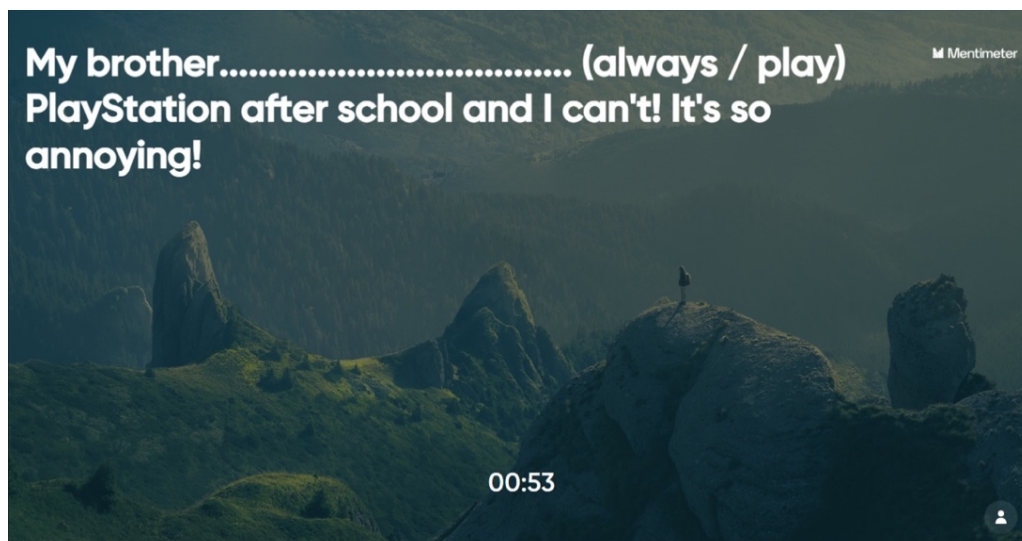


Mentimeter.com was another tool used for grammar practice. After accessing the site via a provided code, learners typed their names, and an avatar was assigned to them. Then, they answered questions on their mobile phones. Particularly, they had to determine whether the Present Simple or Present Continuous was appropriate for a given sentence and type the correct form (Figure 2 below). Faster correct responses yielded higher scores, which were shown after each question. All answers given by the students, along with the correct ones, were displayed on the screen for feedback. The online quiz was accompanied by music. Wang and Lieberoth (2016) found that the addition of music and points accumulated based on the time pressure in *Kahoot* quizzes has a positive effect on learners' concentration, engagement and motivation compared to the absence of these two characteristics. Additionally, the choice to include musical elements and time pressure was made to establish a competitive atmosphere which motivates learners (Zhou, 2016) and to create an authentic language learning environment where EFL teachers utilise the *kahoot.com* website without removing these two characteristics.

² Picture taken from <https://educationalgamedesign.com/kahoot-as-an-engaging-game-based-learning-tool.html>.

Figure 2

Type-in Question on menti.com



Quizizz.com offered a blend of online presentations and quizzes where learners accessed a presentation on the IW and their mobile phones. The presentation comprised two parts: The first part was a slide covering theoretical content (e.g., word order rules) and sentences. The second part contained a timed question related to the previous theoretical slide. The learners answered the questions by choosing an option or typing their answers. Music accompanied these quizzes, and correct answers were shown after learners had submitted their answers. In the end, a leaderboard of the points accumulated by each student was broadcast (see Appendices 24, 25, 26). The online quizzes on *kahoot.com*, *mentimeter.com* and *quizizz.com* measured learners' declarative knowledge of tenses and included the same kinds of activities as the pre- and post- tests on tenses. Specifically, the questions of the quizzes prompted learners to practice forming the tenses correctly and distinguishing which tense to use based on the context. The online quizzes were structured following Deterding et al.'s (2011) definition of *gamification*, which is the use of game design elements in non-game contexts (p. 11), due to the positive effect of gamification on learners' motivation and engagement (Azzouz

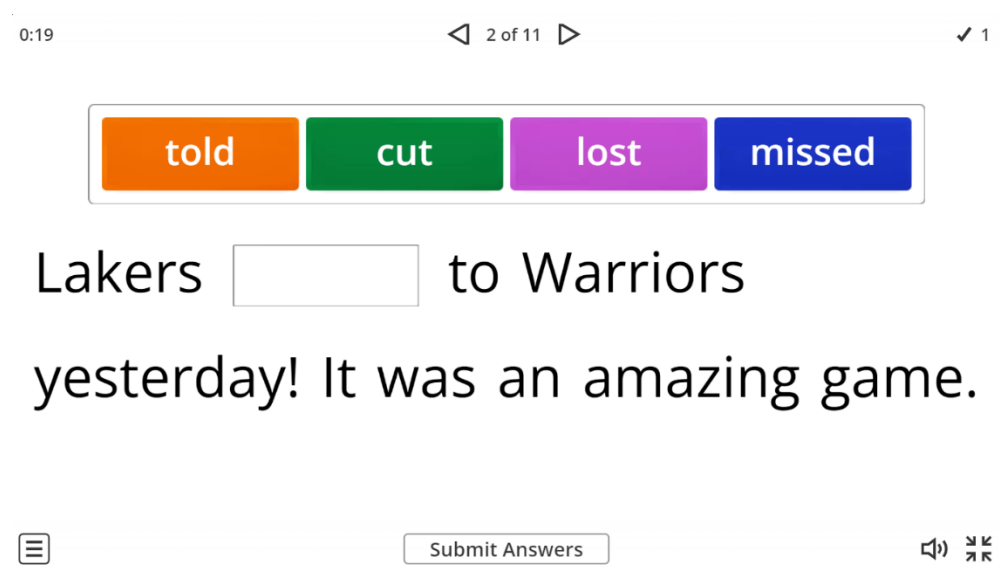
Boudadi & Gutiérrez-Colón, 2020). Gamification has been associated with Deci and Ryan's Self-Determination Theory (SDT) since it enhances learners' autonomy, competence and relatedness which can positively affect their intrinsic motivation (Botte et al., 2020; Lamprinou & Paraskeva, 2015; Van Roy & Zaman, 2017).

For polysemous words, a PowerPoint presentation with images introduced students to their different meanings. The PowerPoint presentation with images was selected to refrain from using the Greek translation when students guessed the different meanings. To practise polysemy, a quiz on polysemous vocabulary was designed on *wordwall.net* and was accessed through mobile phones by scanning QR codes broadcasted on the IW. In the quiz, students read a sentence and chose the word that best fitted the gap by dragging the correct answer (Figure 3 below). At the end of the quiz, the leaderboard with the students' names and scores was displayed. Flashcards on *cram.com* were also used to practise polysemous words. They were displayed on the IW, featuring both the written version and an image of the word to aid learning and practice. The PowerPoint presentations and the quiz on *wordwall.net* were used to measure learners' declarative knowledge and the flashcards tapped into their procedural knowledge of polysemous words. Similarly to the tests on polysemous words the learners were asked to read a sentence, understand the context and choose the correct polysemous word, the PowerPoint presentations and the quiz on *wordwall.net* exposed learners to sentences with polysemous words. These activities enabled them to practice and explore the different meanings of polysemous words. The flashcards were employed to help learners acquire the different meanings of words through visual cues. The integration of PowerPoint presentations and flashcards into the lesson aimed to accommodate diverse learning styles – Visual, Aural, Read/Write, and Kinaesthetic (VARK) – in line with Fleming and Mills' (1992) VARK learning style model. This approach ensures learners can engage with the material through their preferred mode of learning. Additionally, *wordwall.net* was employed to enhance learners'

intrinsic motivation and introduce gamification elements, similar to the online quizzes on platforms such as *kahoot.com* and *mentimeter.com* mentioned above.

Figure 3

Polysemy Quiz on wordwall.net



Speaking skills were practised using a musical speaking wheel on wordwall.net, which transformed speaking exercises into engaging activities (Figure 4 below). Students had to press a button on the IW to spin the wheel and answer the revealed questions. After answering the revealed question, this was eliminated – if the elimination button was selected – so that no question was repeated. The Speaking Wheel on *wordwall.net* targeted learners' procedural knowledge. It was employed to familiarise learners with orally answering questions presented to them, mirroring the structure of the speaking test. Aligned with Krashen's (1982) theory of the affective filter – which posits that input becomes comprehensible and facilitates output in a low-anxiety environment – this activity was chosen to make speaking practice enjoyable. By reducing stress, it aimed to create a more engaging and relaxed atmosphere for learners during speaking tasks.

Figure 4

The Speaking Wheel on wordwall.net

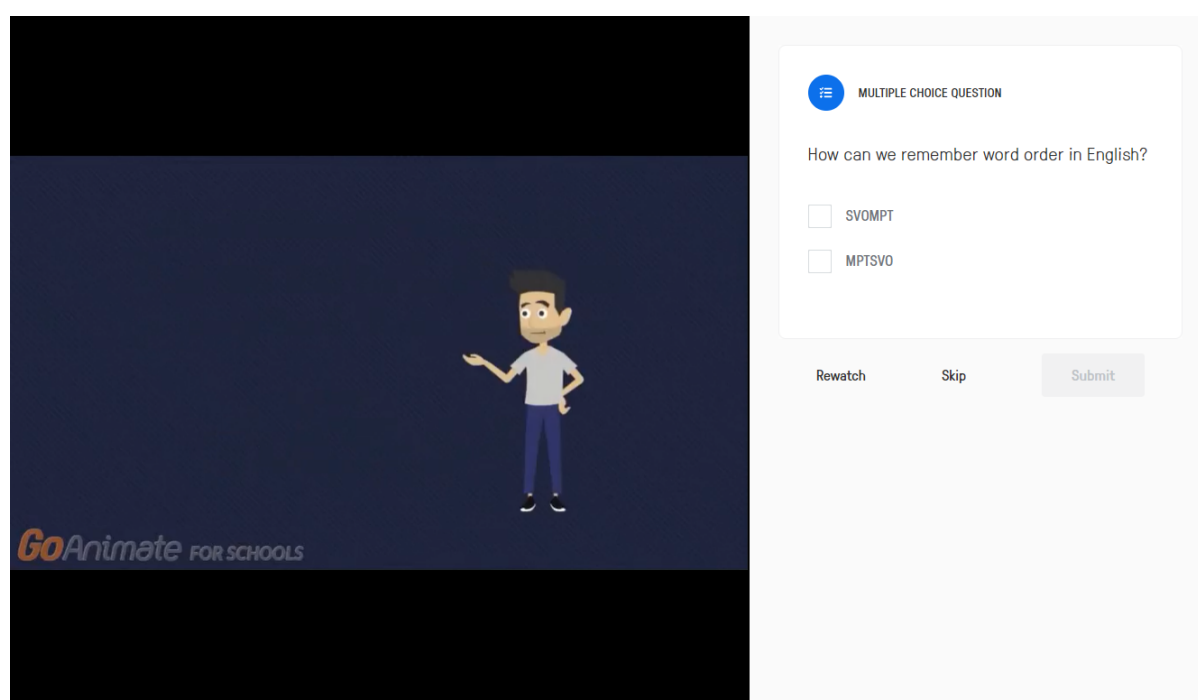


Videos were incorporated to teach various linguistic structures and skills. For instance, YouTube videos were used to comprehend and practise the Present Simple tense. The videos were employed to cater to visual and auditory learners (Fleming & Mills, 1992) and targeted learners' declarative knowledge of the Present Simple tense. They introduced learners to the use and form of the tense, aligning with the pre- and post-tests, where learners were required to correctly form the tense and distinguish its appropriate usage. Additionally, listening practice utilised the edpuzzle.com website, where videos were uploaded. While watching the video on the website, listening comprehension questions on the video content appeared at intervals. In those intervals, learners answered multiple-choice or open-ended questions (Figure 5 below). This activity engaged learners' declarative knowledge of syntax and aimed to enhance their listening skills and understanding of word order. Specifically, learners had to identify key details in a video, mirroring the format of the listening test, where they had to discern specific information from dialogues. Additionally, the video introduced basic word order rules (e.g.,

subject – verb – object – manner – place – time), which were assessed in the tests on word order. These syntactical rules were introduced gradually, in line with Krashen's (1982) theory of comprehensible input, according to which learners acquire new knowledge when presented with structures just beyond their current level of understanding.

Figure 5

Interactive Video on Word Order (edpuzzle.com)



The IW was employed to display sentences in Present Continuous and Present Simple to elicit learners' grammatical understanding, to produce sentences using the tenses, and to ask concept-checking questions. The IW was also used for various activities, including scrambled sentence exercises for word order practice and PowerPoint presentations addressing challenging language learning aspects, such as vocabulary acquisition techniques.

Incorporating gamification opportunities, educraft.tech offered computer games to practise prepositions and other language skills. In the first game on prepositions, learners read

and listened to sentences to find the position of objects in different rooms. In the second football-themed game, learners answered questions on word order and conjugated different verbs (i.e., can, be, have). By choosing the correct answer, they scored a goal against an opponent. The theoretical foundation of the computer games on *educraft.com* is rooted in game-based learning (Gee, 2008). These games leveraged learners' declarative knowledge of word order and prepositions while enhancing their listening skills. Specifically, the games were designed to familiarise learners with basic English word order structures – such as subject-verb-object – which were later assessed in the word order test. The exposure to oral dialogues aimed at helping learners improve their listening comprehension required both for the pre- and post- listening tests and interim testing. The intervention group also used a talking pen and the storybook "Aladdin" as an A1-level reader. This digital pen narrated the story from the book, aiding listening and pronunciation practice.

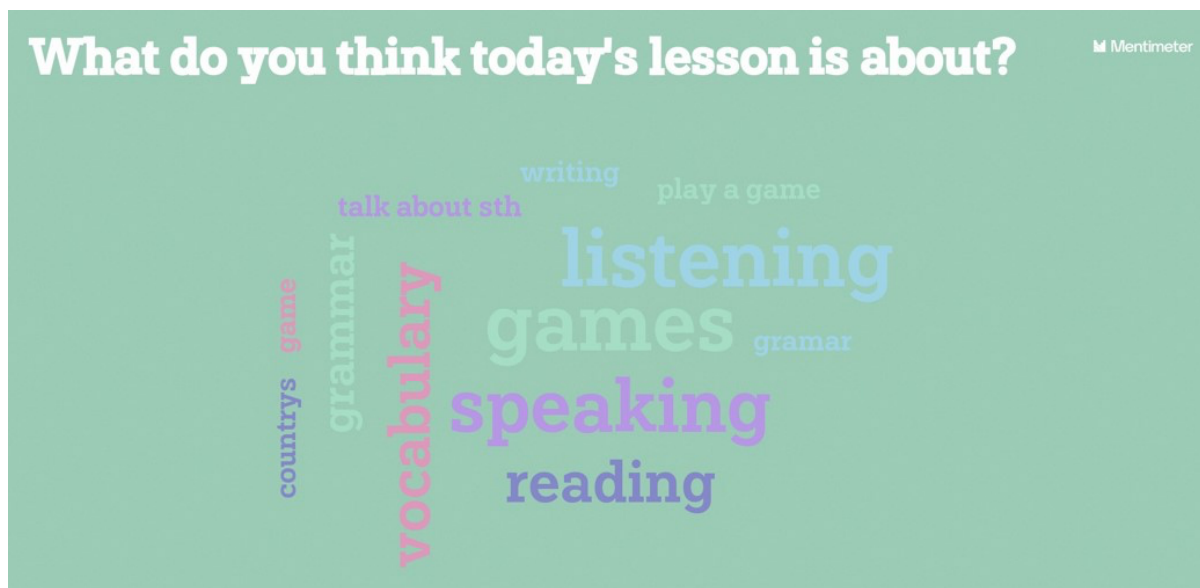
Virtual reality (VR) glasses and a mobile app called Tech it easy! 3 were included in the lessons. Their use allowed students to visit different places virtually and listen to related oral texts. To practise reading and listening comprehension, Augmented Reality (AR) activities were completed using a tablet, a book containing AR elements, and the mobile app "Tech it easy! 4" to visually and auditorily enhance pages of the "Tech it easy! 4" book. AR offered an interactive learning experience where students viewed and interacted with enhanced digital content during reading and listening. Although the talking pen and both the AR and VR activities did not aim at improving learners' declarative or procedural knowledge in any of the targeted linguistic structures, they were used to enhance learners' listening skills needed both for the pre/post- tests and interim testing. The activity with the talking pen also aimed at facilitating their reading skills. The integration of AR and VR was grounded in Vygotsky's (1978) sociocultural theory, which emphasises the importance of social interaction with the environment and peers to enhance knowledge. Additionally, it was based on the Experiential

Learning Theory (Kolb et al., 2001), which states that learning occurs through experiences. The AR and VR activities encouraged learners to interact with both their peers and the environment, thereby enabling a language learning experience that extended beyond the boundaries of traditional classroom settings.

Beyond language practice, the use of technology aimed at learners' engagement and a smooth introduction to the content of the lesson. Brainstorming activities were conducted using mentimeter.com and learners' mobile phones. On menti.com, students responded to questions prompting them to guess the topic of the lesson. Students' responses formed a word cloud with their guesses, which was displayed on the IW (Figure 6 below). Although this activity did not measure learners' declarative or procedural knowledge nor did it target specific language structures, it was employed to encourage learners' participation and critical thinking while considering different lesson topics. All teaching materials mentioned are detailed in Appendix 23.

Figure 6

Learners' Guesses on the Lesson Content as Displayed on mentimeter.com



5.3.3 The Control Group

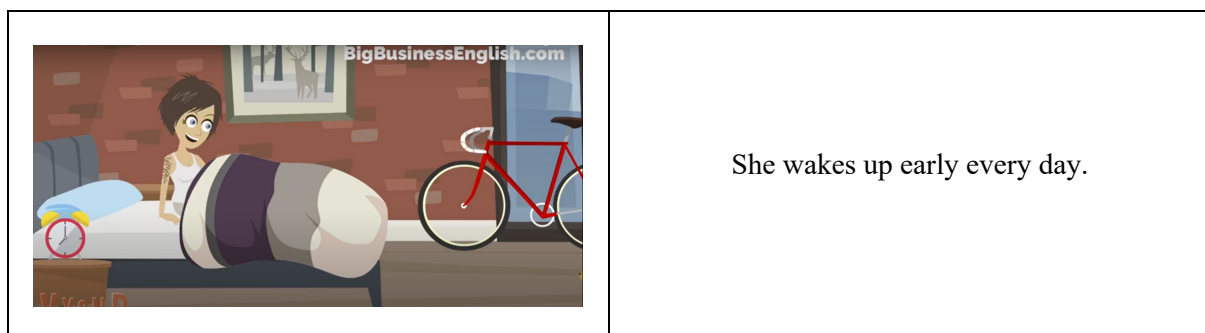
To resemble the traditional approach to language learning where non-technological learning resources are used, a wide range of teaching materials were incorporated into the control group's lessons. All the materials of the intervention group detailed in section 5.3.2 **The Intervention Group** above were adapted into paper-based formats and presented using pictures, comic books, stories, flashcards, sheets or slips of paper, photocopies and classroom equipment, including the whiteboard. This adaptation ensured that the same content of teaching materials was used for both groups, and the means of delivery was the differentiating factor. Therefore, they measured the same kind of knowledge and were grounded in the same theoretical backgrounds –i.e., noticing hypothesis, TBLT, discovery learning, VARK, affective filter hypothesis, comprehensible input, game-based learning, experiences and social interaction with the environment/peers. The materials were employed to support learners' acquisition of the structures assessed in the pre- and post- tests as described in section 5.3.2 **The Intervention Group** above. The materials for the control group were selected to reflect

teachers' choices of learning materials employed in traditionally taught classrooms and ensure a wide variety of resources, similar to the intervention group. In what follows, the teaching materials of the control group and the way they were matched to the intervention group are presented.

In the first lesson, the whiteboard and printed pictures were used as an alternative to the PowerPoint presentations of the intervention group to introduce learners to the structure of the lessons and practise the Present Continuous tense. In the next lesson, realia were incorporated into the learning process to engage the students. Particularly, comic books were utilised, and their layouts were presented on the whiteboard before students created their own comic books in their notebooks. This activity was an alternative to the storyboard that website which was used in the intervention group. The YouTube videos that were then employed to expose the intervention students to Present Simple were transformed into printed stories, which are frequently integrated into traditional language classes. All the images and script of the YouTube videos were retained to illustrate the use of the Present Simple tense (see Figure 7 below and Appendix 22 Lesson 10 for the full version).

Figure 7

A Snippet of the Printed Version of the YouTube Story



	<p>She gets up.</p>
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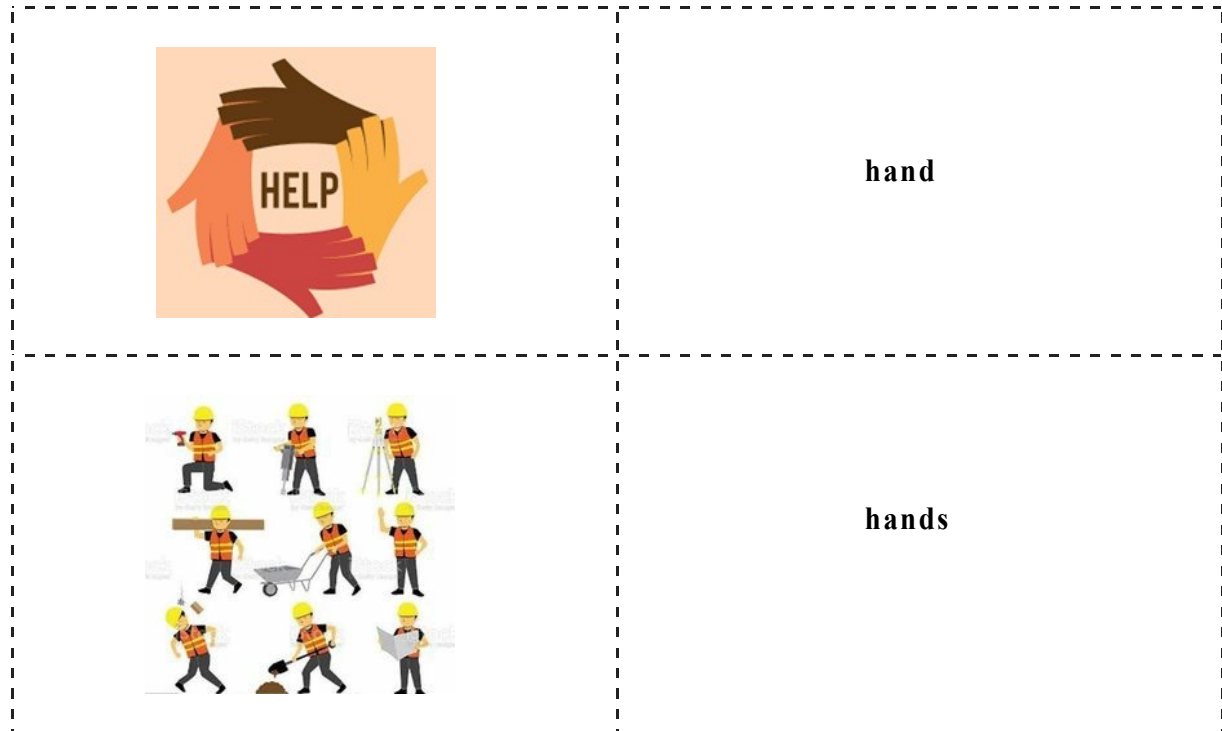
Photocopies were employed to transform digital teaching materials into a paper-based version to practise tenses, polysemous words, word order, listening, and speaking. The online Kahoot and Mentimeter quizzes on the tenses used for the intervention group were printed along with their accompanying images. The control learners completed the quizzes on paper either in competing groups, pairs, or individually to resemble the gamified experience of the intervention group. Similarly, the online quizzes of polysemous words on wordwall.net were printed as fill-in-the-gap activities. Word order was taught using a combination of photocopies and the whiteboard. In particular, the whiteboard was employed to give a presentation on the different word order rules, which were then practised using photocopied exercises. This combination of the whiteboard and the photocopied exercises was designed to resemble the structure of the online rules and activities on quizizz.com. In terms of oral comprehension, the listening activities were photocopied and carried out with the use of audio speakers instead of IW-displayed audio files, which were used for the intervention group. Similarly, the speaking wheel, which was used online for the intervention group, was recreated in a paper version. The topics were printed and randomly selected by students, simulating the online version's arbitrary selection process. Students then presented each topic orally.

