

NOVA

IMS

Information
Management
School

MGI

Master's Degree Program in
Information Management

*Effectiveness of Mobile Apps in Language Learning: A Comparative
Study of Duolingo and Traditional Classroom Methods*

Guilherme Oliveira da Direita Calheiros

Master Thesis

presented as partial requirement for obtaining the Master Degree Program in Information Management

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação

Universidade Nova de Lisboa

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação
Universidade Nova de Lisboa

**EFFECTIVENESS OF MOBILE APPS IN LANGUAGE LEARNING: A
COMPARATIVE STUDY OF DUOLINGO AND TRADITIONAL
CLASSROOM METHODS**

By

Guilherme Calheiros

Master Thesis presented as partial requirement for obtaining the master's degree in information management, with a specialization in Information Systems and Technologies Management

Supervised by

Vítor Manuel Pereira Duarte dos Santos, PhD, NOVA Information Management School

July 2024

STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledge the Rules of Conduct and Code of Honor from the NOVA Information Management School.

Lisbon, 15/07/2024

DEDICATION

To my mum, for the relentless support and unwavering belief, where love is a symbol of resistance.

To my dad, for the calm support and quiet confidence, where taunting meets strength.

To my brotHer, for the forever presence and my confidence, where legacy meets heritage.

To my brotheR, for the mental boost and complete understanding, where design meets patience.

To my slster, for the ceaseless companionship and obnoxious trust, where nutrition meets creed.

To my friends, that met me in those late nights, with last-minute information, or worried about how this work was proceeding, thank you, this would not be possible alone.

To those who no longer are with us, for the protection and vigilance, where loneliness was a mirage.

To the playlists, I have created along the way, I will cherish every beat with love.

ACKNOWLEDGEMENTS

I would like to express my gratitude to my advisor Professor Vítor Santos for his dedicated assistance in guiding me throughout the Thesis and the study that I realized to substantiate my thesis.

I would, also, like to thank all the participants that were part of my “Duolingo versus Traditional Chinese classes” study, who have helped me reach the results presented in this thesis and dedicated their time and effort to learning a new and hard language, such as Chinese, aiding me proving the main premise of my thesis and to the teacher as well as to 李 老师. Thank you all.

ABSTRACT

Education is suffering a massive modernisation, and the field of Language Learning is no exception. Traditional methods used to teach a language from scratch are being challenged by contemporary Information Systems, especially by Mobile Language Learning Apps (LLAs). The popularity, convenience and gamified experience of the most popular LLA - Duolingo – has attracted millions of users to learn a language every day. This study develops both approaches and compares them, testing its effectiveness in Language teaching, in a complex Language setting: Chinese Mandarin. Data associated with the performance in language acquisition (LA), was mainly collected twice: before the study, in a Diagnostic test and afterwards, in a Final Exam that comprehended specific topics like Characters recognition, Listening comprehension and Pronunciation. In a study of 31 final participants, Traditional approach students, scored on average, greater than Duolingo students, in every aspect of evaluation, including the Final Score which is divided in a Writing Part and an Oral one. Although, the efficiency of the Duolingo group was proved to be higher, on average, than the ones on Traditional side. Both groups, overall scored poorly in certain areas, such as Character recognition, exposing the complexity of the Chinese Language from scratch, although the difference between both is observable. The lack of dialogue capabilities is also unimpressive from the Duolingo approach, where students are not able to answer a simple question, hindering fluency. Duolingo, as it stands, is not able to fully replace a professor, by not providing optimal results, despite its potential as a complementary tool, due to its constant access ability and for the introduction of new vocabulary.