The whiteboard was employed as an alternative to the intervention group's PowerPoint presentations on tenses, word order, and polysemous vocabulary, as well as to present printed pictures. Regarding tenses, the same sentences as in the PowerPoint presentations were written on the whiteboard to teach Present Simple and Present Continuous, elicit and practise their

forms, and ask concept-checking questions. The whiteboard was also used to give a presentation on the different word order rules, including the same information and questions as in the edpuzzle.com videos employed for the intervention group. For polysemous vocabulary, the whiteboard displayed the same sentences as the ones used in the intervention group's presentations to help students infer the meanings of the polysemous words. Printed pictures were displayed on the whiteboard to encourage the production of Present Continuous sentences and to teach the various meanings of polysemous words. The printed pictures were used as alternatives to the images on the PowerPoint presentations.

Furthermore, the vocabulary techniques introduced to the intervention group through the PowerPoint presentation were presented and analysed on the whiteboard. The use of the whiteboard also helped direct learners' attention to lesson content. This was achieved through a voting system where students' guesses on the lesson content were collected on the whiteboard and then counted to reveal the prevailing ones, akin to the online brainstorming activity on mentimeter.com.

Instead of online flashcards on cram.com, paper flashcards (Figure 8 below) depicting polysemous words were used to engage students in the vocabulary activities explained in section 5.2.7 Polysemy above (see Appendix 22 Lesson 17 for the complete list of flashcards). Additionally, slips of paper were used for the control group's activities. The paper-based activities included a) using auxiliary verbs printed on slips of paper – as an alternative to the QR codes – to form interrogative, negative, and short answers in the Present Simple tense, b) organising phrases printed on slips of paper to practise word order, and c) conjugating verbs (have, can, be) in competing groups/pairs to resemble the learning elements of the computer games on educraft.tech.

Figure 8*Example of Paper Flashcards*

Moreover, listening activities from augmented and virtual reality videos were converted into printed activities for the control group. A picture from the Aladdin story was used for listening comprehension activities, and images from augmented and virtual reality videos were printed for students to describe orally, enhancing their speaking and listening skills (Figure 9 below; see Appendix 22 Lesson 19 for all printed pictures).

Figure 9

Printed Pictures Taken from the Aladdin Story and the Augmented Reality



Realia from the classroom and various learning materials were used for classroom games to replicate the entertaining elements of the VR and AR activities. For example, the whiteboard and a chair facilitated a game for speaking. In this game, a word was written on the board and was read by the whole class, except for one student who had to guess it by asking yes or no questions to the classmates. Furthermore, texts were also used to practise listening comprehension and create an engaging learning environment. Specifically, the texts included some words that were repeated many times and were assigned to different students. The teacher read the text, and upon hearing their assigned word, the students had to get up and stand next to their chairs. The listening and speaking activities from the Aladdin story and the classroom games were selected to engage learners with different learning experiences and prompt them to interact with their peers. All these materials aimed to provide an equivalent educational experience with the delivery method as the difference between the two groups. The complete set of teaching materials is available in Appendix 22.

5.4 The Role of the Researcher

Typically, the role of the researcher is not considered part of the methodological design. However, in the present study, the researcher was also the teacher of the intervention. Therefore, a description of the teacher who conducted the lessons is presented. Firstly, she is a qualified English teacher and a graduate of the School of English Language, Literature and Translation. She specialised in Foreign Language Learning and Teaching and holds a CELTA certificate to teach English as a Foreign Language to speakers of other languages and a Qualified Teacher Status, which is a prerequisite to work as a teacher in state schools in England and Wales. She has extensive teaching experience across all English proficiency levels and age groups in a Greek context and abroad. From the beginning till the end of the intervention study, she taught all classes to ensure consistency in instruction, assessment, grading, and the influence of the teacher's personality.

Section 2 Summary

This section offered an overview of the current study's methodology. Chapter 4 introduced the study methodology by presenting the approvals, participants, research questions, and procedures. Following this, the tests and questionnaires were described by referring to their original versions to present their content and structure. In Chapter 5, the classroom intervention was introduced, focusing on the general teaching approaches employed, as well as the teaching strategies used to teach the language skills (e.g., reading, listening, speaking) and the kinds of linguistic knowledge (e.g., tenses, word order, polysemy). The chapter proceeded with the teaching materials employed in the lessons for each group to describe the content of the intervention. Subsequently, the role of the researcher in the classroom intervention was presented.

Section 3 Data Analysis and Results: Overview

Section 3 provides a comprehensive description of the data analysis and study results. It begins with Chapter 6, which outlines the stages of data preparation necessary for statistical analysis. Then, the chapter presents an exploratory analysis of the data aimed at analysing the relationships between the different variables that were later used in the modelling phase. Chapter 6 concludes with a summary of the descriptive statistics of these variables. Chapter 7 focuses on the linear models addressing the research questions of the study. It opens with the ANOVA-like linear models, assessing the impact of the intervention on linguistic knowledge and learners' attention and motivation in class. Next, the chapter presents an analysis of the linear regression models that explore how individual differences (IDs) affect language learning. Finally, it discusses how the teaching methodology modulates the influence of IDs on language learning outcomes.

6. CHAPTER 6: DATA PREPARATION AND EXPLORATORY ANALYSIS

6.1 Introduction

All the data collected from the linguistic tests were assessed, scored, and digitalised. The pen-and-paper questionnaires were also converted to digital format. Additionally, the participants who met the exclusion criteria explained in section 4.2 **The Participants** above were removed from the dataset. The following sections describe the data preparation and exploratory analysis conducted prior to the modelling phase.

6.2 Comparison of Pre-tests

To ensure equal baseline conditions across both groups, proficiency levels and knowledge of linguistic skills and structures (including listening, speaking, Present Simple and Present Continuous, polysemous words, and word order) were assessed. Additionally, the participants' attention, working memory, academic motivation and motivation in lessons prior to the intervention were examined, as these factors impact language learning (Gupta & Mili, 2017; Masgoret & Gardner, 2003). Establishing a comparable starting point was crucial, as differences in initial linguistic knowledge, cognitive capacities or (academic) motivation could compromise the validity of findings regarding the impact of technology on language learning. To confirm this, scores on the placement test, pre-tests of the (above mentioned) language skills and structures, as well as measures of attention, working memory, motivation and academic motivation, were compared, using a series of independent t-tests and Mann-Whitney tests, depending on the data distribution. Importantly, no significant differences were found between the two groups at the outset of the intervention. This ensured an identical starting point for all participants (see Appendix 28 for the findings of group comparison tests).

6.3 Data Cleaning and Preparation

The participants' attentional capacity and in-class attention were assessed, and the linguistic tests were scored as part of the data cleaning and preparation process. Additionally, the dimensionality of questionnaire variables was reduced, and multicollinearity issues were addressed. The distribution of the data was examined, leading to the power transformation of certain variables where necessary. Finally, group correlations were computed to identify the variables for the models (see the following subsections for further details).

6.3.1 Attentional Capacity

The participants' attentional capacity was measured utilising the Eriksen Flanker, Visual Search and Go/No-Go tasks, following the standardised scoring methods specified for each test. In the case of the Eriksen Flanker task, the number of congruent and incongruent trials, as well as accuracy and reaction times (RT), were assessed. The difference between mean RTs for correct congruent and incongruent trials, known as Flanker Interference, showed the participants' selective attention and inhibitory control (Howard et al., 2014; Sanders et al., 2018). A Not Available (NA) value was detected and removed in the Flanker variable. Regarding the Visual Search task, the inefficiency score was calculated using the mean correct RT, which indicated the participants' selective attention (Müller & Krummenacher, 2006; Yates & Stafford, 2018). Additionally, the participants' attentional capacities were assessed using the commission error rate in the Go/No-Go task. This rate, determined by errors made during the No-Go condition, reveals participants' inhibitory control (Wright et al., 2014).

6.3.2 In-Class Attention

Based on the self-report attention questionnaire described in section 4.8.3 **In-class Attention Questions** above, the participants' attention during lessons was measured on a scale from 0 to 1, with 0 indicating a complete lack of attention and 1 indicating fully sustained attention. The process of calculating the 0-1 scale involved three steps. First, the total number

of lessons attended by each participant was recorded. The decision to prioritise the exact number of attended lessons over the total number of intervention lessons was made to ensure accurate results based on participants' attendance. Next, the number of lessons in which each participant maintained full attention was determined. This was achieved by identifying how often they responded to the first question of the in-class attention questionnaire with, "*During the lesson, I always paid attention.*" Finally, the ratio of intact attention to attended lessons was calculated by dividing the number of lessons where attention was fully maintained by the total number of lessons attended. The resulting ratio was used as the variable representing each participant's in-class attention rate.

6.3.3 Conversion to Relative Scores

Since each pre- and post- test on linguistic knowledge had a different (unique) scale with different maximum score, I converted raw scores to relative scores, using the proportion of the maximum to facilitate comparisons (e.g., Bode & Wright, 1999; Moeller, 2015). Specifically, scores were converted to a range between 0 and 1, where 0 indicated the lowest score, and 1 indicated the highest possible score. This scaling was achieved by dividing each participant's score by the maximum score for that test. This method accurately reflected individual scores and group differences in the correct proportions (Moeller, 2015, p. 3) and also made the scores easier to interpret. Furthermore, this method is recommended for identifying mean-level differences over time in longitudinal studies (Little, 2003, pp. 18-19).

The next step was to calculate the difference between pre- and post- tests, examining whether there was an increase, decrease or no change in the relative scores. This calculation followed the method of difference for analysing repeated measurements or parallel test forms (see Gauvreau & Pagano, 1993; Howell, 2010). Instead of relying on pre- and post- test scores, which would require more complex interaction tests, I used the simple difference in relative scores as the main response variable. This made it possible to test the hypothesised effects more

easily. Essentially, the difference between pre- and post- tests showed the change, with predictors being analysed for their impact on the difference. This approach simplified the analysis by converting a potential 3-way interaction (test by group by predictors) into a more manageable 2-way interaction, making it easier to interpret the findings. Crucially, this simplification retained all necessary information by shifting the test variable to the left side of the model.

6.3.4 Multicollinearity Treatment

Multicollinearity occurs in a statistical model when two or more independent variables are highly correlated to each other (Daoud, 2017), causing them to provide redundant information about the dependent variable. This redundancy results in unreliable coefficient estimates and inflated standard errors (Alin, 2010; Vatcheva et al., 2016). To address this issue and reduce the dimensionality of numerous questionnaire variables, PCA was preferred over averaging scores across questions. PCA is a standardised method that allows for optimal weighting, thereby enhancing the accuracy and reliability of the total score. PCA was applied to the questionnaires on personality, academic motivation, and motivation in English lessons using the `princomp()` function from the `psych` package (Revelle, 2024). The motivation questionnaire specifically assessed the participants' motivation in the English lessons they attended.

For the personality questionnaire, PCA was applied to the questions related to each personality type to derive a principal component score for each type (Markos & Kokkinos, 2017). Five personality types were identified. Similarly, PCA was performed on items measuring different types of academic motivation as categorised by Vallerand et al. (1992b). Seven principal components were identified, each representing a distinct type of academic motivation. Additionally, PCA was used for the questionnaire items measuring English course evaluation in Attitude Motivation Test Battery (Gardner, 2004), which resulted in a single

principal component representing learners' motivation in the English class. The principal components derived from PCA for the five personality dimensions, the seven types of academic motivation, and learners' motivation in the English class were then used as independent variables in subsequent analyses.

6.3.5 Handling Multicollinearity

To address the issue of multicollinearity, highly correlated variables were identified in the data preparation phase. To achieve this, a correlation matrix of the variables, along with their Variance Inflation Factor (VIF) values, was computed using the `vifcor()` function from the `usdm` package (Naimi, 2015). Initially, a correlation threshold of 0.7 was set, revealing three variables suspected to cause multicollinearity. After removing these highly collinear variables, the threshold level was lowered to 0.5, isolating nine additional variables of concern: (a) variables related to speaking (speaking score, grammatical range and accuracy in speaking, lexical resource in speaking, fluency and coherence in speaking, pronunciation in speaking); (b) personality traits (*Agreeableness* and *Conscientiousness*); and (c) academic motivation (*intrinsic motivation towards knowledge*, *intrinsic motivation towards accomplishments*, *extrinsic motivation-external regulation*, *extrinsic motivation-introjected*). A stepwise process was followed by examining the coefficients among those highly collinear variables and removing the redundant ones.

The multicollinearity test indicated a high correlation between the total Speaking Score and the four speaking criteria (i.e., *lexical resource*, *fluency and coherence*, *grammatical range and accuracy*, and *pronunciation*) as detailed in Appendix 29 Table 1. Since these criteria were used to compute the participants' total speaking scores, the individual variables representing distinct speaking aspects were excluded. This decision prioritised the variable that encompassed overall speaking performance. Additionally, *Agreeableness* displayed a high correlation with three other personality traits (*Conscientiousness*, *Intellect*, and *Emotional*

Instability), and thus, it was removed (see Appendix 29 Table 2 for the VIF values of each personality type). Conscientiousness also correlated with two personality types (*Emotional Instability* and *Intellect*) and two types of academic motivation (*Intrinsic motivation towards stimulation* and *Amotivation*), which led to their removal (see Appendix 29 Table 3). Four types of academic motivation (*Intrinsic motivation towards knowledge*, *Intrinsic motivation towards accomplishments*, *Extrinsic motivation- external regulation*, and *Extrinsic motivation-introjected*) also caused multicollinearity issues and were removed (see Appendix 29, Table 4 & 5 for VIF values of each variable). Multicollinearity issues were further examined for each group separately, with similar results observed.

Additional variables were removed to ensure relevance and construct validity. Specifically, the GoNoGo task score was excluded from the models because it measured the total number of errors rather than reaction times, as in the Flanker and Visual Search tasks. Furthermore, the difference in the number of words produced between the pre- and post-speaking tests was removed, as the quantity of words does not effectively capture the accuracy of oral production. After removing these variables, no multicollinearity issues were observed. All VIF values were below 2 and are shown in

Table 8 below. Table 9 below presents the abbreviated forms of the variables along with their full equivalent terms in alphabetical order for cross-referencing.

Table 8

VIF Values of Final Variables

Variable	VIF Value
ClassAtt	1.489
Consc	1.672
DfL	1.292

DfP	1.313
DfPSPC	1.275
DfSScore	1.321
DfSSentL	1.144
DfWO	1.477
ExtMotIde	1.400
Extr	1.150
Flanker	1.302
MotEngClass	1.405
VisSearch	1.615
WM	1.492

Table 9

Abbreviated and Full Versions of the Variables in the Correlation Plots

Abbreviated Version	Full Version
ClassAtt	In-class Attention
Consc	Conscientiousness
DfL	Difference in Listening
DfP	Difference in Polysemy
DfPSPC	Difference in Present Simple vs Present Continuous
DfSScore	Difference in Speaking Score
DfSSentL	Difference in Sentence Length in Speaking
DfWO	Difference in Word Order
ExtMotIde	Extrinsic Motivation-Identified
Extr	Extraversion
Flanker	Flanker
MotEngClass	Motivation in the English Class
VisSearch	Visual Search
WM	Working Memory

Importantly, after applying PCA and removing redundant variables, as suggested by the VIF analysis, a balanced ratio of participants to variables was achieved – specifically, a 3 to 10 ratio of participants to variables (Hocking, 1996).

6.3.6 Distributional Properties of Variables and Variable Transformation

To prepare the data for statistical modelling, the data distributions of variables were analysed, and transformations were applied when necessary. The process involved plotting the data, conducting Box-Cox testing, transformation, removing outliers, and re-plotting to evaluate data distribution after transformation.

Initially, a density plot and a Shapiro–Wilk test were conducted to identify any variables with non-normally distributed data. These variables included the difference in word order and speaking score, speaking sentence length, extraversion, conscientiousness, extrinsic motivation-identified, in-class attention, motivation in the English class, as well as Flanker, visual search, and working memory. Power transformation was applied to those variables following the Box-Cox test (Box & Cox, 1964; see also Baayen & Milin, 2010; Fox & Weisberg, 2018). For the Visual Search and Working Memory tasks, which had positive values, the variables were directly raised to the Lambda value. However, some of the variables included negative values, including the differences in word order, speaking score, speaking sentence length, personality and academic motivation scores, as well as learners' attention and motivation in the class. Therefore, a two-parameter modification of the Box-Cox family was applied, which accommodates negative values (cf., Hawkins & Weisberg, 2017). Each variable was raised to the computed Lambda value, and the final power-transformed variable was used in the following statistical modelling. In cases of considerable inflation or deflation of variance, variables were scaled (i.e., Flanker, visual search, speaking sentence length).

After applying power transformation, density plots were recreated to assess the data distribution and identify outliers. Outliers that caused a clearly discontinued distribution of data

points were very conservatively removed (Baayen & Milin, 2010). The density plots showed normal distributions for all variables except the Flanker test and the motivation in the English class, which required further outlier removals. Specifically, four outliers were removed from the Flanker variable, and one outlier was removed from the motivation in the English lesson variable. After these adjustments, density plots were recreated, confirming a normal distribution for all variables.

6.3.7 Group Correlations

To explore the relationships between the different variables, I examined correlations within groups. Correlation matrix plots were computed and visualised for both groups, as shown in 10 and Figure 11 below (see Table 9 above for the abbreviated and full name of each variable).

Figure 10

Correlation Plot of the Variables in the Control Group

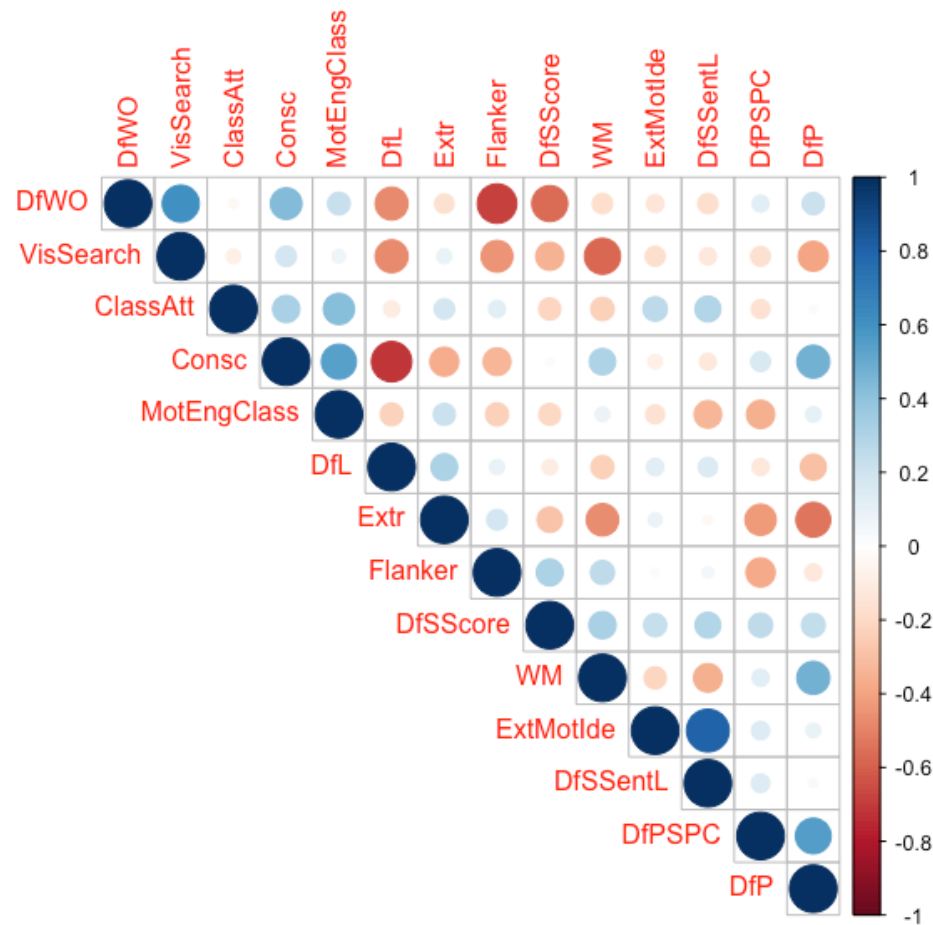
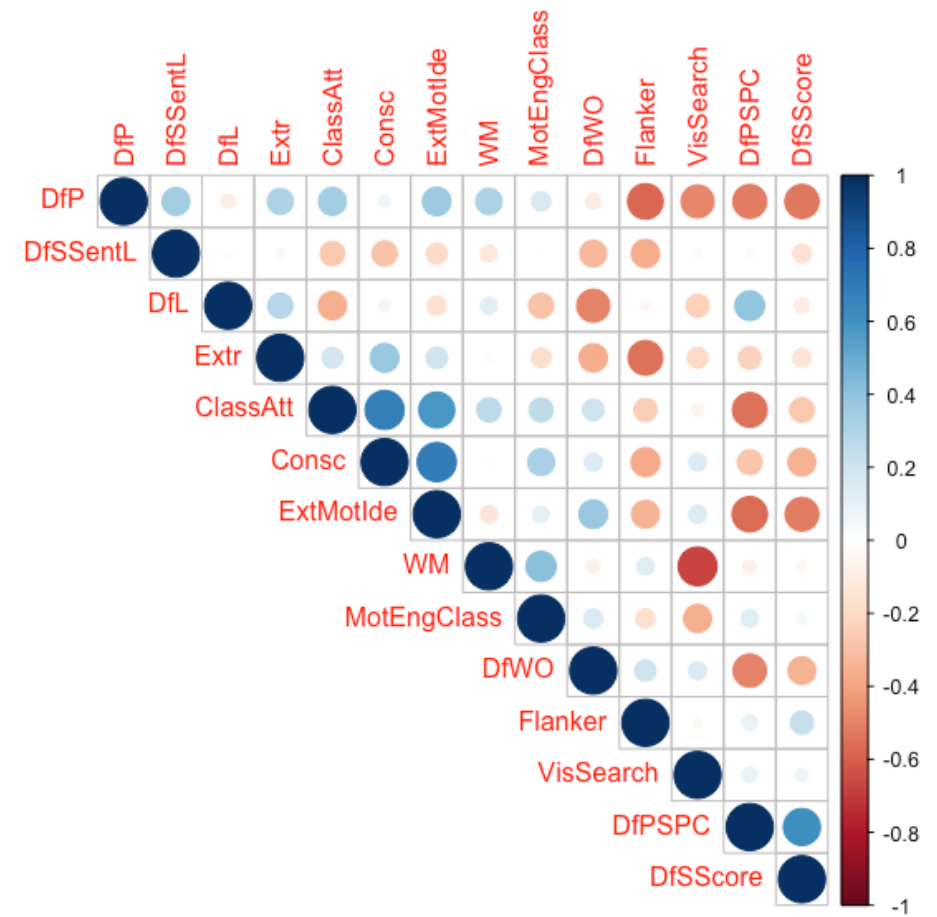


Figure 11

Correlation Plot of the Variables in the Intervention Group



Examining the two plots revealed correlations across different variables in each group. Due to the number of significant correlations, I decided to focus the statistical modelling on specific research questions rather than building the model with all possible predictors, thereby avoiding capitalising on chance (MacCallum et al., 1992; Raykov & Widaman, 1995). I specifically examined the correlation between linguistic knowledge and cognitive and conative variables to examine the relationship between individual differences and language learning. Additionally, I investigated the correlation between factors integral to language acquisition, such as motivation in the English class and in-class attention, and conative variables.

As shown in 10 and Figure 11 above, the plots highlight cognitive and conative variables correlations with linguistic knowledge and factors influencing language acquisition. In terms of linguistic knowledge, the *difference in word order* and *difference in polysemy* yield the most frequent and strongest correlations with various variables. Specifically, the difference in polysemy correlates with cognitive capacities within the intervention group, while the difference in word order shows correlations with both cognitive capacities and personality traits within the control group.

With regard to the factors influencing language acquisition, *in-class attention* and *motivation in the English class* show correlations with conative variables. Within the intervention group, a notable correlation between in-class attention and both conscientiousness and extrinsic motivation-identified is observed. Within the control group, motivation in the English lesson correlates with conscientiousness. These inconsistencies in variable correlations between the two groups suggest underlying differences potentially stemming from the teaching methodologies.

To sum up, this exploratory analysis revealed strong correlations in two key areas: a) the relationship between differences in word order and polysemy with cognitive capacities and personality, and b) the relationship between in-class attention and motivation in the English

class with conative variables. These relationships were further explored in the linear regression models.

6.4 Descriptive Statistics

The study examined several dependent variables: the difference between pre- and post-tests on Present Simple and Present Continuous, polysemy, word order, listening and speaking skills, the average sentence in speaking, and the questionnaires on in-class attention and motivation in the English class. The independent variables were Flanker, visual search, working memory, conscientiousness, extraversion, extrinsic motivation – identified, and group (intervention vs control).

The descriptive statistics of the variables are shown in Table 10 below. The power transformed variables included the word order and speaking score, speaking sentence length, extraversion, conscientiousness, extrinsic motivation – identified, in-class attention, motivation in the English class, as well as Flanker, visual search, and working memory.

Table 10

Descriptive Statistics of the Variables

Variable	Mean	Median	SD
Listening	0.13	0.13	0.14
Present Simple & Present Continuous	0.13	0.11	0.13
Polysemy	0.16	0.15	0.16
Word Order	0.53	0.54	0.10
Speaking Score	1.03	1.04	0.36

Sentence Length in Speaking	-4.79084e ⁻¹⁷	0.06228953	1
Motivation in the English Class	8.42	8.73	3.01
In-class Attention	0.73	0.88	0.31
Flanker	-2.500204e ⁻¹⁶	-0.05579676	1
Visual Search	1.280033e ⁻¹⁶	-0.05810092	1
Working Memory	1.48	1.50	0.06
Conscientiousness	8.48	8.62	3.40
Extraversion	5.79	5.89	2.43
Extrinsic Motivation - Identified	10.50	11.64	4.21

The descriptive statistics of the linguistic tests and factors integral to learning (e.g., in-class attention and motivation in the English lesson) for each group are shown in Table 11 and Table 12 below, respectively. Note that the values for speaking and average sentence length show the differences between pre- and post- test scores, while the values for polysemy, tenses, word order, and listening reflect the differences between pre- and post- tests as relative scores (proportion of maximum; see section 6.3.3 **Conversion to Relative Scores** above for details). The speaking score and average sentence length values were not turned into relative scores as there were no maximum points in these tests. Additionally, in-class attention rates were determined by the proportion of lessons in which participants were fully attentive compared to the total number of lessons they attended (see section 6.3.2 **In-Class Attention** above). The motivation in the English class was measured using PCA on the post-questionnaire items from the English course evaluation part of the Attitude Motivation Test Battery (Gardner, 2004; see section 6.3.4 **Multicollinearity Treatment** above).

Table 11*Descriptive Statistics of Linguistic Tests*

Test	Group	Mean	Median	SD
Polysemy	Control	0.09	0.09	0.12
	Intervention	0.22	0.22	0.16
Present Simple & Present Continuous	Control	0.11	0.07	0.13
	Intervention	0.15	0.15	0.13
Word Order	Control	0.53	0.54	0.09
	Intervention	0.53	0.49	0.10
Speaking Score	Control	0.94	1.04	0.39
	Intervention	1.11	1.04	0.33
Speaking Sentence Length	Control	-0.05	0.12	0.95
	Intervention	0.05	0.05	1.06
Listening	Control	0.11	0.13	0.14
	Intervention	0.14	0.13	0.15

Table 12*Descriptive Statistics of Factors Integral to Learning*

Test	Group	Mean	Median	SD
In-class Attention	Control	0.66	0.78	0.33
	Intervention	0.80	0.89	0.28
Motivation in the English Lesson	Control	7.65	7.41	3.09
	Intervention	9.08	9.32	2.81

The mean values suggest that L2 learners taught using technology outperformed learners taught without technology in their knowledge of polysemous words, speaking score, in-class attention, and motivation in the English lesson. No differences were observed in word order, tenses, and listening skills. To examine whether these differences were significant, ANOVA-like linear models were built (CHAPTER 7: LINEAR MODELS).

7. CHAPTER 7: LINEAR MODELS

7.1 Introduction

For the analysis of the data, linear models were built in R (Version 4.3.2; R Core Team, 2023). For research question 1, ANOVA-like linear models – where predictors were categorical – were used. To address research questions 2 and 3, I built linear regression models with nested variables. The linear models were built using the `lm` function (Version 3.5.0, 2017), which is included in R's base packages. In all models, the control group was set as the reference level (i.e., intercept). The performance of each model was evaluated by the R-squared value (R^2), which captures the extent to which the model can explain the variation in the dependent variable (Miles, 2005). After building the linear models, model criticism was carried out to identify and address the model for any distortions caused by influential data points, such as outliers and extreme values (Baayen & Milin, 2010, p. 26).

7.2 ANOVA-like Linear Models

Research question 1: *Does Technology Enhanced Language Learning (TELL) significantly improve language development, in-class attention, and motivation in the English lesson?* This question investigates the impact of technology for language learning purposes on L2 learners' performance compared to a traditional teaching approach that relies on paper-based materials. The impact was examined from a linguistic perspective, focusing on various aspects of linguistic knowledge: a) vocabulary acquisition, specifically polysemous words; b) morphology, including the Present Simple and Present Continuous tenses; and c) syntax, particularly word order. Additionally, the study assessed language skills: a) listening comprehension of English excerpts and b) speaking skills. The impact of TELL was also evaluated based on factors integral to learning: a) in-class attention and b) motivation in English lessons.

Previous studies (e.g., Adair-Hauck et al., 2000; Berns et al., 2016; Bester & Brand, 2013; Marsaulina, 2020; Smith et al., 2013) suggest that improvements in both groups will be comparable, with the exception of polysemous vocabulary, speaking skills, in-class attention, and motivation in English lessons. The ANOVA-like linear models used the differences in participants' scores between the pre- and post- versions of each language test as the dependent variable and the group as the independent variable. The purpose of these models is to assess whether the group variable can predict linguistic improvement, learners' attention in class, and their motivation in the English lessons which they attended. The equation of the ANOVA-like linear models is as follows:

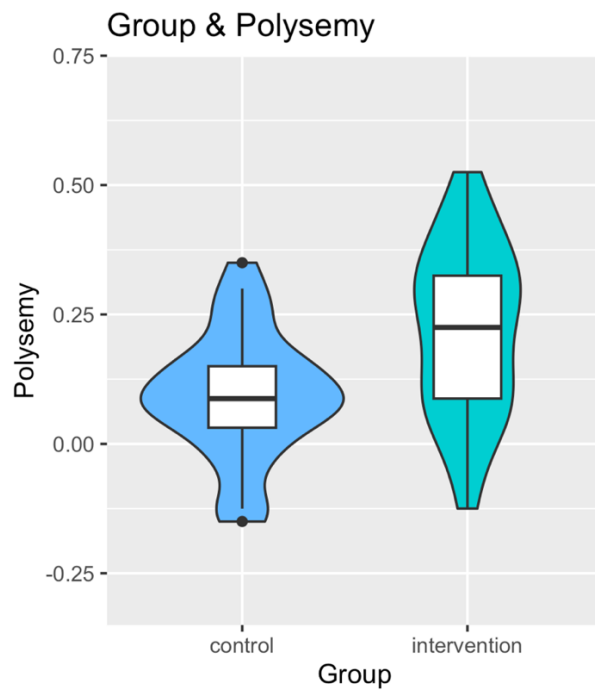
$$lm \text{ (Dependent Variable} \\ \sim \text{Group,} \\ \text{data=df)}$$

7.2.1 Kinds of Linguistic Knowledge

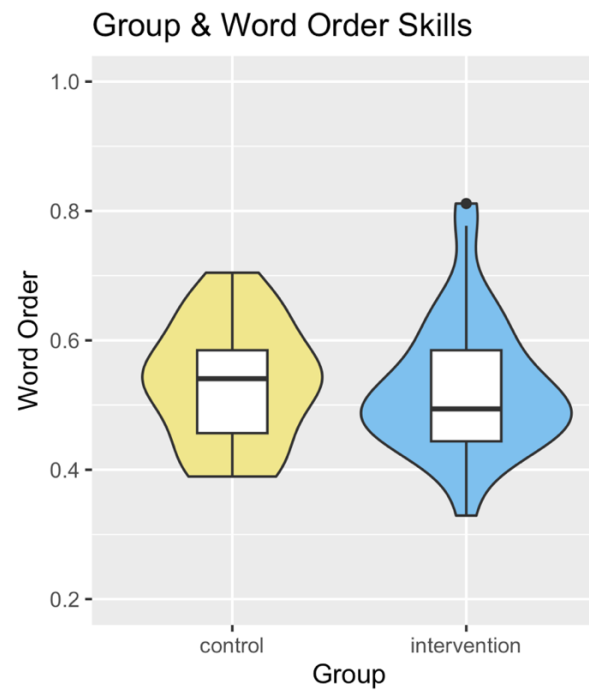
Figure 12Figure 13Figure 14 below illustrate the differences in linguistic knowledge between the two groups. The x-axis represents the group, while the y-axis represents the differences in scores between the pre- and post- tests across various aspects of linguistic knowledge. Based on these figures, a slightly higher median is observed for polysemy in the intervention group compared to the control one. This suggests that the intervention may have some effect on increasing polysemy. The medians for word order appear similar in both groups. The median for tenses is slightly higher in the control group, but the distributions are comparable. This suggests no significant differences between the two groups. To confirm these observations, statistical models were built, and the findings are presented in the following sections.

Figure 12

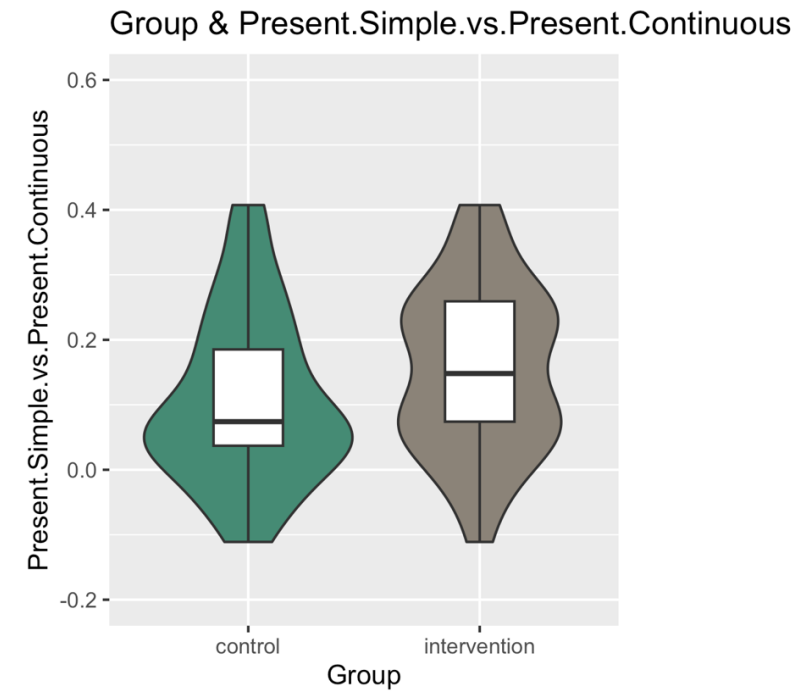
The Improvement of Polysemous Words in the Two Groups

**Figure 13**

The Improvement of Word Order in the Two Groups

**Figure 14**

The Improvement of Tenses in the Two Groups



7.2.1.1 Polysemous Words. The model on polysemy yielded the following coefficients, as presented in Table 13 below. The results revealed a significant difference between the two groups. The intervention group ($M = 0.22$) outperformed the control one ($M = 0.09$), $t(63) = 3.457$, $p < .001$. The R-squared value ($R^2 = .159$) suggests that the model can explain almost 16% of the variation in polysemous words.

Table 13

The ANOVA-like Linear Model on Group and Polysemy

Group and Polysemy					
<i>Predictors</i>	<i>Estimates</i>	<i>std. Error</i>	<i>95% CI</i>	<i>t value</i>	<i>p</i>
(Intercept)	0.093	0.026	0.041 – 0.146	3.531	0.001
Group [intervention]	0.125	0.036	0.053 – 0.197	3.457	0.001
Observations	65				
R ² / R ² adjusted	0.159 / 0.146				

To ensure that outliers did not distort the findings, data points with absolute standardised residuals exceeding 2.5 standard deviations (i.e., the difference between the observed value and the fitted value; Myers et al., 2010, p. 13; Baayen & Milin, 2010) were removed. The results remained consistent with those obtained from the initial model, $t(63) = 3.457$, $p < .001$, and $R^2 = .159$. In a nutshell, these findings confirm the research hypothesis of previous studies (e.g., Berns et al., 2016; Smith et al., 2013), demonstrating a positive impact of TELL on vocabulary knowledge.

7.2.1.2 Tenses. The results revealed no significant difference between the control ($M = 0.11$) and the intervention group ($M = 0.15$), $t(63) = 1.475$, $p = .145$. In this model, the R-squared value ($R^2 = .033$) denotes that the model can predict around 3% of the variation in acquiring the two tenses (Table 14 below).

Table 14

The ANOVA-like Linear Model on Group and Present Simple & Present Continuous

Group and Present Simple & Present Continuous					
<i>Predictors</i>	<i>Estimates</i>	<i>std. Error</i>	<i>95% CI</i>	<i>t value</i>	<i>p</i>
(Intercept)	0.107	0.023	0.061 – 0.154	4.586	<0.001
Group [intervention]	0.047	0.032	-0.017 – 0.111	1.475	0.145
Observations	65				
R ² / R ² adjusted	0.033 / 0.018				

Similar to the previous model criticism conducted for the model predicting Polysemy, the same approach was followed to assess whether the statistically non-significant results reported above remain after removing any residuals exceeding 2.5 standard deviations. The findings remained similar across both models, $t(63) = 1.475$, $p = .145$, and $R^2 = .03$. This study confirms the hypothesis built from previous studies (e.g., Marsaulina, 2020) that the teaching methodology has no impact on the improvement of tense use.

7.2.1.3 Word Order. The result revealed no significant difference between the control ($M = 0.53$) and the intervention group ($M = 0.53$), $t(63) = -0.259$, $p = .797$, $R^2 = .01$ (Table 15 below).

Table 15

The ANOVA-like Linear Model on Group and Word Order

Group and Word Order					
<i>Predictors</i>	<i>Estimates</i>	<i>std. Error</i>	<i>95% CI</i>	<i>t value</i>	<i>p</i>
(Intercept)	0.534	0.018	0.499 – 0.569	30.298	<0.001
Group [intervention]	-0.006	0.024	-0.054 – 0.042	-0.259	0.797

Observations	65
R^2 / R^2 adjusted	0.001 / -0.015

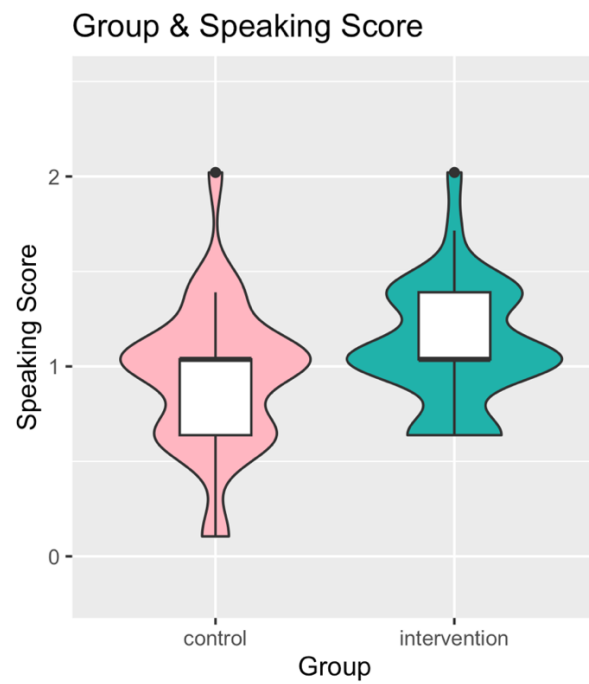
For the model criticism, I followed steps similar to those of the previous two models. After removing the residuals exceeding 2.5 standard deviations, there were some variations in the coefficients. Specifically, $t(63) = -0.259$ increased to $t(61) = -1.049$. The p -value decreased from 0.797 to 0.298, and the multiple R-squared value increased from 0.001 to 0.017. These coefficients do not indicate a statistically significant difference between the two groups. Based on these findings, it is revealed that the improvement in word order is independent of the teaching methodology (see also Tausch, 2012). These findings support the hypothesis that the teaching methodology does not influence L2 learners' acquisition of word order.

7.2.2 Language Skills

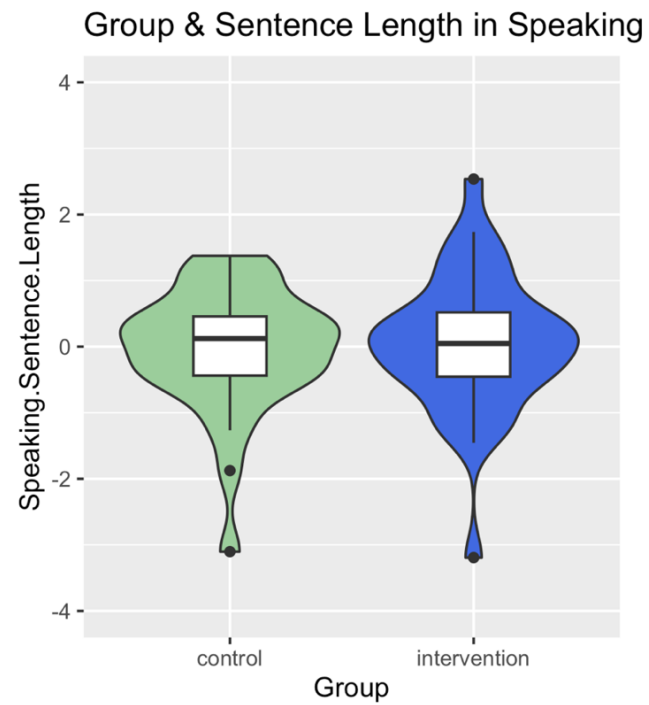
The impact of TELL on learners' speaking and listening skills in comparison to a traditional paper-based approach was further examined. Figure 15Figure 16Figure 17 below illustrate the difference in language skills, revealing a similar range, median and variation in the distributions between the two groups. The findings of the statistical models examining differences in speaking and listening skills between the two groups are presented in the following sections.