KEYWORDS

m-Learning; Language Learning App; Duolingo; Chinese Language; Traditional Education; Learning

Sustainable Development Goals (SGD):



INDEX

1. Introduction	1
1.1. Background and problem identification.....	1
1.2. Objectives	2
1.3. Importance and Relevance.....	2
2. Literature Review	4
2.1. Overview of the Language teaching problematic	4
2.1.1. Communication	4
2.1.2. First Language & Second Language Acquisition	4
2.1.3. Motivation	4
2.1.4. Age.....	5
2.2. Pedagogical approaches for Language teaching	6
2.2.1. L2 Strategy.....	6
2.2.2. Self-Regulation	6
2.2.3. Language Learning Theories.....	7
2.3. The role of technology in Language teaching	8
2.3.1. Overview.....	8
2.3.2. Education Roles	8
2.3.3. Technology in Language Learning	8
2.3.4. Distance Learning	9
2.3.5. Types of Technology in FL Learning.....	9
2.3.6. Mobile Learning.....	10
2.3.7. Language Learning Apps (LLAs)	11
2.4. Related Work on the use of LLA for Language teaching	12
3. Methodology.....	14
4. Empirical Study	16
4.1. Experimental Design.....	16
4.1.1. Participants.....	16
4.1.2. Group Assignment	16
4.1.3. Learning Methods	16
4.1.4. Study Duration and Daily Commitment	16
4.1.5. Control and Monitoring.....	16
4.1.6. Relevant Factors Assessment & Interviews	17
4.1.7. Data Collection	17

4.2. Execution	18
4.2.1. Pre study.....	18
4.2.2. Study.....	19
5. Results and discussion	25
5.1. Time Spent Learning.....	25
5.2. Participation	26
5.3. Final Exam Results	26
5.4. Effectiveness.....	27
5.5. Subskills Evaluation	28
5.5.1. Chinese Characters.....	28
5.5.2. Listening.....	29
5.5.3. Pinyin	29
5.5.4. Pronunciation skills.....	30
5.5.5. Dialogue.....	32
5.6. Qualitative analysis.....	32
6. Conclusions and future works	33
6.1. Synthesis of the developed work	33
6.2. Limitations	34
6.2.1. Study.....	34
6.2.2. Material	34
6.2.3. Influences	34
6.3. Future work	34
Bibliographical REFERENCES.....	2
Appendix A. Duolingo Students Screenshots	11
Appendix B. Questions from the Written exam	13
Appendix C. Oral Exam CRITERIA.....	14
Appendix D. Duolingo registration table.....	15
Appendix E. Students general scores	16
Appendix F. comprehensive Oral score.....	17

LIST OF FIGURES

Figure 1 - Example of a Diagnostic Exam's question.....	19
Figure 2 - One of the questions asked when configuring Duolingo's Chinese class.....	20
Figure 3 - Screenshot from Duolingo's exercise of sentence organisation.....	21
Figure 4 - Slideshow presented during a Traditional Approach Class.....	21
Figure 5 - Full Hearts in Duolingo.....	22
Figure 6 - Losing all hearts in the middle of a lesson.....	22
Figure 7 - Example of questions representing sounds.....	23
Figure 8 - Example of questions representing Characters and Meaning.....	23
Figure 9 - Final Grade Average of Students for each Approach, in which green represents Duolingo, and blue represents Traditional Classes. Maximum 29 points. Minimum Positive Line in 14.5.....	27
Figure 10 - Percentage of correct answers, between Duolingo (represented by the green colour) and Traditional Students (represented by the blue colour), by components of the Writing Exam	30
Figure 11 - Box Plot of Pronunciation, Duolingo & Traditional.....	31

LIST OF EQUATIONS

Equation 1 – Effectiveness Formula.....	27
---	----

LIST OF TABLES

Table 1 - Attendance registration for the Traditional Approach students	25
Table 2 - Effectiveness Calculation of each Student, and respective results in Writing and Oral part	28
Table 3 - Pronunciation Results - summarised.....	31

LIST OF ABBREVIATIONS AND ACRONYMS

CALL	Computer Assisted Language Learning
CMC	Computer-Mediated Communication
FL	Foreign Language
L2	Second Language
LL	Language Learning
LLA	Language Learning App
MALL	Mobile-Assisted Language Learning
NBLT	Network Based Language Teaching
NLP	Natural Language Processing
PDA	Personal Digital Assistant
SLA	Second Language Acquisition

1. INTRODUCTION

1.1. BACKGROUND AND PROBLEM IDENTIFICATION

Today's ongoing globalisation fosters international connections between people which presents an imperative necessity to be able to communicate in different languages (Cenoz, 2013; Crystal, 2012). Therefore, a necessity to learn a new language is presented consistent with its worldwide demand, a skill expanding remarkably.