Figure 15

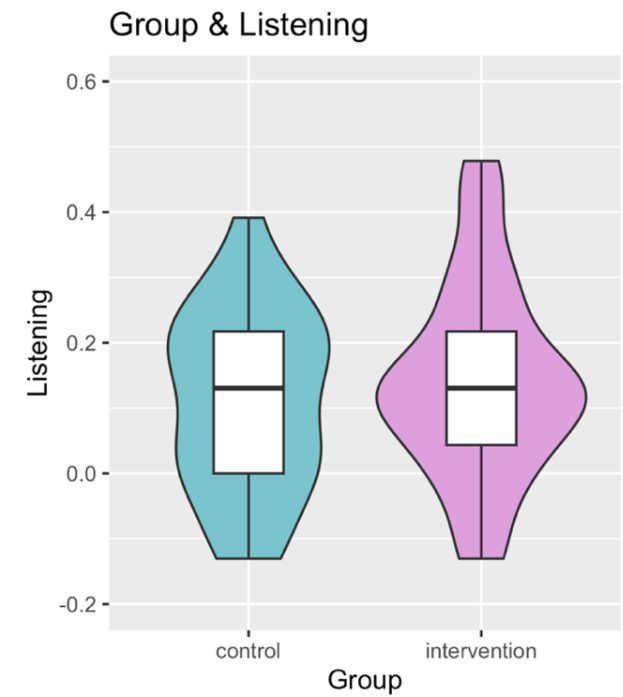
The Improvement in Speaking Score in the Two Groups

**Figure 16**

The Improvement in Speaking Sentence Length in the Two Groups

**Figure 17**

The Improvement in Listening in the Two Groups



7.2.2.1 Speaking. Two forms of assessment were employed to measure learners' improvement in speaking (section 4.9.3 **Speaking Test** above). The participants' improvement in speaking was assessed through their scores, encompassing aspects of fluency, coherence, lexical resource, grammatical range, and accuracy in their use of grammar features, as well as pronunciation in their oral production. The second form of assessment examined the average sentence length of their produced speech.

Table 16 below shows the model findings for the speaking score between the control ($M = 0.94$) and the intervention group ($M = 1.11$). The results revealed a significant difference (i.e., though only marginally) between the two groups, $t(63) = 1.929$, $p = .058$. The intervention group outperformed the control one. The model explains around 6% of the variation in speaking score ($R^2 = .056$).

Table 16

The ANOVA-like Linear Model on Group and Speaking Score

Group and Speaking Score					
<i>Predictors</i>	<i>Estimates</i>	<i>std. Error</i>	<i>95% CI</i>	<i>t value</i>	<i>p</i>
(Intercept)	0.935	0.065	0.806 – 1.065	14.418	<0.001
Group [intervention]	0.171	0.088	-0.006 – 0.347	1.929	0.058
Observations	65				
R^2 / R^2 adjusted	0.056 / 0.041				

For model criticism, I followed similar steps as the previous models resulting in some notable variations in coefficients. Specifically, $t(63) = 1.929$ increased to $t(61) = 2.309$, and the p -value decreased from 0.058 to 0.024. Lastly, the explanatory power of the model also increased from 0.06 to 0.08, as indicated by the multiple R-squared value. These findings attest

to the positive influence of technology on L2 learners' speaking skills compared to a traditional, paper-based methodology.

7.2.2.2 Speaking Sentence Length. The model on speaking sentence length included one less observation than the other models because one participant had to be excluded due to non-consent for recording, as reported in section 4.4 **Procedure** above. The results revealed no significant difference between the control ($M = -0.05$) and the intervention group ($M = 0.05$), $t(62) = 0.393$, $p = .696$, $R^2 = .002$, as shown Table 17 below.

Table 17

The ANOVA-like Linear Model on Group and Sentence Length in Speaking

Group and Sentence Length in Speaking					
<i>Predictors</i>	<i>Estimates std. Error</i>		<i>95% CI</i>	<i>t value</i>	<i>p</i>
(Intercept)	-0.053	0.184	-0.420 – 0.315	-0.287	0.775
Group [intervention]	0.099	0.252	-0.405 – 0.603	0.393	0.696
Observations	64				
R ² / R ² adjusted	0.002 / -0.014				

Model criticism resulted in some variations in coefficients, but none reached a statistically significant level. Specifically, $t(62) = 0.393$ increased to $t(60) = 0.431$, and the p -value decreased from 0.696 to 0.668. Lastly, the R-squared value increased from 0.002 to 0.003. These results show that the teaching methodology, TELL vs the traditional paper-based method, does not influence learners' improvement of the length of their produced speech.

The research hypothesis based on previous studies (e.g., Qiao & Zhao, 2023; Adair-Hauck et al., 2000) partially confirms that technology has no impact on speaking skills. The TELL approach positively influences fluency, coherence, lexical resource, grammatical range

and accuracy, and pronunciation in speaking. However, it does not influence the length of learners' oral output in L2.

7.2.2.3 Listening. The results of the model on listening revealed no significant difference between the control ($M = 0.11$) and the intervention group ($M = 0.14$), $t(63) = 0.807$, $p = .423$, $R^2 = .010$, as presented in Table 18 below.

Table 18

The ANOVA-like Linear Model on Group and Listening

Group and Listening					
<i>Predictors</i>	<i>Estimates std. Error</i>		<i>95% CI</i>	<i>t value</i>	<i>p</i>
(Intercept)	0.110	0.026	0.057 – 0.163	4.177	<0.001
Group [intervention]	0.029	0.036	-0.043 – 0.101	0.807	0.423
Observations	65				
R^2 / R^2 adjusted	0.010 / -0.005				

Model criticism was carried out to assess whether the statistically non-significant results remained after removing the residuals. No differentiated results were observed after removing the residuals that exceeded 2.5 standard deviations. All remained the same. These findings support the conclusion that the teaching methodology does not influence L2 learners' improvement in listening skills. They also confirm the research hypothesis based on the previous studies (e.g., Hsu et al., 2023; Adair-Hauck et al., 2020), which anticipated no discernible difference between the two groups.

7.2.3 Factors Integral to Learning

In addition to linguistic improvement, the intervention examined two factors influencing language learning: in-class attention and motivation in the English lesson. In-class attention refers to the attention paid by the learners during each lesson (section 4.8.3 In-class

Attention Questions Learners' motivation in the English lesson was assessed at the end of the intervention and reflected their evaluation of the lessons which they attended (section 4.8.1

Motivation Questionnaire). Figure 18Figure 19 below indicate a slightly higher median of both variables for the intervention group, with a similar distribution in both groups.

Figure 18

In-Class Attention in the Two Groups

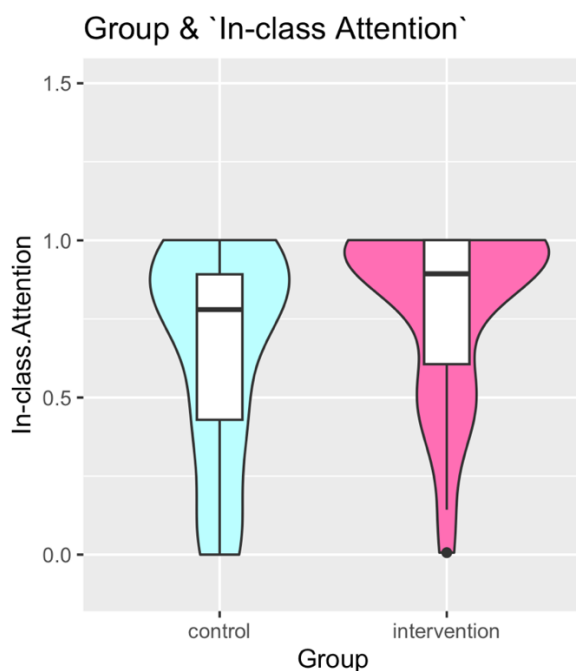
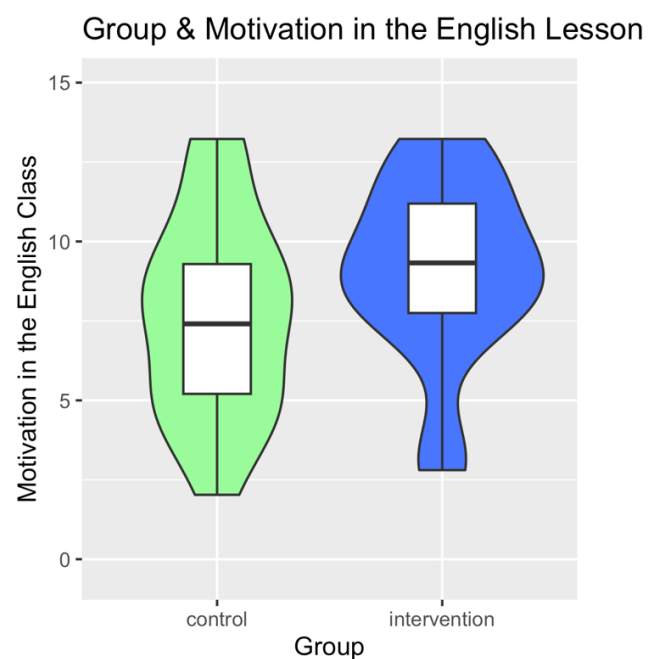


Figure 19

Motivation in the English Lesson in the Two Groups



The results of the models are reported below. Based on the research hypothesis informed by previous research (e.g., Berns et al., 2016; Berns et al., 2013; Bester & Brand, 2013), both variables are expected to be higher in the intervention group.

7.2.3.1 In-class Attention. The results of the model on in-class attention show a significant difference (i.e., though only marginally) between the control ($M = 0.66$) and the

intervention group ($M = 0.80$), $t(63) = 1.856$, $p = .068$. The R-squared value ($R^2 = 0.052$) explains approximately 5% of the variation in in-class attention (Table 19 below).

Table 19

The ANOVA-like Linear Model on Group and In-class Attention

Group and In-class Attention					
<i>Predictors</i>	<i>Estimates std. Error</i>		<i>95% CI</i>	<i>t value</i>	<i>p</i>
(Intercept)	0.657	0.055	0.547 – 0.768	11.891	<0.001
Group [intervention]	0.140	0.075	-0.011 – 0.290	1.856	0.068
Observations	65				
R ² / R ² adjusted	0.052 / 0.037				

Following the same process of removing residuals exceeding 2.5 standard deviations, $t(63) = 1.856$ increased to $t(62) = 2.263$, the p -value decreased from 0.068 to 0.027, and the multiple R-squared value increased from 0.052 to 0.076. It is possible to suggest that L2 learners taught using digital resources show greater attention in lessons compared to those instructed in a traditional way without the use of technology. Thus, the research hypothesis, which posits a positive impact of TELL on L2 learners' in-class attention, as supported by previous studies (e.g., Bester & Brand, 2013), is confirmed.

7.2.3.2. Motivation in the English Lesson. The results of the ANOVA-like linear model revealed a significant difference between the control group ($M = 7.65$) (i.e., though only marginally) and the intervention group ($M = 9.08$), $t(63) = 1.956$, $p = .055$. The model predicts almost 6% of the variation in Motivation in the English Class ($R^2 = .057$), as shown in Table 20 below.

Table 20

The ANOVA-like Linear Model on Group and Motivation in the English Lesson

Group and Motivation in the English Lesson					
<i>Predictors</i>	<i>Estimates std. Error</i>		<i>95% CI</i>	<i>t value</i>	<i>p</i>
(Intercept)	7.649	0.538	6.574 – 8.724	14.220	<0.001
Group [intervention]	1.434	0.733	-0.031 – 2.899	1.956	0.055
Observations	65				
R ² / R ² adjusted	0.057 / 0.042				

Model criticism was conducted to assess whether the findings hold after removing any outliers. The analysis revealed no changes in the coefficients. The findings suggest that the use of digital tools could positively influence L2 learners' motivation in English lessons, as opposed to traditional learning methods, which do not predict learners' motivation. In line with prior studies (Berns et al., 2013; James & Mayer, 2018), the research hypothesis that TELL positively impacts L2 learners' motivation in English class is supported. However, this conclusion should be approached with caution due to the marginal statistical significance of the p-value.

7.3. Linear Regression Models

Linear regression models with nested groups were used to examine the exploratory research questions of this study: a) *Do cognitive capacities and personality moderate the acquisition of word order and polysemy in TELL versus the traditional teaching methodology?* b) *How do personality and academic motivation correlate with in-class attention in TELL versus the traditional teaching methodology?* and c) *How does personality correlate with motivation in TELL versus the traditional teaching methodology?* These questions aimed to determine whether the teaching methodology modulates the relationship between individual

differences and language learning. I considered both cognitive and conative (i.e., personality) individual differences. Cognitive differences were measured by attention and working memory, while conative differences were assessed through personality traits (conscientiousness and extraversion) and academic motivation (extrinsic motivation – identified). The personality traits and the type of motivation were included in the models as they did not cause multicollinearity issues (see section 6.3.5 **Handling Multicollinearity** above). Word order, polysemous vocabulary, in-class attention, and motivation in the English lesson were examined as the exploratory analysis revealed their correlations with different variables within each group (see section 6.3.7 **Group Correlations** above for more details). Additionally, while no group differences were found for word order, polysemy showed a significant difference favouring the TELL group (see section 7.2.1 **Kinds of Linguistic Knowledge** above). Therefore, it is relevant to examine how cognitive and conative variables contribute to these group differences or lack thereof. In each model, group was treated as a nested variable to predict the dependent variable within each group.

The models examined the extent to which the participants' individual differences could predict the dependent variables (word order, polysemy, in-class attention, and motivation in the English lesson). Additionally, they examined whether the teaching methodology indicated by the group (intervention vs control group) influenced these predictions. The full models (Appendix 30) initially included all possible predictors, and non-significant ones were removed to find the best fit. A forward model-building approach was used, starting with a single independent variable and gradually adding others (Gatu & Kontoghiorghes, 2006). ANOVA tests were then conducted to compare models and identify the best fit, defined as the model with significantly better performance. To validate the forward selection and ANOVA results, the best subset selection method was employed as an approach to identify the optimal predictors. The best subset method is used to find the variables that best explain the dependent

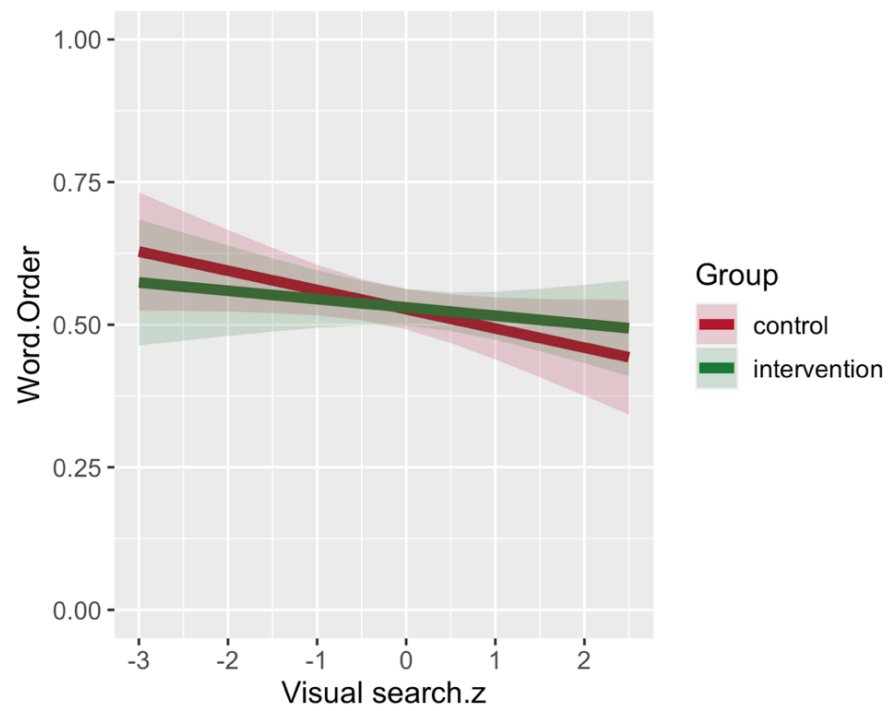
variable (King, 2003). The outcomes from the best subset selection matched those of the forward models. The findings are visualised in Appendix 31, using the Adjusted R^2 for each predictor variable. The simpler models were more parsimonious and showed significantly better goodness of fit, so they are reported below. In some cases, models with additional predictors were non-significant due to overlapping variables, requiring the use of two separate models.

7.3.1 Word Order

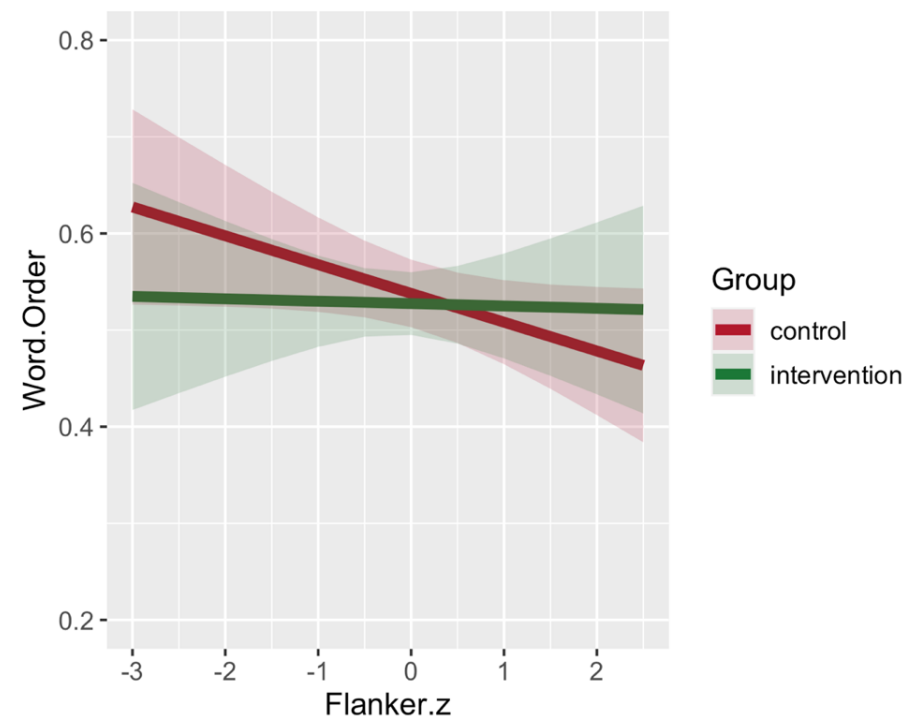
Regarding word order, the forward model building and the ANOVA tests revealed that working memory and personality types did not yield any statistically significant results in either of the groups. This finding indicates that neither working memory nor personality predicts word order acquisition in English. Attention capacities were found to predict the acquisition of word order. Figure 20 Figure 21 below illustrate the relationship between word order and attention capacities. The x-axis represents the Visual Search/Flanker values after power transformation and scaling, and the y-axis represents the participants' word order scores after power transformation. In Figure 20, a negative relationship between visual search and word order is observed in both groups, with the control group experiencing a steep decline in word order. In Figure 21, a different pattern between the two groups is observed. In the intervention group, word order scores remain stable as Flanker values increase. In contrast, in the control group, an increase in Flanker is associated with a decline in word order scores.

Figure 20

The Visual Representation of Visual Search-Word Order Relationship in Both Groups

**Figure 21**

The Visual Representation of Flanker-Word Order Relationship in Both Groups



To further examine these observations, a combined model including both visual search and Flanker was constructed. However, the model did not yield statistically significant results, indicating that the two variables may overlap in the variance they explain regarding the dependent variable, *word order*. As a result, the two best candidate models are presented separately. Below is the model with visual search as the independent variable:

```
lm (Word.Order ~
    Group /
    Visual.Search.z,
    data=df)
```

The above model assessed the predictability of word order by visual search and examined any difference in this prediction attributed to the group. The model yielded the following coefficients, as shown in Table 21 below.

Table 21

The Linear Regression Model on Word Order and Visual Search with Nested Groups

Word Order and Visual Search per Group					
<i>Predictors</i>	<i>Estimates std. Error</i>		<i>95% CI</i>	<i>t value</i>	<i>p</i>
(Intercept)	0.527	0.018	0.492 – 0.562	29.880	<0.001
Group [intervention]	0.003	0.024	-0.045 – 0.051	0.131	0.896
Group [control] * Visual Search z	-0.034	0.017	-0.069 – 0.001	-1.932	0.058
Group [intervention] * Visual Search z	-0.015	0.017	-0.048 – 0.019	-0.875	0.385
Observations	65				
R ² / R ² adjusted	0.070 / 0.024				

The results reveal notable differences in the interactions between group and visual search. In the intervention group ($M = 0.53$), visual search does not predict the acquisition of word order. In the control group ($M = 0.53$), $t(61) = -1.932$, $p = .058$, there is a negative relationship, Estimate = -0.034, between visual search skills and word order acquisition (marginal though). Visual search predicts 7% of the variation in word order ($R^2 = .070$).

As in sections 7.2.1 Kinds of Linguistic Knowledge 7.2.2 Language Skills, model criticism was conducted by trimming any residuals exceeding 2.5 standard deviations. With regard to the interaction between group and visual search, the $t(61) = -1.932$ increased to $t(59) = -2.217$, and the p -value decreased from 0.058 to 0.030, reaching a statistically significant level in the control group. The multiple R-squared value increased from 0.070 to 0.095, indicating that the model, after criticism, was more powerful in predicting the variation in word order. The interaction between group and visual search in the intervention group was not significant.

The model, which included Flanker and word order, was:

```
lm (Word.Order ~
      Group /
      Flanker.z,
      data=df)
```

Table 22 below presents the results of the model. In the control group ($M = 0.53$), there is a negative relationship between Flanker and word order acquisition, Estimate = -0.030, $t(61) = -1.968$, $p = .054$. No statistically significant results are reported for the intervention group ($M = 0.53$). The multiple R-squared value ($R^2 = 0.061$) suggests that Flanker explains approximately 6% of the variance in word order.

Table 22

The Linear Regression Model on Word Order and Flanker with Nested Groups

Word Order and Flanker per Group					
<i>Predictors</i>	<i>Estimates std. Error</i>		<i>95% CI</i>	<i>t value</i>	<i>p</i>
(Intercept)	0.538	0.017	0.503 – 0.573	30.768	<0.001
Group [intervention]	-0.011	0.024	-0.058 – 0.037	-0.441	0.660
Group [control] * Flanker z	-0.030	0.015	-0.060 – 0.000	-1.968	0.054
Group [intervention] * Flanker z	-0.002	0.020	-0.042 – 0.037	-0.126	0.900
Observations	65				
R ² / R ² adjusted	0.061 / 0.015				

For model criticism, trimming the residuals exceeding 2.5 standard deviations led to a change in the coefficients. This resulted in a statistically significant relationship between word order and Flanker in the control group. Specifically, $t(61) = -1.968$ increased to $t(59) = -2.303$, and the p -value decreased from 0.054 to 0.025. For the intervention group, there was no statistically significant relationship between the acquisition of word order and Flanker scores. The R^2 increased to 0.121. In summary, the results indicate a negative effect of Flanker and visual search on word order in traditionally taught classes, whereas no effect of Flanker and visual search on word order is observed in TELL classes.

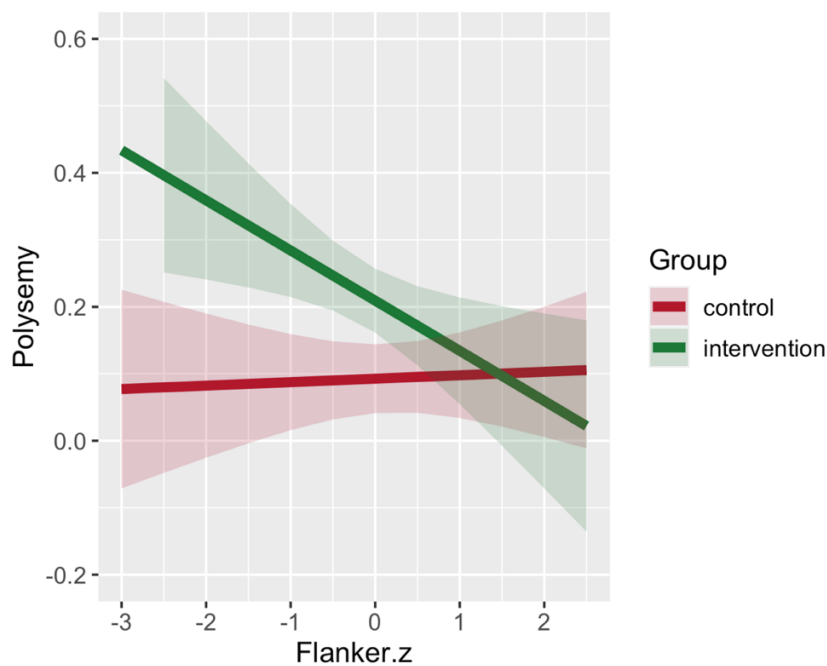
7.3.2 Polysemy

The relationship between cognitive capacities, personality, and the acquisition of polysemous words was examined. The forward model building revealed that visual search, working memory and personality types did not reach statistical significance as predictors of polysemy in either of the groups. However, the score on the Flanker task was a significant

predictor, consistent with the results for word order. Figure 22 below illustrates a different relationship between polysemy and Flanker (after power transformation and scaling) in the two groups. In the control group, a positive relationship is observed – higher Flanker scores correspond with slightly improved polysemy performance. In the intervention group, however, higher Flanker scores are associated with lower polysemy scores.

Figure 22

The Visual Representation of Flanker-Polysemy Relationship in Both Groups



To assess these observations, the formula of the model on Flanker and polysemy was:

```
lm (Polysemy ~
    Group /
    Flanker.z,
    data=df)
```

As shown in Table 23 below, notable differences in the interactions between group and Flanker emerge. There is a significant negative relationship between Flanker and polysemy, Estimate = -0.075, $t(61) = -2.603$, $p = .012$ in the intervention group ($M = 0.22$). Flanker does not predict the acquisition of polysemous words in the control group ($M = 0.09$). Flanker accounts for a significant portion, i.e., 24%, of the variation in polysemy ($R^2 = 0.244$).

Table 23

The Linear Regression Model on Polysemy and Flanker with Nested Groups

<i>Predictors</i>	Polysemy and Flanker per Group				
	<i>Estimates</i>	<i>std. Error</i>	<i>95% CI</i>	<i>t value</i>	<i>p</i>
(Intercept)	0.093	0.026	0.041 – 0.144	3.611	0.001
Group [intervention]	0.117	0.035	0.047 – 0.187	3.329	0.001
Group [control] * Flanker z	0.005	0.022	-0.039 – 0.050	0.232	0.817
Group [intervention] * Flanker z	-0.075	0.029	-0.132 – -0.017	-2.603	0.012
Observations	65				
R ² / R ² adjusted	0.244/0.207				

Subsequently, model criticism was conducted to verify or dispute the above results. The coefficients remained consistent across both models. In summary, the results of research question 2 – *Do cognitive capacities and personality moderate the acquisition of word order and polysemy in TELL versus the traditional teaching methodology?* – indicate that attention capacities, as measured by the Flanker and visual search tasks, negatively impact the acquisition of word order when L2 learners are taught through a traditional approach. However, this negative effect is not observed in a technology-based learning environment. On the contrary, attention capacities, captured through the Flanker task, have a negative effect on

learning polysemous words in a technology-based learning environment but not in a traditional one.

7.3.2 In-class Attention

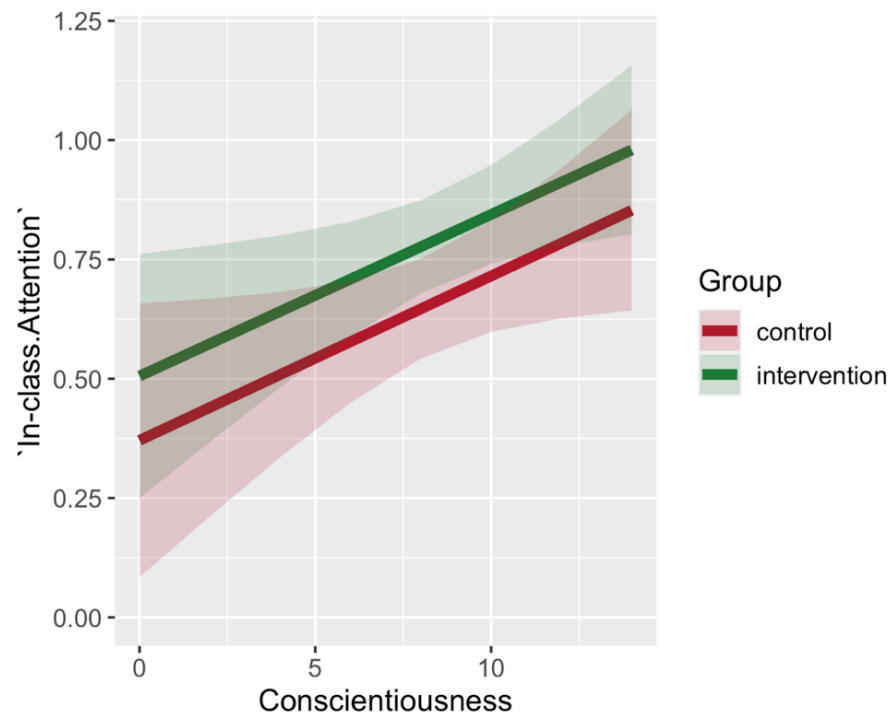
The model fitted to examine the prediction of in-class attention by conscientiousness and extrinsic motivation – identified was:

```
lm (InClass.Attention~
Group /
(Conscientiousness +
Extrinsic.Motivation.Identified),
data=df)
```

Conscientiousness and extrinsic motivation – identified were selected as independent variables because the exploratory analysis revealed distinct variable correlations within the groups (section 6.3.7 **Group Correlations**). As shown in Figure 23Figure 24 below, the relationship between in-class attention and these independent variables is positive in both groups. The x-axis represents conscientiousness and extrinsic motivation – identified after power transformation, and the y-axis represents in-class attention after power transformation. Specifically, as conscientiousness and extrinsic motivation–identified rates increase, in-class attention also increases in both groups.

Figure 23

The Visual Representation of In-Class Attention and Conscientiousness Relationship in Both Groups

**Figure 24**

The Visual Representation of In-Class Attention - Extrinsic Motivation-Identified Relationship in Both Groups

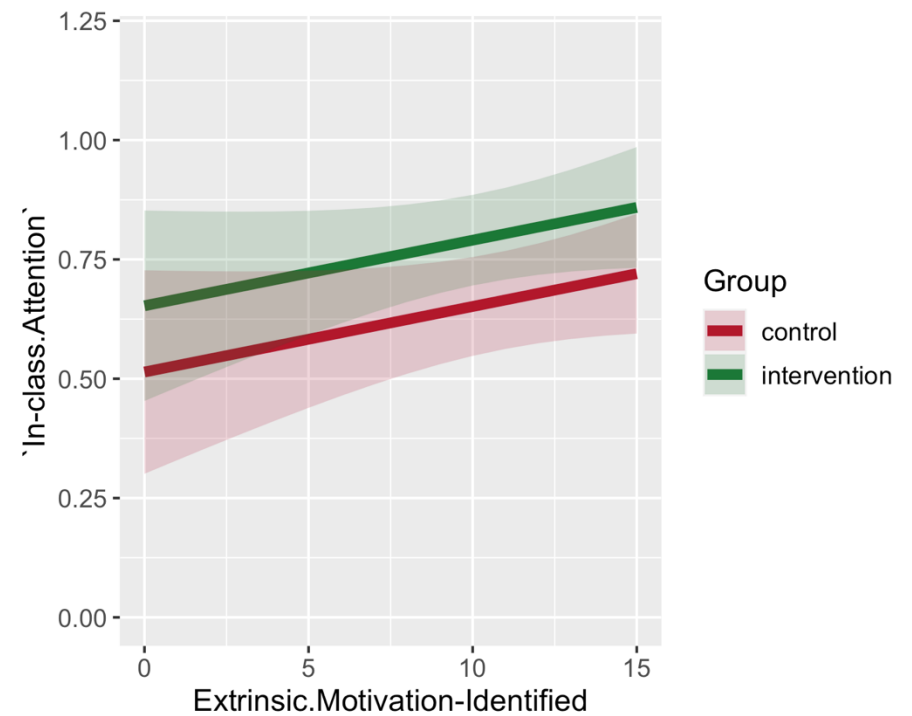


Table 24 below presents the results of the model after the ANOVA tests and the best subset method (Appendix 31). The results reveal different interactions between the group and both conscientiousness and extrinsic motivation – identified. There is a positive relationship between in-class attention and conscientiousness in control ($M = 0.66$), Estimate = .034, $t(59) = 2.166$, $p = .034$, and the intervention group ($M = 0.80$), Estimate = 0.032, $t(59) = 2.231$, $p = .029$. However, extrinsic motivation – identified does not predict in-class attention in the intervention group. In the control group, there is a positive significant relationship (only marginally, though) between in-class attention and extrinsic motivation – identified, Estimate = .026, $t(59) = 1.958$, $p = .055$. The multiple R-squared value ($R^2 = 0.244$) indicates that the independent variables explain 24% of the variation in in-class attention.

Table 24

The Linear Regression Model on In-class Attention and Conscientiousness, Extrinsic Motivation – Identified with Nested Groups

In-class Attention and Conscientiousness, Extrinsic Motivation-Identified per Group					
<i>Predictors</i>	<i>Estimates</i>	<i>std. Error</i>	<i>95% CI</i>	<i>t value</i>	<i>p</i>
(Intercept)	0.093	0.200	-0.307 – 0.493	0.466	0.643
Group [intervention]	0.380	0.248	-0.117 – 0.877	1.532	0.131
Group [control] * Conscientiousness	0.034	0.016	0.003 – 0.066	2.166	0.034
Group [intervention] * Conscientiousness	0.032	0.014	0.003 – 0.061	2.231	0.029
Group [control] * Extrinsic	0.026	0.013	-0.001 – 0.052	1.958	0.055

Motivation- Identified					
Group	0.005	0.011	-0.018 – 0.027	0.422	0.675
[intervention] *					
Extrinsic Motivation- Identified					
Observations	65				
R ² / R ² adjusted	0.244 / 0.180				

For model criticism, removing residuals exceeding 2.5 standard deviations revealed increased coefficients. With regards to conscientiousness, $t(59) = 2.166$ increased to $t(58) = 2.301$, and the p -value decreased from 0.034 to 0.025 in the control group. As for the intervention group, $t(59) = 2.231$ increased to $t(58) = 2.499$, and the p -value decreased from 0.029 to 0.015. Regarding extrinsic motivation – identified, $t(59) = 1.958$ increased to $t(58) = 2.080$, and the p -value decreased from 0.055 to 0.041 in the control group. No statistically significant results were reported for the interaction between intervention group and extrinsic motivation – identified after model criticism. The power of the model was also improved as the multiple R-squared value increased from 0.244 to 0.301. These increased coefficients after trimming provide evidence for the improved power of the model.

In sum, the results reveal a) a positive effect of conscientiousness on in-class attention in both groups and b) that extrinsic motivation – identified positively influences L2 learners' in-class attention when exposed to the traditional teaching approach. On the contrary, no such relationship is observed in a technologically enhanced language learning environment.

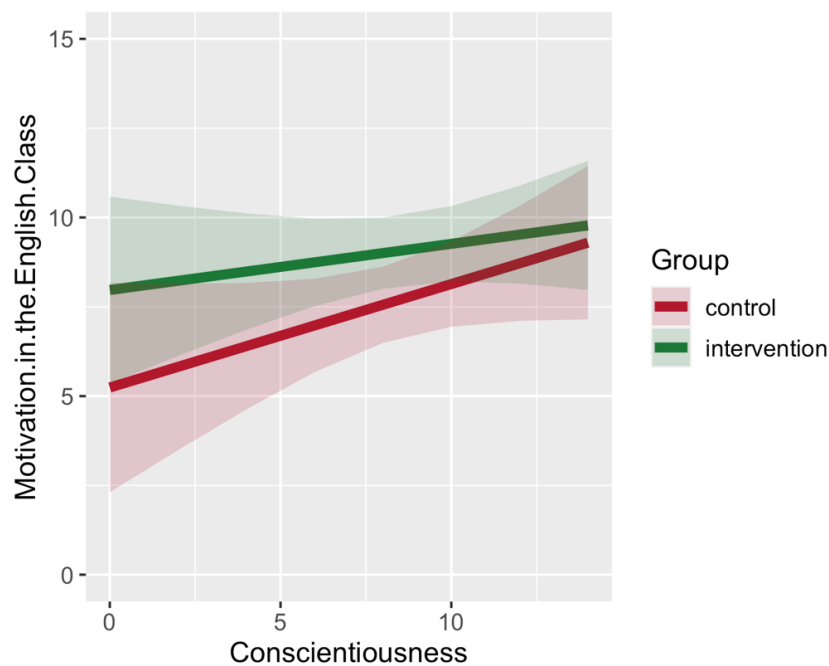
7.3.3 Motivation in the English Lesson

The exploratory analysis (section 6.3.7 **Group Correlations**) reported a correlation of conscientiousness with motivation in the English class in the control group. Figure 25 below

shows a positive relationship between both groups' motivation in the English lesson (after power transformation) and conscientiousness.

Figure 25

The Visual Representation of the Relationship Between Motivation in the English Class and Conscientiousness in Both Groups



To examine whether this relationship was significant, the following model was fitted:

```
lm (Motivation.in.the.English.Class ~
    Group /
    Conscientiousness,
    data=df)
```

As shown in Table 25 below, conscientiousness does not predict motivation in the English lesson in either the control ($M = 7.65$), Estimate = 0.290, $t(61) = 1.764$, $p = .083$ or the intervention group ($M = 9.08$), Estimate = 0.129, $t(61) = 0.918$, $p = .362$. Even though the

finding cannot be interpreted as statistically significant, the p -value = 0.083 may be considered marginally significant from an exploratory analysis perspective, which shows that the results are tentative (see Nosek & Lakens, 2016). The multiple R-squared value ($R^2 = .115$) shows that conscientiousness explains 11% of the variation in polysemy.

Table 25

The Linear Regression Model on Motivation in The English Class and Conscientiousness with Nested Groups

Motivation in the English Class and Conscientiousness per Group					
<i>Predictors</i>	<i>Estimates</i>	<i>std. Error</i>	<i>95% CI</i>	<i>t value</i>	<i>p</i>
(Intercept)	5.240	1.465	2.311 – 8.169	3.577	0.001
Group [intervention]	2.731	1.963	-1.195 – 6.656	1.391	0.169
Group [control] * Conscientiousness	0.290	0.164	-0.039 – 0.618	1.764	0.083
Group [intervention] * Conscientiousness	0.129	0.141	-0.152 – 0.410	0.918	0.362
Observations	65				
R^2 / R^2 adjusted	0.115 / 0.071				

Subsequent model criticism and removal of any data points with absolute standardised residuals of more than 2.5 standard deviations did not lead to any change in the coefficients. Overall, the modelling results and model criticism provisionally show a positive relationship between conscientiousness and motivation in the English lessons for learners taught through the traditional teaching approach. However, the result was marginally significant, which requires cautious inferences. Regarding the intervention group, no interaction between

conscientiousness and motivation in the English class was observed. These findings suggest that learners' motivation in a TELL environment is not influenced by their traits of conscientiousness.

Section 3 Summary

The section on *Data Analysis and Results* started with Chapter 6, which offered a description of the data cleaning and preparation stages necessary for the statistical analysis of the data. Exploratory analysis was completed with correlation plots, and the identified relationships between variables guided the following linear regression models. In Chapter 7, the findings of the three research questions of the study were presented. ANOVA-like linear models were built for research question 1: *Does Technology Enhanced Language Learning (TELL) significantly improve language development, in-class attention, and motivation in the English lesson?* The findings reported that technology positively affects learners' acquisition of polysemous words, speaking skills, in-class attention, and motivation in the English lesson.

Linear regression models with nested groups were fitted for research question 2: *Do cognitive capacities and personality moderate the acquisition of word order and polysemy in TELL versus the traditional teaching methodology?* and 3: *a) How do personality and academic motivation correlate with in-class attention in TELL versus the traditional teaching methodology? b) How does personality correlate with motivation in TELL versus the traditional teaching methodology?* The linear regression models were used to identify which variables predict an outcome (i.e., dependent variable) and nested groups were selected to discern whether this prediction varies within each group. For research question 2, the findings revealed that visual search and Flanker negatively affect word order acquisition in a traditional paper-based learning environment. In contrast, Flanker negatively affects polysemy learning in a TELL methodology. Regarding research question 3, conscientiousness was identified as a contributory factor in maintaining attention during the lesson, irrespective of a TELL or a traditional teaching methodology. Academic motivation, as measured by extrinsic motivation – identified, was found to positively affect L2 learners' attention to lessons in a traditional class.

Finally, conscientiousness traits may positively influence learners' motivation in the English class taught in a traditional teaching methodology.

Section 4 Discussion: Overview

Section 4 consists of two chapters. Chapter 8 discusses the findings and integrates them with those of previous studies. It begins with a brief overview of the aims of the study and explains the rationale for technology-enhanced language learning (TELL) and the traditional paper-based methodologies as the focus of comparison. Then, the chapter addresses the research gaps this study sought to fill, followed by a synopsis of the rationale behind conducting the intervention study in an authentic language learning environment. After a brief summary of the study, the results are analysed and compared with previous findings. The aim of this chapter is to position the findings of the present study within the broader field of Applied Linguistics and provide recommendations for future exploratory research.

Chapter 9 discusses the pedagogical implications of the findings, offering effective teaching strategies informed by both intervention lessons and research findings. This chapter aims to lay a foundation for practical teaching recommendations. Presenting practical considerations is a novel approach to discussing research findings, aligning with the current emphasis on evaluating the impact of research studies. Furthermore, the chapter addresses teachers' ongoing dissatisfaction with research results that are often not easily applicable to language classrooms.

8. CHAPTER 8: DISCUSSION OF RESEARCH FINDINGS

8.1 Introduction

This study examined two distinct teaching methodologies currently used in language classes: TELL and the traditional paper-based methods, focusing on language learning and individual differences. Previous literature provides substantial empirical evidence that individual differences among language learners affect language acquisition (Dörnyei, 2005; Gas et al., 2013; Kid et al., 2018; Segalowitz & Frenkiel-Fishman, 2005; Skehan, 1991). In this study, I also explored individual differences to better understand how they affect language learning through the lens of both TELL and the traditional paper-based methods. Mainly, this research examined two types of individual differences, namely cognitive capacities (e.g., attention and working memory) and conative factors (e.g., personality traits, academic motivation). Regarding the teaching methodologies, the present study had three main objectives: a) to compare the effectiveness of TELL over the traditional paper-based methodology for adolescent Greek L2 learners of English, b) to investigate whether the teaching methodology modulates the impact of individual differences on language learning, and c) to provide clear and practical teaching recommendations to language teachers.

The traditional paper-based method was chosen because of its widespread use in public schools in Greece. Teachers in these schools adopt this teaching approach as they are familiar with using government-mandated coursebooks alongside photocopied teaching materials. Additionally, many public schools lack suitable digital equipment. The TELL approach was selected because of the increasing integration of technology into language learning, which offers many advantages for both the learner and the teacher and has opened up new potentials in language classes (Ahmadi, 2018).

The present study addressed two research gaps: a) the impact of TELL on younger learners, as most research has focused on adult L2 learners (Chang & Hung, 2019; Fajaruiddin et al., 2024; Shadiev & Wang, 2022), and b) the largely understudied effect of TELL on young Greek learners of English as an L2. Specifically, no prior research has compared the effect of TELL and the traditional teaching methodologies on various aspects of learning among young Greek EFL learners. Additionally, in a more exploratory fashion, this study examined the impact of individual differences in the two teaching methodologies.

The objective of the intervention study was to employ an authentic language learning environment to yield reliable results that can be transferred to and applied in L2 classrooms. Studies with a methodological design that utilises an authentic learning environment and investigates a combination of learning aspects (e.g., Adair-Hauck et al., 2000; Alvarez-Marinelli et al., 2016; Wei, 2023) reflect classroom realities and served as the foundation of the methodological design of the present study.

8.2 Summary of the Study

A classroom intervention study was conducted with Greek adolescent learners of English as an L2 at a secondary public school in Greece. The participants, aged 11 to 13 (mean age 12.1), were randomly divided into two groups: a control group that followed the traditional methodology using books and paper-based learning materials and an intervention group that incorporated digital learning resources into the lessons. The decision to conduct the intervention with young teenagers rather than adults was made because the effects of TELL at earlier ages have not been widely examined. Previous research has primarily focused on university students, with less than a fifth of studies involving participants at the secondary education levels (e.g., James & Mayer, 2018; Hung, 2016; Lys, 2003; Smith et al., 2013; Tang et al., 2011). All participants attended 9.5 hours of English lessons spread across three months (two 30-minute lessons per week). The majority of TELL intervention studies have lasted

approximately three months and reported their findings (Chang & Hung, 2019; Shadiev & Wang, 2022). Furthermore, studies examining a combination of language learning dimensions – similar to the present study – lasted from 2.5 to 6 months (Adair-Hauck et al., 2000; Alvarez-Marinelli et al., 2016; Wei, 2023). Both groups of the study were taught by the same teacher, using identical teaching materials and learning goals. The only difference between the two groups was the delivery method of the teaching materials: digital vs traditional. In other words, efforts were made to keep all conditions identical between the two groups, except for the delivery method of the materials. The lesson plans were designed to ensure that the method of delivery was the main difference between the two groups, allowing an accurate assessment of the impact of TELL (see section 5.3 **The Teaching Materials** above for details).