Language Learning (LL) and Language Learning Apps (LLA) have drastically changed the learning scenario, allowing a democratisation and an on-demand access to content and learning access. However, several factors will hinder Second Language Acquisition (SLA), such as the native language (Cheng, 2023), time needed to be proficient (United States Government Accountability Office, 2017), different environments and stimuli (Blake, 2013) and age (Hu, 2016).

This raises questions about whether such apps and technology may fully replace a traditional learning environment, where there is a more learner-centred approach, a constant close evaluation and a progress tracking of the student, whose replication in information systems is complex, especially when the student aims for a non-familiar Language.

The effectiveness of these apps is unclear, namely when they are used outside school context, besides the lack of studies comprising the introduction of a completely new language to learners. This situation led to several Research Questions about the effectiveness of LLA:

- How important is an information system like a mobile app in facilitating the understanding and comprehension of a foreign Language across different Linguistic Components?
- Are difficult and complex Languages learnable exclusively through these platforms, and in what way may replace a teacher associated with a traditional classroom?
- In a complete introduction of a new Language, are Information Systems capable to accurately teach a learner?

Challenges and potential improvements of these apps will be presented in this study.

These interrogations allow to the formulation of a general research question:

Research Question: *What is the real effectiveness of LLAs?*

1.2. OBJECTIVES

The research goal is to conduct a comparative analysis of the effectiveness of different LLAs and traditional language teaching methods to assess the capacity to learn a language from scratch.

To achieve this goal, the following intermediate objectives were defined:

- Framework the language teaching problematic.
- Study current language teaching pedagogical approaches.
- Analyse the existent LLA.
- Build and execute an experience of teaching a completely new language using traditional approaches, LLAs, and a combination of both.
- Analyse the results.

1.3. IMPORTANCE AND RELEVANCE

The achievement of the research goal will help to assess the real effectiveness of the LLAs. The study's results are expected to accept technology as a major asset in the development of students, by increasing practice opportunities (*Blake, 2013*) and exposure to the language and repetition, crucial to a Language Acquisition (*Hummel, 2020*).

Firstly, with the conclusion of the study future learners will be able to understand what distinguishes a professor teaching from a popular app. This will assist in the conclusion process of how to learn a new language, clarifying doubts and help learners select the method that fulfils their personal needs and boost their motivation. Not solely focusing on those who are interested of learning complex languages, but all students that may extrapolate new strategies, by understanding the pros and cons of each approach.

The results will help schools define realistic strategies on the use of LLAs, and learners will be encouraged to apply their recently developed knowledge in real-world situations. This could lead to more comfortable conversations with native speakers. Consequently, teachers would be able to use more pragmatic strategies, increasing student engagement in the language realm and benefit long-term investment in their education towards the learning of a new language.

Learning Foreign Languages (FLs) is highly valued in schools, being established in Portuguese Law, as vehicles of global and multicultural identity (article 4, paragraph 1, al. o) from Decree-law n.º 55/2018) and facilitating access to information and technology and to promote their learning in written, oral and visual (article 19, paragraph 1, al. c) from Decree-law n.º 55/2018), being mandatory for all students as part of compulsory education, in accordance to the Decree-law n.º 55/2018 dated 6th July, where the study may provide insightful information, in a legislative perspective in how the integration of technology in FL education, and the importance of Professors and Technology, allowing a greater access to education from the general public.

Moreover, LLA developers will be able to use the results to upgrade their platforms, with a greater focus on customization or the correction of learners' systematic errors, for example. They could look for cooperation with educational institutions to increase their user rate and enhance teaching methods

by aligning them with teachers and instructors, developing greater pedagogical results as well as enhancing learners' comprehension of the target language.