Tests assessing participants' speaking and listening skills, as well as their knowledge of language structures (i.e., the Present Simple and Present Continuous tenses, word order, and polysemous words in English), were administered at both the beginning and the end of the intervention. Additionally, the participants were also asked to complete tests on the language structures one month after the intervention. A questionnaire measuring their motivation in the lesson was administered at the beginning and the end of the intervention, along with assessments of their attention to the lesson measured at the end of each session. Tests on attention and working memory as cognitive capacities, along with questionnaires on personality and academic motivation, were administered at the beginning of the intervention. Interim assessments of their listening skills were conducted each month during the intervention. Technology enjoyment and teacher observation questionnaires were also utilised. A selection of these tests and questionnaires was made to address the research questions. Specifically, the pre- and post- tests on language structures and skills, the cognitive tests (attention and working memory), conative tests (personality and academic motivation), and the questionnaires on factors impacting learning (in-class attention and motivation towards the lesson) were included

in the data analysis. The following sections present the findings of the study and discuss them in light of the findings of previous research, focusing on each research question separately.

8.3 Research Question 1. Does Technology Enhanced Language Learning (TELL) significantly improve language development, in-class attention, and motivation in the English lesson?

Research Question 1 examined the impact of TELL on L2 learners' knowledge of language structures (tenses, word order and polysemous words), language skills (speaking and listening), in-class attention and motivation in the lesson. The results were compared with a control group using the traditional paper-based methodology. These language structures and skills were chosen because they are particularly challenging for Greek L2 learners of English due to interference from their L1. As mentioned in CHAPTER 1: INTRODUCTION, distinguishing and correctly using the Present Simple and Present Continuous tenses is difficult for Greek learners because: a) Greek has only one tense to refer to the present, which is used both for actions that occur regularly and those happening at the moment of speaking, and b) auxiliary verbs are not required to form the present tense in Greek. Additionally, Greek word order is more flexible than English (Papaefthymiou-Lytra, 2001), and English polysemous words often translate into either a single word or multiple words in Greek, adding to the complexity of their acquisition. Furthermore, speaking and listening skills tend to be less emphasised in Greek language classes compared to L2 reading, grammar, and vocabulary, leading to frequent communication issues for Greek learners of English. Finally, in-class attention and motivation play key roles in successful language learning (Gardner, 2007; Gardner, 1983; Olney et al., 2015). A lack of motivation not only hinders learners' progress but also complicates the teacher's role, as unmotivated students may engage less and take less responsibility for their learning (Filgona et al., 2020; Young, 2005).

In sections 8.3.1 **Language Structures** and 8.3.2 **Language Skills**, the findings related to language structures and language skills are discussed, respectively, while section 8.3.3 **Factors Integral to Learning** focuses on the findings related to in-class attention and motivation in the lesson.

8.3.1 Language Structures

By comparing the improvement in linguistic knowledge of participants exposed to TELL and those who received the traditional teaching methodology, the results of the study report the positive impact of TELL on polysemous words. No significant difference was observed in their knowledge of tenses (Present Simple and Present Continuous) and word order in English. These findings show that the use of technology is conducive to L2 vocabulary learning. However, both TELL and the traditional methodologies can effectively enhance learners' grammar (i.e., tenses) and knowledge of word order structures. The research hypothesis, which predicted the favourable effect of TELL on vocabulary and no difference between the two groups, is confirmed. This prediction was based on previous studies (e.g., Berns et al., 2016; Marsaulina, 2020; Smith et al., 2013; Tausch, 2012) that examined L2 learners' knowledge in technologically enhanced language learning environments and reported similar findings to this study.

The positive impact of technology on learners' vocabulary knowledge is attributed to the affordances of the digital resources that offer interactive and engaging learning environments, which are not easily achieved in traditional classrooms. Compared to learning vocabulary using pen and paper and completing exercises on photocopies, online quizzes and games create gamification opportunities, provide interactive feedback, and offer competitive experiences, which are usually motivating for teenagers. These opportunities result in active engagement and reinforce learning. Given these advantages, it is unsurprising that vocabulary is the type of linguistic knowledge mostly examined in technology-based learning

environments (Chang & Hung, 2019; Fajaruiddin et al., 2024). The findings of this study align with previous studies, reporting the effectiveness of technology for L2 vocabulary learning. By utilising digital materials, such as computer games in e-books (Smith et al., 2013), game consoles with vocabulary games (Cobb & Horst, 2011), and Web 2.0 applications (Kazu & Kuvvetli, 2023), L2 learners' vocabulary knowledge has been shown to improve. Alvarez-Marinelli et al. (2016) and Wei (2023) also highlighted the positive impact of TELL on vocabulary knowledge. Furthermore, meta-analyses by Fajaruiddin et al. (2024) and Chang and Hung (2019), which examined technology-based language learning, found that the use of technology significantly improves vocabulary knowledge compared to traditional methods. The widespread use of digital resources for vocabulary knowledge has led to meta-analyses solely focused on technology-assisted L2 vocabulary learning. Their findings consistently reveal the effectiveness of technology for L2 vocabulary learning (e.g., Hao et al., 2021; Yu & Trainin, 2022) and corroborate the findings of the present study. Therefore, the positive impact of TELL on L2 learners' vocabulary knowledge should be advocated and generalised.

The comparable effects of both methodologies on learners' knowledge of word order structures and tenses both contradict and align with previous research findings. As presented in the review of literature in **CHAPTER 3: TECHNOLOGY IN LEARNING**, different results were found between technology-enhanced language learning and traditional methodologies regarding learners' word order and tense knowledge. Tausch's (2012) results indicated that L2 learners' word order abilities improved regardless of whether they were taught using digital tools (e.g., PowerPoint presentations) or more traditional methods (e.g., printed stories and pictures). In contrast, Tang et al. (2011) and Zibin and Altakhaineh (2019) found that technology positively influences L2 learners' syntactic knowledge. However, Tang et al.'s (2011) findings were based on learners' perceptions of technology's influence on their linguistic skills rather than objective test scores. While the learners' perceptions should not be

disregarded, objective test scores would offer more reliable results. Additionally, Zibin and Altakhaineh (2019) employed a blended approach in which the experimental group combined online and in-class instructions while the control group received only in-class teaching. This difference in exposure time suggests that the experimental group's better performance could be attributed to additional learning hours rather than the use of technology alone.

With regard to tenses, Marsaulina (2020) found that learners equally improved their knowledge of tenses, whether taught through a TELL method or a traditional approach. However, AbuSeileek and Rabab'ah's (2007) study showed that EFL learners gained a greater understanding of tenses when taught with technology compared to traditional methods. Meta-analyses show that only 5-10% of studies on technology-based language learning have focused on grammatical knowledge (Chung & Hang, 2019; Shadiev & Yang, 2020; Shadiev & Wang, 2022). Thus, further future research should incorporate grammatical knowledge before a consensus can be reached on the effectiveness of technology in the development of L2 knowledge of grammar features.

8.3.2 Language Skills

By comparing the pre- and post- test results, valuable insights were gained regarding learners' language skills. The results of the current study indicated that the TELL group showed greater improvement than the control group in speaking skills. This suggests that technology can be effectively used to address learners' communicative challenges. The positive impact of technology on speaking skills is likely due to the enhanced opportunities for interaction and communication in digital learning environments (Hung, 2016; Nardi et al., 2007; Mroz, 2014; Qiao & Zhao, 2023). In other words, digital language learning resources offer exposure to authentic language use, while their interactive and game-like features promote engagement and motivation. These opportunities make speaking practice less daunting compared to traditional classrooms, where speaking practice usually takes the form of question-answer interactions

between teachers and learners. This form of speaking practice offers fewer interactive and engaging opportunities for language use.

As presented in section 4.9.3 **Speaking Test** above, the participants' improvement of speaking skills was assessed using the IELTS speaking exam based on two criteria: a) a score evaluated based on the fluency and coherence, lexical resource, grammatical range and accuracy, pronunciation of their oral production and b) the average sentence length of their oral production. It should be noted that the positive impact of TELL on learners' speaking skills was evident when considering their overall speaking score but not the average sentence length of their oral production. The results showed no difference between the groups in the average length of their oral productions. Therefore, the research hypothesis regarding the positive impact of technology on speaking skills is partially confirmed. Overall, the findings suggest that digital resources enhance the quality but not the quantity of learners' oral productions. The difference between the two findings can be attributed to the duration of the intervention. We assume that it is rather unlikely for low-proficiency learners to produce longer sentences after a 9.5-hour, which focuses on a variety of skills and structures rather than solely on speaking improvement. However, the content of their speech can be improved due to their exposure to various language structures.

The results above on the effectiveness of TELL for speaking skills both support and contradict previous studies. Abedi (2022) and Akkara et al. (2020), who employed the same speaking evaluation criteria (fluency and coherence, lexical resource, grammatical range and accuracy, and pronunciation) as the present study, found that digital tools positively impacted L2 learners' speaking skills compared to traditional methods. This suggests that the TELL approach can enhance learners' fluency, coherence, lexical resources, grammatical range and accuracy, and pronunciation. However, Adair-Hauck et al. (2000) evaluated speaking

improvement based on overall scores and found no significant difference between TELL and traditional methods.

Regarding the second speaking criterion of the present study – average sentence length – the findings contradict previous research. Wang and Han (2021) examined L2 speaking skills after learners practised with a game-based language learning mobile app, and their results showed that the app helped increase the average number of words in learners' speaking. Similarly, Lys (2013) reviewed the effects of iPads and apps on improving L2 learners' speaking German and found that using technology led to a higher total word count and increased average sentence length. A meta-analysis by Chang and Hung (2019) revealed that, up until 2015, only 1.2% of TELL studies examined speaking skills, and the overall effect of technology on speaking skills was relatively small (Chang & Hung, 2019). Shadiev and Yang (2020) noted a significant increase in the number of studies on speaking skills, with 63% of TELL studies addressing speaking by 2019. However, despite this growth, Shadiev and Yang (2020) did not report the effect size of technology on speaking skills. Therefore, the impact of technology on learners' speaking skills is yet to be examined further.

A comparative review of the collected data revealed no significant differences between the groups in their listening skills, confirming the research hypothesis that both teaching methodologies would be equally effective. This finding suggests that L2 learners improve their listening skills when targeted through both traditional, paper-based methodology and with the aid of technology. The results of the present study are consistent with the previous studies (Adair-Hauck et al., 2000; Hsu et al., 2023). Similarly, Fajaruiddin et al.'s (2024) meta-analysis on the impact of technology on language learning reported that L2 learners improve their listening skills in both TELL and traditional paper-based classes. However, Chang and Chang (2014) reviewed the effect of YouTube videos and found that the use of videos led to improving L2 listening skills. Importantly, their study lacked a control group, leaving the effectiveness of

the traditional paper-based method unconfirmed. Sejdiu (2017) included a control group and found a greater improvement in listening skills compared to regular listening instruction. The authors did not offer any explanation about how the regular listening instruction was provided. These conflicting findings highlight that the effect of TELL on listening skills remains inconclusive. A meta-analysis (Chang & Hung, 2019) covering a period of 25 years from 1990 to 2015 revealed that listening was very rarely the focus of technology-based learning studies, with less than 5% of the studies investigating L2 learners' listening skills (Chang & Hung, 2019). More recent meta-analyses (Shadiev & Wang, 2022; Shadiev & Yang, 2020) showed that listening skills remain underexplored with only about 10% of studies. The present study contributes to the growing body of research on speaking skills and to the limited studies on listening.

8.3.3 Factors Integral to Learning

The results from the questionnaires on in-class attention and motivation showed that the participants in the intervention group were more attentive and motivated than those in the control. These findings confirmed the research hypothesis, which predicted a positive impact of technology on learners' in-class attention and motivation. It is important to note that the result related to motivation was marginally significant. The positive impact of technology on learners' attention and motivation can be attributed to interactive elements of digital learning resources and the gamification features that keep students engaged, which is a prerequisite for sustained motivation and attention. Online games, quizzes, and videos provide opportunities for multisensory learning, encouraging interaction with both the learning resources and their classmates. In contrast, traditional teaching methods, where teachers rely on whiteboards and paper-based materials, tend to involve passive absorption of information. Additionally, the combination of visuals, audio and text in digital learning accommodates different learning needs, leading to more engaged and attentive learners. It is also important to note that the use

of technology is rather limited in Greek public schools, where teachers often rely on traditional methods. Therefore, this novelly explains why the intervention group demonstrated higher motivation and attention compared to the control group.

The findings of this study are consistent with previous research. Numerous studies (e.g., Bautista-Vallejo et al., 2020; Berns et al., 2013; Bester & Brand, 2013; Chen et al., 2021a; Hung, 2016; James & Meyer, 2018; Perry, 2015) have reported that, compared to traditional paper-based methods, the use of applications, interactive digital whiteboards, social media platforms, games in virtual environments, mobile games, and the use of virtual and augmented reality enhances learners' motivation and attention. Meta-analyses also indicate that the use of technology positively influences motivation in foreign language classes (Shadiev & Wang, 2022; Wei, 2022). Therefore, it is possible to suggest that technology is an effective tool for maintaining students' motivation and attention in language learning environments.

It is important to highlight that while meta-analyses have specifically examined learners' motivation in technology-based learning environments (Wei, 2022), in-class attention has not been reviewed, as few studies have targeted this construct. This lack of research is likely due to the difficulty of accurately measuring in-class attention. The present study aimed to address this gap by designing a self-report questionnaire that the participants completed at the end of each lesson. The decision to administer the questionnaire after each lesson was based on previous research, showing that attention fluctuates, with lapses occurring in cycles as short as 1 to 5 minutes (Bunce et al., 2010). Administering the questionnaire only at the end of the intervention would not have captured these fluctuations in attention. In contrast to this approach, previous studies (Bautista-Vallejo et al., 2020; Bester & Brand, 2013) measured participants' attention at the end of the study and reported the positive effect of technology use. Bester and Brand's (2013) study lasted 2 hours (three 40-minute lessons), while Bautista-Vallejo et al.'s (2020) study had learners use a game-based application for fifteen minutes. The

short duration of Bester and Brand's and Bautista-Vallejo et al.'s studies explain the reason why in-class attention was measured at the end of these studies. Therefore, we suggest that the duration of a study is the key factor when determining how often to measure learners' attention. Longer studies require more frequent assessments of attention compared to shorter ones. These findings highlight the importance of considering duration as a key variable when examining in-class attention.

The findings of the study make a meaningful contribution to the existing body of knowledge by offering insights into the effectiveness of two teaching methodologies on young EFL learners. Firstly, as discussed in **CHAPTER 3: TECHNOLOGY IN LEARNING**, previous research has predominately targeted adult L2 learners, leaving the effects of TELL on younger populations understudied. Specifically, less than 18% of studies have been conducted with young teenagers (Chang & Hung, 2019; Fajaruiddin et al., 2024; Shadiev & Wang, 2022). Furthermore, a considerable number of studies – 82.1% – have examined only one aspect of language learning (Chang & Hung, 2019). However, to more closely resemble more authentic language learning environments, examining multiple aspects of language learning is crucial. In typical language classes, teachers often focus on different L2 structures, skills, classroom management issues, and learners' attention and motivation. Additionally, previous studies have focussed on the effectiveness of TELL from diverse L1 backgrounds (e.g., Chinese, German, Spanish) who were learning English, French, Spanish, or German as an L2. For Greek learners of English, TELL studies have predominately been conducted outside classroom environments, focused on only language features or skills, or lacked a control group using traditional learning methods. To the best of the author's knowledge, the current study is the first to examine the effectiveness of TELL with young Greek learners of English across a variety of factors in an authentic classroom environment.

To conclude the evaluation of the studies in the field of TELL, several methodological considerations should be addressed. Amid the growing body of research on the effectiveness of technology on language learning, some studies have reported the positive effects of technology by using different teaching materials for each group, providing the intervention group with additional teaching time or a different teacher, or failing to include a control group taught without digital resources. Such methodological decisions warrant careful consideration. It is essential to design studies in a way that does not give the intervention group an unfair advantage over the control group. The only distinguishing factor should be the method of delivering the materials.

This section concludes the comparison between a traditional paper-based methodology and a technology-enhanced one in terms of their effectiveness in language knowledge, attention, and motivation in the classroom. A detailed comparison of these fundamentally different teaching approaches sheds light on the lifelong debate and teachers' uncertainty about which teaching approach to adopt. Overall, the findings suggest that when the teaching goal is the acquisition of vocabulary or the improvement of speaking skills, the use of technology for learning purposes is recommended. Since the intervention group included digital tools and paper-based materials, a combination of these kinds of teaching materials is suggested. Conversely, for teaching word order, tenses, and listening skills, both paper-based and technologically enhanced methodologies are similarly effective. Additionally, when teachers face difficulties with classroom management issues related to learners' attention and motivation in class, the use of technology is advised. These results advance our current understanding of the field of TELL and lay the foundations for further empirical research on different L1/L2 combinations. Due to the limited number of studies and their contradictory findings, future research is needed to explore the impact of technology on grammatical knowledge, speaking, and listening skills.

8.4 Exploratory Research Questions

Research questions 2 and 3 investigate how individual differences influence language learning and examine how different teaching methodologies modulate this influence. Despite extensive efforts to locate previous studies that specifically explored the effect of teaching methodology – namely technology-enhanced language learning and traditional paper-based methods – on the relationship between IDs and language learning, no relevant studies were identified in the existing literature. Given this limitation, I compared the results of this intervention with studies that focused on the effect of individual differences on language learning alone and subsequently discussed how the teaching methodology may interact with these effects.

In this study, I examined working memory, attention, personality traits (conscientiousness and extraversion), and academic motivation (extrinsic motivation – identified) as IDs. Attention was measured through Flanker and visual search tasks, which indicated participants' selective attention (Müller & Krummenacher, 2006; Sanders et al., 2018). Flanker also indicated their inhibitory control (Howard et al., 2014). As explained in CHAPTER 6: DATA PREPARATION AND EXPLORATORY ANALYSIS, these variables were selected as they yielded the strongest correlations with linguistic knowledge and factors influencing language acquisition.

8.4.1 Research Question 2: Do cognitive capacities and personality moderate the acquisition of word order and polysemy in TELL versus the traditional teaching methodology?

Research Question 2 examines how attention, working memory, and personality traits influence learning polysemous words and word order in English, comparing TELL with the traditional paper-based methodology. A comparative examination of the results obtained from the linear regression models with nested groups revealed that the influence of attention on word

order and polysemous vocabulary differs across the two teaching methodologies. In contrast, the findings reported that neither working memory nor personality traits influence the acquisition of word order or polysemous words in either of the two methodologies.

An analysis of group differences revealed that the teaching methodology modulates the relationship between attention and language learning. Specifically, the results show that in TELL classes, L2 learners acquire word order structures regardless of their attentional capacities. In traditional paper-based classes, attentional capacities hinder the acquisition of word order. In contrast, learners acquire polysemous words regardless of their attention in traditional classes, while attention hinders their acquisition in TELL classes. The results suggest that a) in a TELL class, learners' inhibitory control and selective attention enhance the acquisition of word order, and b) in traditional paper-based classes, learners' selective attention and inhibitory control facilitate the acquisition of polysemous vocabulary.

These findings highlight an intriguing relationship between attention and language learning across distinct methodologies. In terms of word order, digital learning materials appear to enhance learners' attention, leading to improved acquisition of L2 syntax. It is suggested that the interactive visual elements of digital tools facilitate learners' inhibitory control and selective attention to word order structures. In contrast, paper-based materials lack these affordances, which may explain why they do not enhance attention capacities that facilitate word order acquisition. Regarding polysemy, technology seems to negatively affect learners' selective attention and inhibitory control, leading to a decline in the acquisition of polysemous words. One hypothesis is that the interactive elements of digital tools may distract learners from focusing on polysemous words, while paper-based materials help direct attention to polysemous vocabulary. These comparisons indicate that the teaching methodology modulates the relationship between individual differences and language learning depending on the type of linguistic knowledge.

The differences in results influenced by learners' individual differences can be explained by the learning conditions of each group. The two groups completed either online or paper-based quizzes and they both received immediate feedback on their answers. Specifically, after selecting their answers, students were provided with metalinguistic feedback, which included cues for finding the correct answer, prompts to explain their choice, and referring to the rule. However, in the case of the intervention group, the online quizzes provided the correct answer as a recast and then the learners received metalinguistic feedback. In the control group, there was no recast but rather metalinguistic feedback since learners were asked to explain why they chose a specific answer before the teacher approved or disregarded the given answer. It can thus be hypothesised that the difference in feedback between the two groups, i.e., recast combined with metalinguistic feedback vs. metalinguistic feedback alone, may affect the acquisition of word order and polysemous words. In other words, combining two types of feedback may positively enhance learners' inhibitory control and selective attention, facilitating the acquisition of word order structures in English. On the contrary, the combination of two types of feedback may negatively impact learners' attentional capacities which in turn hinders the acquisition of polysemous words.

Evaluating these findings in comparison to previous literature is challenging since the impact of the teaching methodology on the IDs-language learning relationship has not been explored before. Existing studies have reported contradictory findings on the relationship between attention and language learning when measuring learners' attentional capacities. Some studies have found that attention facilitates L2 learning (Dolgunsöz, 2015; Gas et al., 2003; Namaziandost et al., 2020; Segalowitz & Frenkiel-Fishman, 2005), while others found no relationship between the two (Kim, 2006; Ghaffarvand Mokari & Werner, 2019; Linck & Weiss, 2015). It is suggested that the conflicting findings of the present study may stem from the specific attention tests used (Flanker and visual search), the interference of learners' L1 to

English, or learners' ways of learning (visual, auditory, kinaesthetic). To validate these assumptions, future research should explore the modulating role of teaching methodology.

The results also showed that working memory does not impact vocabulary and word order learning in either group. This finding contradicts previous research on the relationship between working memory and language learning. Although previous research has not explored the relationship between these constructs in different teaching methodologies, a positive influence of working memory on L2 knowledge is well-documented. Studies have shown that working memory capacities support various aspects of L2 learning, including syntactic processing (Sagarra & Herschensohn, 2010; Zabihi, 2018) and L2 vocabulary knowledge (Swanson et al., 2015). A meta-analysis by Linck et al. (2014) further confirmed the positive association between working memory and L2 acquisition. However, Chrysochoou et al. (2013) found that, after the age of 9.5, working memory was no longer related to vocabulary knowledge for Greek speakers. Given that the participants in the current study had a mean age of 12.1, it is reasonable to infer that age may have played a role in why working memory had no effect on vocabulary learning. While the findings of this study align with Chrysochoou et al.'s (2013) results, it is important to note that their study focused on vocabulary acquisition in the first language (L1).

The findings of the present study align with a smaller number of studies which examined working memory and L2 learning. Previous research found no effect of working memory on language comprehension (MacDonald & Christiansen, 2002), syntactic processing and reading time (Juffs, 2005) and L2 proficiency in English (Gilabert & Muñoz, 2010). For Greek speakers of English, Felser and Roberts (2007) found that working memory capacities do not affect the processing or acquisition of L2 syntactic features. Overall, as presented in

CHAPTER 2: INDIVIDUAL DIFFERENCES AND LANGUAGE LEARNING PARAMETERS, previous literature on the relationship between cognitive capacities (working

memory and attention) and linguistic knowledge has reported contradictory findings, with fewer published studies advocating the disassociation between cognitive IDs and linguistic knowledge. The contradictory findings are attributed to the combinations of L1/L2, learners' proficiency levels, the types of linguistic knowledge and language skills, and the methodologies of the studies.

With regard to personality, the results of this intervention study indicate that L2 learners' acquisition of polysemous vocabulary and word order is not influenced by their conscientiousness and extraversion in either group. Evaluating and comparing these findings is challenging due to the scarcity of similar research. As presented in **CHAPTER 2: INDIVIDUAL DIFFERENCES AND LANGUAGE LEARNING PARAMETERS** previous research has not extensively examined specific types of linguistic knowledge in relation to personality. Instead, they focused on the effect of personality on L2 proficiency or language skills. Previous research corroborates that conscientiousness positively affects academic success (e.g., Kaufman et al., 2008) and achievement (Komarraju et al., 2009), and learners' extraversion predicts their L2 acquisition (Suliman, 2014). Moreover, Chen et al.'s (2021b) meta-analysis on the relationship between L2 learning and the Big Five personality traits revealed that all personality traits, except neuroticism, significantly influence L2 achievement in the four language skills. These findings appear to contradict the findings of the present study. Golaghaei and Sadighi (2011) focused on L2 vocabulary and extraversion and reported contradictory results to the present study. They found that extrovert learners have greater vocabulary knowledge compared to their introvert peers, which suggests that extraversion facilitates L2 vocabulary acquisition.

Based on the findings of the present study, the integration of technology in EFL classes is a recommended teaching methodology for learning word order structures. In contrast, a paper-based methodology is suggested when learners acquire polysemous words. The latter

recommendation seems to contradict the results presented in section 8.3.1 Language Structures which highlighted the positive impact of technology on the acquisition of polysemous vocabulary and led to a suggestion for using technology in the classroom. However, the recommendation for distinct teaching methodologies in the acquisition of polysemous vocabulary arises from learners' individual differences in attention. Specifically, when considering learners' individual differences in attention, the use of coursebooks, photocopies, and other paper materials is more effective for vocabulary acquisition. The pedagogical suggestion from the current study is to combine teaching methodologies. Teachers should structure their lessons on vocabulary by using paper-based materials and digital ones to address students' different learning needs, as shaped by their IDs in attention capacities (see CHAPTER 9: **RESEARCH IMPACT** for more details).

8.4.2 Research Question 3

Research question 3 investigated how conative individual differences relate to various aspects of language learning. The first sub-question examined the correlation between personality/academic motivation and in-class attention in TELL versus the traditional teaching methodology. The second sub-question explored how personality relates to motivation in TELL versus the traditional teaching methodology. In the present intervention, in-class attention refers to learners' attention during the lesson, while motivation in the lesson reflects their attitudes and evaluations of the lessons they attended (Gardner, 2004). Additionally, academic motivation refers to students' motives for attending school (Vallerand et al., 1992a, CHAPTER 4: **DATA COLLECTION**).

Research question 3 examines in-class attention and motivation in the lesson since they are integral parts of language learning, impacting learning processes, learners' engagement, and teachers' efforts. The importance of attention has been highlighted by Schmidt (2012), who emphasised that learners acquire knowledge only when they notice the linguistic features to

which they are exposed. Motivation is related to self-regulation (Benati & VanPatten, 2015, p. 45) and influences learners' acquisition and behaviour in class. Measuring in-class attention has proven difficult, as there is no validated tool for its assessment. This difficulty has hindered research across various fields, making it difficult to compare this study's findings on in-class attention with those of previous studies. Instead, after considering the impact of the teaching methodology, we will focus on other variables (personality and academic motivation) to evaluate and interpret the findings. As presented in **CHAPTER 6: DATA PREPARATION AND EXPLORATORY ANALYSIS**, conscientiousness and extrinsic motivation – identified were retained in the analysis after addressing the multicollinearity issues.

8.4.2.1 3a) How do personality and academic motivation correlate with in-class attention in TELL versus the traditional teaching methodology? By examining the relationship between attention and learners' conscientiousness, the results show a positive relationship between those two variables within both groups. This finding suggests that the presence or absence of technology in language classrooms does not affect conscientious learners' ability to remain attentive to the lesson. This observed relationship is grounded on traits such as self-discipline, diligence, and persistence, which enable conscientious learners to focus on the learning process. Overall, it is possible to say that conscientiousness traits facilitate learners' attention in the class regardless of the teaching methodology employed.

Previous studies on attention have not explored its relationship with personality traits. Instead, they have focused on topics such as attention lapses and time intervals (e.g., Bunce et al., 2010) or the impact of a teaching approach on learners' attention (e.g., Bester & Brand, 2013). On the other hand, research on personality has focused on its relationship with various theoretical constructs. As discussed in **CHAPTER 3: TECHNOLOGY IN LEARNING**, studies have found that conscientiousness affects L2 learning experiences (Ghapanchi et al., 2011), academic success (Kaufman et al., 2008), academic motivation and achievement

(Komarraju et al., 2009). These observations suggest that jointly investigating personality and in-class attention is still at a very early research stage. Although direct comparisons cannot be made, we can make some assumptions based on previous research on personality. For example, studies by Komarraju et al. (2009) and Kaufman et al. (2008) show a positive impact of conscientiousness on learners' achievement and academic success. Conscientious learners' academic achievements may imply their attention to the learning process. This could justify the positive relationship between in-class attention and conscientiousness reported in the present study.

By comparing the model results on in-class attention and academic motivation, valuable insights are gained into their relationship within teaching methodologies. The results show that academic motivation positively influences learners' in-class attention only in a traditional paper-based methodology. This suggests that academic motivation is a prerequisite to keep learners attentive in a traditional paper-based lesson, whereas it does not play a major role when technology is used. In technology enhanced classrooms, academic motivation may not be a decisive factor, as the interactive characteristics and gamification opportunities are likely to keep learners engaged. On the contrary, in traditional paper-based lessons, where the above-mentioned affordances are limited, traits of academic motivation become a more important factor. The digital materials used in the intervention group incorporated music, videos, and interactive elements. These features are absent in the traditional paper-based methodology. It can be hypothesised that these digital affordances help engage and sustain learners' attention. On the contrary, the lack of such features in traditional paper-based classes makes maintaining attention more challenging, and therefore, learners' academic motivation traits become a prerequisite in ensuring their attention to a traditional lesson.

Considering that previous research has not explored the relationship between in-class attention and academic motivation, we can interpret these findings by drawing on existing

literature about academic motivation. Vallerand et al. (1992a) provided a definition of extrinsic motivation – identified (which was the type of academic motivation examined in this study). They described it as a kind of behaviour that is valued by the individual, and it has been chosen by oneself. They explained that an individual characterised by this type of academic motivation would say, *"I've chosen to study tonight because it is something important for me"* (Vallerand et al., 1992a, p. 1007). They suggest that academically motivated learners are driven by achievement, and their behaviour is contingent on what they consider valuable. It is likely that their ambition to reach their goals encourages them to pay attention to lessons. This supports the positive relationship between in-class attention and academic motivation found in the present study.

Evaluating these observations in direct comparison with studies on academic motivation presents challenges, as academic motivation has been predominately examined in relation to academic success, language learning achievements, personality traits, and self-efficacy (e.g., Honicke & Broadbent, 2016; Komarraju & Karau, 2005; Taylor et al., 2014; see **CHAPTER 2: INDIVIDUAL DIFFERENCES AND LANGUAGE LEARNING PARAMETERS**). However, the findings of the current study align with Omar's (2021) study, which examined EFL learners' academic motivation in online English classes. The results showed that high academic motivation levels lead learners to participate actively in English language classes. While active participation is not explicitly viewed as attention in class, it presupposes a certain level of in-class attention. Omar et al. (2021) did not pinpoint a specific kind of academic motivation. Instead, they investigated academic motivation as learners' self-regulation learning and self-efficacy, which also depict their behaviour to achieve a learning aim. The findings suggest a correlation between in-class attention and academic motivation.

8.4.2.2 3b) How does personality correlate with motivation in TELL versus the traditional teaching methodology? The results of the current study indicated a positive

relationship between conscientiousness and motivation in the lesson. Importantly, this relationship was found only in the control group. This finding suggests that a) when learners are taught in a traditional paper-based way, their conscientiousness contributes to their motivation in class, and b) learners who are taught with digital tools stay motivated regardless of their conscientious traits. This comparison shows that the use of technology for learning purposes balances out the impact that conscientiousness has on motivation in a traditional paper-based lesson. However, it is essential to clarify that this result was marginally significant in cases of exploratory research. The difference in the relationship between conscientiousness and motivation in each teaching methodology can be explained by the integration of digital resources, which introduces a twofold learning process. Before engaging with digital tools for language learning, learners are first required to learn how to use websites, apps, virtual reality devices, or complete augmented reality activities. Therefore, integrating technology in class not only enhances language proficiency but also equips learners with digital skills. This additional learning step can be more motivating than completing a variety of traditional paper-based activities. The improvement of both their technological competency and linguistic knowledge could explain why learners remain motivated in a TELL lesson. In contrast, they need to be conscientious to maintain their motivation in a traditional class, where the primary focus is mainly improving linguistic knowledge.

The results of the current study are consistent with previous studies that investigated the relationship between motivation and personality. Although no comparisons were made pertaining to the teaching methodology, they reported the positive impact of personality on learners' motivation. Jung Ku et al. (2021) examined motivation for learning Mandarin as an L2 and found that conscientiousness has a positive impact on L2 learners' motivation. Similar findings were reported by Ku et al. (2022), who also demonstrated a positive relationship between conscientiousness and motivation. Although research has reported contradictory

findings about other personality traits (e.g., openness to experience, extraversion, and agreeableness) and motivation in L2 learning, a meta-analysis on personality traits and motivation by Judge and Ilies (2002) revealed that conscientiousness has been consistently reported as a positive predictor of motivation.

By interpreting this study's findings from a learning perspective, learners' conative individual differences, as shown by their academic motivation and personality, positively influence their attention and motivation in the lesson. The use of technology in language classrooms neutralises a) the need to be academically motivated to pay attention to the lesson and b) the need to be conscientious to stay motivated in the lesson. As a pedagogical suggestion, teachers can integrate digital tools into their lessons to teach or practise language skills and structures. This will ascertain learners' attention and motivation in the learning process. By establishing learners' attention and motivation, the teaching process can become less challenging since less classroom management is required on the teacher's part.

Considering the exploratory design of the current study, future research needs to review the marginally significant results on the relationship between conscientiousness and motivation in lessons and the findings and possible interpretations related to a) in-class attention and academic motivation, b) in-class attention and personality, and c) the influence of different kinds of attention on language knowledge. It is important to note that studies on individual differences require larger sample sizes to accurately reveal the nuances among learners and their effect on language learning dimensions. We assume that a larger sample size may lead to statistically more robust findings.

While the current study and previous literature report the positive impact of technology on L2 learning, technology integration into class also entails several challenges. Technological problems related to network quality and malfunctions of devices, apps or sites may interrupt learning processes. Learners may feel frustrated in these instances as their collaboration with

their peers or participation in online activities is interrupted, and valuable class time is spent addressing technical issues. In cases where learners do not have access to a mobile phone or are unaware of the correct use of a website, they may feel estranged from their classmates and become demotivated. This results in additional monitoring required from the teacher to ensure a smooth learning process. Moreover, classroom management may need to increase when learners engage with digital resources that can potentially distract them. These challenges demand teachers' knowledge of technical issues, digital resources suitable for learning, and a gradual exposure to technology use.

Overall, the current study revealed a) that technology positively influences some aspects of L2 learning and b) that the teaching methodology modulates the relationship of IDs with language learning dimensions; a finding which is a novel contribution to our current academic knowledge. The scarcity of previous research on the modulating role of teaching methodologies impeded direct comparisons with previous study findings, but the interpretation and integration of the results into the existing body of knowledge offer new outlets for research. In this section, I evaluated the findings both from theoretical and methodological perspectives. The findings provide valuable insights into the field of TELL, enhance our knowledge of individual differences and open an avenue for examining the importance of teaching methodologies in relation to the IDs in language classrooms.

9. CHAPTER 9: RESEARCH IMPACT

9.1 Introduction

This chapter focuses on the research impact of the study by offering practical teaching suggestions for language teachers. Thomm et al. (2021) reported that educators perceive research findings as irrelevant to their practice, which calls for translating study findings into practical teaching recommendations. Hence, this chapter aims to address teachers' views, inform classroom practice, and facilitate teaching.

Teaching strategies are essential to a learning process, aiding in effective classroom management. Given the multifaceted challenges in a classroom, such as classroom management issues, the learning aims, the varying number of learners, and their individual differences, this chapter cannot comprehensively address every challenge and provide teaching recommendations for all of them. Instead, it will focus on lesson content, specifically lesson structure, feedback, input, and a student-centered approach as essential components of a class. The teaching suggestions related to these factors and their effectiveness are described and supported by previous studies in section 9.2 **Teaching Recommendations on Lesson Content** below. The following section, 9.3 **Individualised Teaching Recommendations for Word Order and Polysemy** presents teaching suggestions for word order and polysemy as shaped by L2 learners' individual differences. The findings of the present study guide these recommendations and include effective teaching strategies for word order and polysemy based

on L2 learners' attentional capacities. The presented recommendations align with this intervention's lesson structure and materials.

9.2 Teaching Recommendations on Lesson Content

The section focuses on lesson content in technology-enhanced and traditional paper-based teaching methodologies by analysing lesson structure, feedback, input, and a student-centered approach (see **CHAPTER 5: THE CLASSROOM INTERVENTION AND TEACHING MATERIALS**). Previous studies have highlighted the importance of the lesson structure, feedback, input, and a student-centred approach to the learning process (Blackie et al., 2010; Hattie & Timperley, 2007; Maulana et al., 2012; Meredith & Catherine, 2020; Snow, 2014).

9.2.1 Recommendations for Lesson Structure

A fixed structure that remains consistent throughout all lessons is linked to academic engagement (Maulana et al., 2012). In the lesson plans designed for this intervention (see Appendix 20, 21 Lesson Plans), greetings and news exchange were the first stages of each lesson. This introductory step is beneficial as it reduces disruptive behaviour and improves academic engagement time (Cook et al., 2018) and on-task behaviour (Allday & Pakurar, 2007). The subsequent stages followed a specific structure, including a stage of inductive and deductive learning and a practice stage of the targeted linguistic skill or structure.

An implicit exposure to knowledge presupposes learners' lack of awareness and attention, and an explicit one presupposes their awareness, attention, and working memory (DeKeyser, 2003; Ellis, 2009). To meet these requirements, the implicit process requires the complete absence of any rule and theoretical explanation, and the explicit process involves explaining rules (Ellis, 2009). The teacher performs the inductive learning stage to guide learners towards using the targeted linguistic structure. The teacher or the learners who have acquired or already know the theoretical explanations of the targeted structure can perform the

following deductive learning stage. The inductive learning stage proceeded to the deductive learning stage to resemble the implicit process of learning a native language. This is suggested because implicit learning leads to native-like language processing (Morgan-Short et al., 2012). The last stage includes the practical implementation, where learners practise what they acquired in the previous two stages. A three-stage process targets learners' needs for inductive and deductive learning and practice (**CHAPTER 5: THE CLASSROOM INTERVENTION AND TEACHING MATERIALS**). Although the above is a suggested course of action, the content of each stage is dependent on the learners' needs and the teacher's selection of suitable teaching materials to achieve the learning goals.

9.2.2 Recommendations for Feedback

Feedback is another dominant component that influences the success of a learning outcome (Hattie & Timperley, 2007). Skinner (1957) identified the importance of feedback through operant conditioning, highlighting that specific behaviour is adopted after reinforcement or punishment. Skinner's operant conditioning is adapted into classes as positive reinforcement, accomplished via different ways of providing feedback. According to Lyster and Saito (2010), the most effective type of feedback is prompts and were predominantly used during the lessons. Prompts are cues given to the learners to elicit the correct form, including clarification requests, repetition, elicitation, and metalinguistic feedback. These types of feedback are suggested, considering that the teacher does not recast the correct form. Instead, learners reflect on their output, recognise, and correct their erroneous utterances. Although this negotiation process of feedback among teachers and learners is more time-consuming than a simple recast, it leads to successful language acquisition (Lyster & Saito, 2010). Following the present study's design, the teacher or a fellow student (after the teacher's encouragement) can provide feedback.

9.2.3 Recommendations for Input

In addition to lesson structure and feedback, input is another critical component of the language learning process. Innatist theories placed minimal importance on the contribution of input, but later, communicative and emergentist theories proposed its contribution to SLA (see **CHAPTER 2: INDIVIDUAL DIFFERENCES AND LANGUAGE LEARNING PARAMETERS**). The importance of input has been emphasised in language acquisition (Schmidt, 2012) since ample input can lead to learners' intake and, ultimately, their output (Crossley et al., 2016). According to Lucas (2022), comprehensible input in an English classroom environment is a necessary teaching technique in L2 acquisition (p. 57). Teachers' endeavours to provide as much L2 input as possible using different resources is recommended. However, it should be noted that an L2 English-only classroom environment is not always attainable because of various factors (e.g., external factors, classroom management, and explanations of abstract topics).

9.2.4 Recommendations for a Student-centered Approach

A student-centered approach is also necessary for classroom environments as it can gradually lead to autonomous learning, and it also creates a safe learning environment where learners do not feel anxious, afraid, or hesitant (O'Toole, 2015; Smit et al., 2014). A student-centered approach and a supporting learning environment were established in the lessons of the present intervention for both groups by engaging students in the learning process. Students' engagement was achieved through a) capturing students' attention at the beginning of the lesson, b) assigning group work and pair work throughout the lesson, c) asking students to reflect on what they have learnt or completed at different lesson intervals, and d) putting students in charge of classroom management or other teaching-related issues. These strategies can be adopted regardless of the teaching methodology, i.e., technology-enhanced or traditional learning.

Firstly, capturing learners' attention at the beginning of the lesson can be achieved by integrating activities that prompt learners to guess the lesson's topic or by asking them any personalised questions related to it. Guessing activities draw learners' attention to the lesson and can be completed on [mentimeter.com](https://www.mentimeter.com) or the whiteboard. By posing personalisation questions on learners' preferences and experiences, they may perceive the lesson topic as relevant to their everyday lives.

The second suggestion, assigning group and pair work, is a proposed technique to divert the learners' focus from the teacher to themselves. Modifying an activity usually completed individually to a group-work one is recommended and enhances learners' communicative opportunities. Whether an activity is structured as group work, pair work or with the whole class is contingent on the learning needs, the goal of the activity, and the learners' characteristics.

The third suggestion, reflection, is asking students to reflect on their learning. Self-reflection helps L2 learners, is related to their metalinguistic awareness, and facilitates their acquisition (Granville & Dison, 2005). Questions structured with a binary choice as an answer (e.g., *is this grammatical phenomenon used in an x or a y case?*) are concept-checking questions to assess learners' understanding. Additionally, open-ended questions (e.g., *What do you think of this language structure?*) facilitate reflection on the targeted structure, skill, or the learning process.

The last suggestion for a student-centered approach is the assignment of different classroom management roles to students. In the present intervention, a student was responsible for the whiteboard use and chose the next speaker among the classmates. The rationale behind this suggestion lies in the teacher not being involved in activities which learners can complete autonomously.

This section offered general teaching recommendations that were implemented throughout the lessons of this intervention and adopted due to their effectiveness and support from previous studies and theories. The following section, 9.3 **Individualised Teaching Recommendations for Word Order and Polysemy** targets two specific kinds of linguistic knowledge, word order and polysemous words, and provides teaching recommendations for these. The results of research question 2, "*Do cognitive capacities and personality moderate the acquisition of word order and polysemy in TELL versus the traditional teaching methodology?*" revealed interesting relationships of both word order and polysemy with L2 learners' individual differences in different teaching methodologies.

9.3 Individualised Teaching Recommendations for Word Order and Polysemy

The findings of research question 2 (see CHAPTER 7: **LINEAR MODELS** CHAPTER 8: **DISCUSSION OF RESEARCH FINDINGS**) reported the impact of learners' attentional capacities on learning word order and polysemous words in English. Firstly, it was found that attention negatively affects the acquisition of word order in a traditional paper-based language learning environment, but not in a TELL one. Secondly, attention hinders the acquisition of polysemous words in a TELL environment but not in a traditional paper-based one. Based on these findings, section 9.3.1 **Teaching Strategies for Word Order Acquisition** presents teaching recommendations for learning word order using digital resources. Section 9.3.2 **Teaching Strategies for Acquisition of Polysemous Words** describes teaching recommendations for learning polysemous words following the traditional paper-based approach. The structure and content of the intervention lessons advised the suggested teaching techniques.

9.3.1 Teaching Strategies for Word Order Acquisition

Based on the findings of the present intervention, technology is recommended for teaching word order structures to EFL learners. In the lessons of the intervention group, learners

were gradually exposed to technology to offer them time to familiarise themselves with digital resources and the habit of using technology for educational purposes.

The initial teaching strategy was the implicit exposure to word order activities. To achieve this, the website educraft.tech offers online games on word order activities. In these games, learners answer questions by putting words in syntactic order. The online games in this study incorporated authentic, real-world references and humorous elements, addressed various language skills and teenagers' preferences, and were well-designed, user-friendly, age-appropriate, interactive, and competitive (see Appendix 21 for examples from the Intervention Group's Lesson Plans). It should be mentioned that these game characteristics are not specific to a technology-enhanced language lesson; instead, they should underpin any language game in a traditional learning environment (except for being user-friendly, which is specific to digital games).

Following the inductive learning phase, deductive learning of word order rules provides a comprehensive dual approach to learning. Deductive learning can be achieved using a video that explains English word order rules (e.g., subject-verb-object). Instead of presenting videos that passively explain word order rules, the edpuzzle.com website was used. The website customised the videos by creating pauses at different intervals. Questions about the content are presented at intervals, and the learners interact with the video by typing or selecting their answers.