The community would greatly benefit from the use of correct tools for learning other languages. Learning additional languages could also improve learners' ability to communicate with people from different cultures, thereby unifying societies and even exchanging cultures at a higher rate. By enabling more individuals to acquire important language abilities, this research promotes the development of a more united and economically strong society.

In its whole, the research will become part of pedagogical technology field of research, providing more data and information, permitting the scientific advancement of this area, with a comparison of Traditional teaching methods with modern and ground-breaking technologies.

Learning a Language is a skill that allows people to search for better conditions. This study promotes innovation, analysing if and how people could learn a language proficiently if they only have access to a free app, internationally available, addressing the global demands of what to expect on the effectiveness of different language education methodologies.

2. LITERATURE REVIEW

The literature review of this study serves to exhibit deeper insights about the topic of Language Learning and associated mobile apps, Second Language Teaching, its theories, and problematics and to achieve a greater understanding of the overall context, as well as, of the research gap of this project.

The present chapter has been divided into 3 parts, where there is a background of the Language teaching problematic, the approaches to teach Second Languages, and what is the role of technology in this sense and a systemic Literature Review of these topics.

2.1. OVERVIEW OF THE LANGUAGE TEACHING PROBLEMATIC

The purpose of achieving a clear comprehension of the problems associated with the process of learning and, therefore, teaching of a Language, will relate to understand the concept of Language, its evolution, and its deep relation with the human nature.

2.1.1. Communication

Communication is a trait present in all animals, which is motivated to enhance trust and cooperation or to interpret whether a threat is faced, although humans have become proficient in the speaking process, by evolving substantially the vocal tract anatomy comparatively with current apes and the last common ancestor (Hurford, 2014).

This evolution permitted the adoption of a system called Language, which was defined as a system of “spoken, manual (signed), or written symbols” from where the human species express themselves, with an ability to communicate and to express their own identity (Robins & Crystal, 2024).

2.1.2. First Language & Second Language Acquisition

So, the first language acquisition in children is an impressive intellectual feat, due to the fact that it is not taught, through a direct teaching, because they cannot comprehend a language in the first place, whose success depends on allying the control of specific muscles, with the knowledge of a comprehensive vocabulary and the inference of structural rules, allowing the “construction of meaningful sentences”, executed with almost no intentional effort (Fisher, 2005; Miller & Gildea, 1987).

The existence of a critical period, indispensable to learn a first Language, occurs from the first years of age until puberty, which corresponds to the period of major transformations on the brain, where it reaches a specific brain’s maturation but ends on the loss of some cerebral plasticity loss, which may correlate with a critical period for Second Language Acquisition (Friedmann & Rusou, 2015; Lenneberg, 1967). Theoretically, the latter period will be significantly different because of the “prepared mind, and sufficient language input” acquired on the first language.

2.1.3. Motivation

Furthermore, the explicit desire to acquire a second language is crucial once motivation plays the most significant role in the language learning process (Jodai et al., 2013), considered a predictor of language acquisition success, although research on its processes may become difficult, due to language learner’s “attitudes and motivations” instability over the learning process (Mihaljevic Djigunovic, 2012).

The renowned Linguist Researcher Zoltán Dörnyei (2009) expresses that even a learner which has excellent instruction and curricula, with an outstanding capacity will not have a guaranteed success in its long-term objectives without motivation and that, conversely, a strong drive and ambition can easily compensate for the “deficiencies both in one’s language aptitude and learning conditions.” (Dörnyei, 1998).

The creation of frameworks that have been accounting motivation to a more successful Second Language Learning have been around for several decades, being the most preeminent works “Gardner’s (1985) original socio-educational model” (Anczewski, 1987) , “Deci and Ryan’s (1985) self-determination theory (SDT)” (Deci & Ryan, 1985) and “Dörnyei’s L2 Motivational Self System”, the latter became fully constructed in 2009, contributing to the creation and development of more empirical researches in order to analyse its use in practical and real environments (Dörnyei, 2009). From here, Teachers may be familiar with these frameworks and theories, although the utilisation of these “theoretical principles” into the learner environment is not direct and simple (Ushioda, 2020).

2.1.4. Age

Another determinant factor that may affect the ability to learn second Language is Age (Hu, 2016). Researchers have studied the younger age learner’s ability to be more proficient, in terms of acquiring a second language (Lenneberg, 1967), as it started to develop as a common believe, that in adulthood a person can no longer develop total proficiency in L2, whereas before it, a young learner can completely evolve into a nativelike L2 speaker due to the occurrence of a developmental period (Birdsong, 2005). Supporting Lenneberg, Children’s brains have a strong plasticity which would allow a grater second Language acquisition, in a more natural and effortless way, believing in an optimal age to learn a L2 (Xu, 2023). However, a myriad of studies were analysed, which regarded the age of learners and the duration of the foreign language learning, did not concluded a clear and explicit advantage for younger learners (Huang, 2016). Moreover, researchers have concluded in empirical studies that older learners are more likely to obtain greater ability in short-term analysis (Huang, 2016; Krashen et al., 1979). And if we extend this period, to a long-term analysis we may observe a catch-up from the younger learners, as we can observe in a larger-scale experiments, such as in the Barcelona Age Factor, despite the overall proficiency did not surpass its peers (Muñoz, 2006).

2.2. PEDAGOGICAL APPROACHES FOR LANGUAGE TEACHING

Throughout the XX century, concerns arose regarding the effectiveness of certain learners in acquiring a second language, prompting studies to evaluate various learning strategies, especially the ones successful at it. Several studies were initially undertaken to understand the difference between learners to develop a second language proficiency, which pointed 3 inherent strategies as the ones used by successful second language learners: active guesser, meaning an effective storage of information, which can be retrieved effortlessly, fearless regarding his appearance to train its communication and new-sentence-maker, by mixing acquired content (*Rubin, 1975*).

2.2.1. L2 Strategy

Since then, pedagogical strategies have evolved as well as its definition, so to distinguish between “*theory and principles and a set of derived procedures*” in the Language Teaching area, it was developed a definition for each concept (*Richards & Rodgers, 2014*), separated by a hierarchy, initiating in the *approach* - “*axiomatic*” - described as a collection of presumptions and beliefs regarding both language teaching and learning, explaining the essence of what is going to be taught, whereas the *method* – “*procedural*” – is connected to the structured generalized strategy employed including the skills used, the provided content and its presentation order for Language Learning, always regarding its previous selected approach, finishing in the fundamental layer where we find the *technique* – “*implementational*” - rooted to its practice in a classroom, using a specific “*trick, stratagem or contrivance*” applied to achieve a compelling goal (*Anthony, 1963*).

Moreover, the effort to execute a taxonomy dividing all existent strategies that existed at a time was into *metacognitive* (focusing on the learning process by paying attention, mental links, creating goals, plans and opportunities, and self-evaluation of the process), *affective* (by controlling the anxiety, by relaxation techniques and laughter, positive reinforcement, and listening to the own body, routinely), *social* (by bonding with multi-cultural comprehension and awareness of others feelings, asking questions and through colleagues cooperation) comprised the indirect methods group, opposite to the direct strategies group which include *memory* ones (using associations, contextualization of new words, imagery, key words and sounds use, organized review and physical action employment), general *cognitive* (by practicing a language, with aid of repetition, also messaging, deeply mind reasoning, and summarizing and note writing) and *compensation* used to overcome restraints (using guessing, and the resource of help by getting it or using mother tongue and miming) (*Oxford, 1990, 2002*); which is related to the taxonomy accomplished by *O'Malley and Chamot (1990)* that divides the strategy into 3 different types: cognitive, metacognitive and social/affective strategies whose authors recognized the latter as a generalized concept, to include all the other strategies that would not fit into the first two categories (*O'Malley & Chamot, 1990*).