Combining theory and practice can provide an additional approach to word order instruction. Specifically, interactive online presentations designed on quizziz.com were utilised and were accessible via learners' mobile phones. The presentations begin with slides that provide examples of various English word order structures (e.g., relative clauses), displayed on both the learners' phone screens and an interactive whiteboard. Learners read the sentences and discern the syntactic rules by responding to the teacher's elicitation questions. Following the

theoretical slide, the next slide presents an exercise on the previously learned rules, allowing learners to apply what they have learned. The slide includes questions which learners answer by selecting the correct option or typing their responses on their phones. This activity is timed and can be completed individually or in pairs. Structuring an activity to integrate both theoretical and practical components offers an alternative to simply presenting theoretical knowledge.

In this final practice stage, feedback is essential for learning and reflection. The quizziz.com website offers feedback by recasting the correct answer in written form. In addition to the written feedback, the teacher can also provide oral recasts during the lesson, which have been proven more effective than digital written feedback (Kourtali, 2022). It is also recommended to ask learners to identify why an answer is syntactically incorrect since metalinguistic feedback is more effective than recasts (Ammar, 2008; Van De Guchte et al., 2015). Based on the results of these studies, combining digital feedback in the forms of written recasts, oral recasts and metalinguistic feedback given by the teachers is suggested.

In a nutshell, the integration of technology is recommended for the acquisition of word order skills by L2 learners since attentional capacities hinder word order learning in traditional methodologies. Briefly, online games, interactive videos, and online presentations that integrate theory and practice can be used to practise word order, discern rules, practise newly acquired knowledge and receive immediate feedback.

9.3.2 Teaching Strategies for Acquisition of Polysemous Words

Although using digital learning resources is essential for teaching word order structures to L2 learners, considering their attentional capacities, acquiring polysemous words requires a different approach. We highlight the importance of attentional capacities since the study findings revealed that these capacities affect the acquisition of word order and polysemous

words differently, given the teaching methodology. Based on the research findings, a traditional paper-based teaching methodology is suitable for learning polysemous words since attentional capacities impede the acquisition of polysemous words when using digital learning materials. This section offers recommendations for teaching polysemy by outlining initial strategies, teaching materials, practice and revision stages, and the feedback process. The materials should be presented in a paper-based format or on the whiteboard to ensure a digital-free learning environment.

In the present intervention, the exposure to learning polysemous words was completed incrementally with a variety of learning materials since repetitiveness in vocabulary teaching is monotonous (A'lipour & Ketabi, 2010; Kruk et al., 2021). The initial step in teaching polysemous words involves eliciting the concept of polysemy from learners using appropriate teaching materials and questions. Specifically, sentences containing words with multiple meanings are presented on the whiteboard or a photocopy. Pictures can be paired with sentences to help students understand the concept of polysemy and distinguish the different meanings of polysemous words.

After understanding the concept of polysemy, various teaching materials can be integrated into the learning process to maintain learners' interest, including activities that combine sentences, definitions, and pictures. Utilising sentences with polysemous words can help learners elicit their various meanings. Using sentences rather than isolated words exposes learners to each word's context. Pictures should be carefully selected to explicitly represent the meanings of the polysemous word to enable L2 learners to efficiently associate each meaning with the appropriate picture (See Appendix 22 Control's Group Teaching Materials for examples of such pictures).

As an additional way to use sentences and pictures, learners can decipher the meaning of a polysemous word within a sentence by selecting the most fitting picture out of two.

Presenting both pictures of the different meanings at the same time facilitates direct comparison and may enhance learners' understanding. This learning process is more demanding on the learner's part as conscious effort and time are required during the comparison stage. However, it is well justified as incrementally exposing learners to more demanding cognitive activities leads to L2 development (Robinson, 2005).

Another method for teaching polysemous words is the use of flashcards as a teaching resource (see Appendix 22 Control's Group Teaching Materials for examples of flashcards with polysemous words). Paper flashcards help distinguish polysemous words that share a single term in the learners' L1. Each flashcard presents the different meanings of polysemous words through images and prompts learners to infer the meaning. After they guess the meaning, the reverse side of the flashcard reveals the word's orthography, allowing learners to practise and see its spelling. This stage can be followed by practice, where learners recall the words by looking only at the pictures. In a more challenging approach, the final practice stage requires learners to remember the words before seeing the image. Additionally, the use of paper flashcards by the students – not the teacher – allows the former to take an active role in the learning process, with the latter adopting a facilitative role in a student-centered learning environment.

Following these activities for learning polysemous words, a practice stage can reinforce the newly acquired knowledge. Firstly, practising new vocabulary can be achieved by constructing sentences using polysemous words. The objective is for learners to write sentences demonstrating the different meanings of the words rather than merely translating them into their L1. A sentence that clearly illustrates the targeted word's meaning suggests that learners know the context in which the word is used.

Secondly, multiple-choice exercises can be implemented for practice, where learners read a sentence, comprehend its context and choose the correct polysemous word to fill the

gap. Thirdly, quizzes with gap-filling sentences and provided options can be integrated into the lesson to consolidate learners' knowledge.

A revision of previously acquired polysemous words before introducing new ones is important. A revising activity is creating word webs – a central circle containing a main word (e.g., polysemous words) with lines extending outward to related words – on the whiteboard can be used. Students are asked to add polysemous words on the lines and recall their different meanings. It should be noted that approximately ten to twelve meanings of polysemous words should be introduced, as a higher number would be too challenging for young teenagers to acquire, recall, and use each word correctly. Although the suggested range of 10-12 words does not originate from a single source, it is a widely endorsed teaching practice in TESOL (Teaching English to Speakers of Other Languages) settings. The concept of presenting learners with smaller, manageable chunks of vocabulary was also recommended by Nation (2022) in his influential work on learning vocabulary in another language.

Feedback provision is also recommended when learning polysemous words, similarly to the process of instructing word order. Rather than the teacher providing the correct answer, an elicitation method is preferred, as previous literature suggests (Lyster & Ranta, 1997; Lyster & Saito, 2010). Eliciting the correct answer and using clarification and concept-checking questions encourages learners to reflect on their responses. Chang (2019) explained that self-reflection contributes to learning and "through reflection, learners review and revisit the knowledge they had learned, explore the depth of the knowledge, and reinforce the knowledge" (p. 104). Peer feedback is also valuable, aside from the teacher's feedback. Classmates can either affirm or suggest alternatives to a peer's answer. During this process, the teacher plays a facilitative role, confirming answers or providing additional information on the different word meanings when necessary. It should be mentioned that the above teaching recommendations are not an extensive list of ways to teach polysemous words.

Lastly, according to the findings of research question 1, "*Does Technology Enhanced Language Learning (TELL) significantly improve language development, in-class attention, and motivation in the English lesson?*", the use of technology is more conducive to learning polysemous words than a traditional paper-based method. This finding suggests the use of digital resources for teaching polysemy and contradicts the above recommendations for paper-based learning of polysemous words. However, using paper-based learning materials is required due to the learners' individual differences in attention (see CHAPTER 7: **LINEAR MODELS** and CHAPTER 8: **DISCUSSION OF RESEARCH FINDINGS**). Therefore, teachers should combine paper-based and digital materials to cater to L2 learners' different needs. The teaching materials proposed in this section can be transformed into digital ones using PowerPoint presentations, pictures on the interactive whiteboard, online quizzes and activities on wordwall.net, and digital flashcards on cram.com.

Section 4 Summary

Section 4 presented a discussion of the findings of the present intervention study. CHAPTER 8: **DISCUSSION OF RESEARCH FINDINGS** began by analysing the rationale of the study, which involved comparing two distinct teaching methodologies – TELL and the traditional paper-based method – and examining their effectiveness and the impact of Greek L2 learners' individual differences on language learning. The research results were evaluated and juxtaposed to previous studies (e.g., Adair-Hauck et al., 2000; Berns et al., 2016; Bester & Brand, 2013; Smith et al., 2013) and contributed to the advancement of the field of TELL and individual differences. CHAPTER 9: **RESEARCH IMPACT** provided teaching recommendations based on the research results and the lessons designed for this intervention. The chapter emphasised the impact of the research by informing classroom practice and offering practical teaching recommendations based on L2 learners' individual differences and teaching methodologies.

10. CHAPTER 10: CONCLUSION

10.1 Introduction

Chapter 10 is the final chapter of this thesis. Following this introduction, the chapter begins with section 10.2 **Rationale and Brief Summary of the Study** which outlines the rationale of the study and presents the reasons for its design and completion. Section 10.2 **Rationale and Brief Summary of the Study** also offers a brief summary of the current study, including the methodology, research questions, and findings. Subsequently, section 10.3 **Significance of the Study** presents the significance of the study in the field of Applied Linguistics, mainly focusing on the issue of individual differences. Section 10.4 **Limitations of the Study and Possible Criticisms** discusses possible criticisms and limitations of the current study by providing a critical view of its limitations and indicating findings which need to be considered with caution. Recommendations for future studies by proposing ways to

expand the findings are offered in section 10.5 **Recommendations for Future Studies**. The aim of this section is to a) identify areas that require further research, b) suggest alternative methodologies to enhance the generalisation of the results and c) provide research suggestions for improving learning in various settings. The last section, 10.6 **Final Conclusion**, is the take-home message of the dissertation. Section 10.6 underlines the theoretical contributions of the study: a) the effectiveness of TELL compared to the traditional paper-based method for adolescent Greek learners of English, and b) how the teaching methodology modulates the relationship between individual differences and language learning. These findings lay the foundations for future studies to develop specific, practical and effective pedagogical recommendations for language learning and teaching.

10.2 Rationale and Brief Summary of the Study

Learning a second language is a complex process influenced by various factors, including the teaching methodology, the learning environment, learners' individual differences and learning styles, and the teacher's character and attitude in the classroom, among others. The teaching and learning process can be long and challenging as teachers and learners navigate their own learning curve. To make this process easier and more effective, it is crucial to identify the best ways students learn, which will guide teachers' instructional choices.

The present study compared two teaching methodologies: a technology-enhanced method and a traditional paper-based one. The traditional paper-based method, widely adopted by teachers due to its familiarity and minimal challenges, contrasts with TELL, which integrates technology to keep learners motivated and attentive (Bester & Brand, 2013). It was important to compare two viable methodologies, so TELL was supplemented with coursebooks and paper-based materials, reflecting realistic classroom practices where teachers typically use a combination of digital and paper-based learning resources. The research focused on three main areas: a) listening and speaking, addressing common communication problems faced by

Greek L2 learners; b) language structures that are challenging for Greek L2 learners, such as word order, polysemous words, and the Present Simple vs. Present Continuous, and c) in-class attention and motivation, which are critical for effective learning (Olney et al., 2015; Gardner, 2007; Gardner, 1983). The study pursued the answers to the following research questions:

1. Does Technology Enhanced Language Learning (TELL) significantly improve language development, in-class attention, and motivation in the English lesson?
2. Do cognitive capacities and personality moderate the acquisition of word order and polysemy in TELL versus the traditional teaching methodology?
3. a) How do personality and academic motivation correlate with in-class attention in TELL versus the traditional teaching methodology?
 3b) How does personality correlate with motivation in TELL versus the traditional teaching methodology?

The two methodologies, TELL and the traditional paper-based one, were compared in a classroom intervention study involving young adolescents learning English as a foreign language. The participants were first-grade secondary school students (aged 11-13) in Greece. They were randomly divided into two groups: one learning English with the aid of technology (e.g., PowerPoint presentations, videos, mobile phones, online games and quizzes, augmented and virtual reality, etc.) and the other using coursebooks and paper-based materials (e.g., whiteboard, stories, pictures, photocopies, flashcards, etc.). The former constituted the intervention group, while the latter served as the control group. The same teacher taught both groups with the same teaching materials, learning goals, and hours of learning. The only difference was the delivery of the teaching materials: digital for the intervention group and traditional paper-based for the control group. Tests assessing the participants' knowledge of different language skills and structures were conducted before, immediately after, and 1.5 months after the intervention. Additionally, tests and questionnaires evaluating cognitive and

conative individual differences were completed at the beginning. The participants' in-class attention was measured in every lesson, and their motivation towards the lesson was assessed at the beginning and end of the intervention.

The study aimed to a) compare and evaluate the efficiency of the two teaching methodologies currently used in language classes, b) examine the impact of L2 learners' cognitive and conative individual differences on their language acquisition across the two methodologies, and c) offer pedagogically viable and effective teaching recommendations advised by learners' individual differences. To the best of the author's knowledge, no previous study has compared the effectiveness of TELL and the traditional paper-based approach on linguistic knowledge, attention and motivation of adolescent Greek L2 learners of English in a classroom setting, nor examined whether the teaching methodology modulates the influence of learners' individual differences on language learning. Similar studies on the efficiency of TELL on a combination of factors have been conducted with Spanish primary school students (Alvarez-Marinelli et al., 2016), English adult learners (Adair-Hauck et al., 2010) and Chinese adult learners (Wei, 2023) without investigating the impact of the teaching methodology on the IDs-language relationship. The present study adopted an exploratory approach towards examining this impact.

Linear models – e.g., ANOVA-like and regression linear models with nested groups – were used to address the research questions. The results of the research question 1 indicated that a TELL methodology was more conducive to learners' attention and motivation in class, the acquisition of polysemous vocabulary and speaking improvement than the traditional paper-based one. Both teaching methodologies were found to be equally effective in terms of listening comprehension and acquisition of tenses (i.e., Present Simple vs. Present Continuous) and word order in English.

With regard to the learners' individual differences explored in the research question 2, working memory and personality were found to have no impact on word order and polysemy in either of the teaching methodologies. A negative relationship between attention and word order was observed in the control group but not in the intervention group. This suggests that, in a TELL class, learners acquire word order skills regardless of their attentional capacities. These, however, hinder word order acquisition in traditional paper-based classes. Conversely, a negative relationship between attention and polysemous vocabulary was found in the intervention group but not in the control group. This indicates that when learning polysemous words through TELL, attentional capacities impede the learning process, whereas in traditional paper-based classes, learners acquire polysemous words irrespective of their attentional capacities.

Regarding the research question 3, which explored learners' individual differences in conation, a positive relationship between conscientiousness and in-class attention was reported in both groups. This suggests that conscientiousness contributes to L2 learners' attention during lessons, irrespective of the teaching methodology employed. On the contrary, a positive relationship between in-class attention and academic motivation, as measured via extrinsic motivation – identified, was observed only in the control group. In other words, learners need to be academically motivated – i.e., having extrinsic motives to learn a language – to pay attention to a traditionally taught lesson. In contrast, in a TELL environment, they remain attentive regardless of their academic motivation. Lastly, the study documented a positive relationship between conscientiousness and motivation in the lesson in the control group but not in the intervention group. This suggests that, within a traditional teaching framework, learners need to be conscientious to remain motivated, whereas, in a TELL setting, learners sustain their motivation independently of their conscientiousness.

10.3 Significance of the Study

The findings of this study revealed the recommended teaching methodology that educators can adopt, contingent on specific learning aims (e.g., tenses, word order, polysemous vocabulary, speaking, listening) and L2 learners' individual differences (e.g., attention, personality, academic motivation). Research has extensively studied individual differences and their impact on learning. However, how this impact changes with different teaching methods needs to be adequately examined. This study addressed this research gap and offered practical teaching recommendations for effective learning. The suggested teaching recommendations stemming from the lessons highlighted the research impact of this study. Moreover, most studies investigating language learning methodologies and linguistic knowledge have predominantly focused on adult L2 learners within controlled environments (e.g., laboratory-based teaching, classroom intervention studies targeting one or two language skills or structures, or online learning activities without the teacher's presence). This study is the only one conducted with Greek adolescent learners in an authentic L2 classroom setting, comparing two distinct methodologies and their effect on the relationship between individual differences and L2 learning. The design of the study underscores its authenticity and ensures the application of its findings in language classes.

10.4 Limitations of the Study and Possible Criticisms

Acknowledging the limitations of this study is crucial for drawing accurate conclusions. Despite the careful steps taken to ensure methodological rigour, there is a number of limitations and possible criticisms in relation to the study. The limitations are categorised based on the methodological design, the statistical analysis, and the teaching/learning component.

Regarding methodology, the exclusion criteria of the study and the extreme scores in tests resulted in a decrease in the initial number of participants from 92 to 65. Although this decrease was necessary for a homogeneous sample, no additional classes were available at the

school to have access to a larger sample size. A larger sample size may increase the statistical power and enhance the generalisation of the findings. Additionally, the study exclusively involved Greek monolingual participants, excluding from the analysis any data from bilinguals, and their proficiency level in English ranged from A1-B1. Consequently, the results cannot be generalised to bilingual learners or L2 learners with higher proficiency who are typically present in language classrooms.

Another limitation is participants' access to English outside school settings. Due to private education in Greece and easy access to English resources online, accounting for these factors and their impact on language learning was unattainable and outside the scope of this research. It should also be noted that the participants were learning English as a foreign language. Supposing that the study had involved learners acquiring English as a second language in an English-speaking country, the linguistic outcomes might have differed due to greater exposure and access to English outside the classroom.

Furthermore, the findings related to speaking improvement of the technology-enhanced group should be generalised with caution. Particularly, learners' speaking skills were assessed through free oral production based on prompts using the IELTS oral exam and its equivalent, published criteria of assessment. Assuming that an alternative speaking test or different assessment criteria were employed, the results related to speaking improvement might have varied. Furthermore, one assessor evaluated the participants' speaking skills, and the inclusion of an additional one could contribute to the reported results. These details regarding the study participants and the speaking assessment warrant careful consideration while evaluating the generalisation of the findings.

It is advisable to develop standardised tools for data collection. Particularly, in-class attention is a complex construct that has posed significant challenges for researchers, and there needs to be a universally validated tool for its accurate assessment. The participants of the

present study completed a self-report instrument designed by the author. Given the absence of a previously validated tool, the results related to in-class attention should be acknowledged with caution. Additionally, considering the absence of validated questionnaires in Greek (e.g., academic motivation), their original English versions were translated into Greek to be understood by the participants whose proficiency level in English was not adequate. Similarly, tests assessing different kinds of linguistic knowledge (e.g., word order, tenses) were designed by the author. Thus, standardised data collection instruments are needed for assessing linguistic knowledge, and we need to develop questionnaires dedicated to specific populations when the original English version cannot be employed.

From a statistical perspective, two variables included in the models, i.e., Flanker and visual search, correlated with each other. Thus, when combined to predict word order, there were no statistically significant results. We hence need to develop instruments that do not overlap. Designing instruments that are not correlated was left outside my research. Another limitation to be considered is that the findings related to the positive impact of technology on learners' motivation and the relationship between conscientiousness and motivation in class were based on a marginally statistically significant p-value. Although conscientiousness was found to be imperative for motivation in a traditionally taught class, the results testifying this relationship may not be replicated by future studies. Therefore, further research is necessary to support or refute the relationship between these constructs under distinct teaching methodologies.

From a teaching perspective, the present intervention was conducted in the aftermath of COVID-19. The students received online instruction during the pandemic, and at the time of the intervention, it was their first experience of in-person learning at a secondary school. Upon their return to school, there were classroom management issues that complicated or delayed the learning process, and these had to be addressed before the lesson could proceed.

Another teaching-related limitation is the transformation of the VR and AR activities into traditional paper-based ones. This was challenging to accomplish since printed pictures for listening and speaking practice taken from the apps cannot fully reflect the experience that intervention learners had while engaging with VR and AR. For that reason, classroom games were used in the control group to replicate the entertaining atmosphere of the intervention group. Lastly, one of the possible criticisms of this study is how the lessons were conducted since the lesson plans were designed based on the author's prior teaching experience and previous research insights. A faithful replication of the lesson plans and teaching approaches is difficult to achieve; instead, it should be adapted to the teacher's choices and way of teaching.

By recognising and transparently discussing these limitations, we can understand the context and generalisation of the research results, guide future research, and provide a balanced view of the findings. Conclusively, acknowledging the study limitations aims to foster rigorous research practice and contribute to the body of knowledge in the field of Applied Linguistics.

10.5 Recommendations for Future Studies

This study reported findings on the efficiency of different teaching methodologies and the relationship of IDs with linguistic knowledge and learners' attention and motivation in class. However, these findings can be further explored to contribute to the advancement of scientific knowledge.

Firstly, this intervention compared TELL with the traditional paper-based methodology. The efficiency of different pairs of methodologies – e.g., TELL, Content and Language Integrated Learning (CLIL), blended learning, task-based learning, etc. – can also be compared in future studies. Considering the wide variety of linguistic structures in each language, replicating this study with different linguistic structures and skills taught through distinct teaching methodologies would provide further insights into the efficiency of teaching methodologies. Furthermore, this study focused on English as a foreign language studied by

native speakers of Greek. It would be beneficial for future research to examine a target language other than English or a first language other than Greek, specifically ones not yet investigated. This approach will enable a future meta-analysis on the impact of TELL versus the widespread traditional paper-based approach to language learning by drawing conclusions from different L1s and L2s.

Another suggestion for future studies is related to individual differences and language learning dimensions. Given that learners' individual differences encompass a broad range of constructs (e.g., kinds of intelligence, types of motivation, language aptitude, learning styles, etc.), it would be advantageous to investigate other IDs within the same teaching methodologies or different ones. With regard to language learning dimensions, more kinds of linguistic knowledge or factors that influence language learning (e.g., anxiety) can be examined to explore their relationships with IDs and how the teaching methodology modulates this relationship. Additionally, it would be interesting to examine other tasks or tests that measure IDs to explore whether they reveal a positive, negative, or no relationship with L2 knowledge. By examining other individual differences, teaching methodologies, language learning dimensions, and tests for IDs, future research will contribute to the overall advancement of the knowledge base and enrich our understanding of language acquisition.

Lastly, the present study was conducted within the context of foreign language learning. An intervention study for other school subjects or professional training programs can be conducted. Investigating the impact of different teaching methodologies and individual differences on various school subjects and professional training programs will potentially help identify effective teaching strategies, thereby making learning less challenging for students, teachers, and employees. Additionally, other linguistic subfields, such as pragmatics and semantics, could be explored to determine how teaching methodologies and learners' individual differences influence learners' understanding of these language aspects.

10.6 Final Conclusion

The theoretical contribution of this study to the existing body of research is two-fold. Firstly, the efficiency of TELL vs the traditional paper-based teaching methodology for Greek L2 learners of English at an adolescent age was reported. Secondly, how the impact of individual differences on a) language structures, b) in-class attention and c) motivation in the lesson is modulated by the teaching methodology was explored. Consequently, this study has established a framework for exploring the effects of teaching methodologies on the relationship between individual differences and L2 learning, thereby paving the way for developing more effective pedagogical practices suitable for language classes.

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Appendices and their references to be provided upon request.