2.2.2. Self-Regulation

However, scepticism around the term *strategy* started to grow, when *Dörnyei (2005)* exposed the replacement made by the scientific community into a more flexible domination of self-regulation, due to the change in the second Language acquisition area of study into a “more applied realm of language teaching methodology” from a broader and more simple research subject (*Dörnyei, 2005*). This shift occurred because it was understood that learning strategies were demonstrated as a far more complex topic than previously described, with an ambiguous definition, concentrating solely on its “surface

manifestations” - which is the tactics, techniques and strategies used by learners - will not properly address the field, so the introduction of the term *self-regulation*, or even “*self-regulated Learning*” was fundamental to switch the research focus to the examination of more dynamic and process-oriented variables from the previous learning/ cognitive techniques, as well as, the extension to other academic fields of psychological and cognitive sciences as a major topic.

2.2.3. Language Learning Theories

The development of Language Learning theories have permitted an advancement on the study of the language acquisition area, which in its core must be able to consider the quantity of elements inherent and the number of situations and contexts of the learner’s language acquisition (*Lightbown & Spada, 2021*), as well as the “cognitive, personal, interpersonal, and social” characteristics of the learner when learning a second language (*Richards & Rodgers, 2014*).

Behaviourism has emerged, through a series of experiments, that essentially a person may learn through the response of its environment to their actions, in which through “operant conditioning” is reported that a positive or rewarding to a certain behaviour, it “increases the probability of further responding” (*SKINNER, 1957*). However, humans are capable of “rational thought”, with an inherent capacity for problem-solving, interpreting, memorising, and thinking, and are not only a result of the exterior, which is described by the Learning Theory *Cognitivism* (*Clark, 2018*). *Constructivism* is a theory, gaining popularity among learning literature despite its difficulty to be defined (*Null, 2004*), based on the nature of knowledge, individuals develop their knowledge from their own experiences, although it may not be always indicative of “the real world” and its inherent experiences (*Kretchmar, 2021*).

In order to be a proficient learner, one must respect three fundamental principles: activity through action, concept to be learned, and the context of the learning process, that must be evolved and used to result in knowledge (*Brown et al., 1989*), where both the learner and its environment are “critical to the constructivist”: Knowledge is created by the interaction of both factors (*Ertmer & Newby, 2013*).

2.3. THE ROLE OF TECHNOLOGY IN LANGUAGE TEACHING

2.3.1. Overview

The integration of communication and information technology into Language education has boosted the interest and scrutiny among researchers and specialists, initially in classrooms environments, due to its capacity to provide “learning materials and inputs” to students, which may be produced directly to language learners (*Skehan, 2003*), performance enhancement of students in the major categories of a L2 and development of interest and excitement (*Frigaard, 2002*) and a visible fluidity, where it was recognized by FL learners the greater independence given, where it was possible to control their own learning process (*Lam & Lawrence, 2002*). The educators, on the other hand, have a crucial role on the implementation of technologies, which it can be a new source of ideas and advancements in language teaching (*Timucin, 2006*) and understand how fundamental was “individualizing his teaching practice” (*Lam & Lawrence, 2002*).

2.3.2. Education Roles

The implementation of technology has marked a turn on the relationship’s dynamic, turning the Language Learning classroom into a more “learner-centred” one, where the teacher plays a role of the class direct assistant or the students’ guide that is readily available to the student and its learning process (*Lam & Lawrence, 2002; Lee & VanPatten, 2003*), instead of only grading a written paper and make students complete “unmanageable revision tasks”, the teacher will be focusing on group projects and their progress report, changing its role to a supporter and not only adviser but guider as mentioned before. Hence, the classroom will replace the use of a more formal “transmission of information”, process also known as *Atlas Complex*, a term that describes the total responsibility and authority of the teacher on the learning process, where students contribute nothing to the class, being mere receivers of information, resulting on the lack of power “to make things happen to their students” into a “learning activity” process that turns students into their own learning managers, by the teacher being capable to monitor each student individually (*Best, 1997; Finkel & Monk, 1983; Lee & VanPatten, 2003*).

It is also important to note the importance of professors for the success of Language Learning Technologies, as Timuçin (2006) describes the implementation of technologies in any teaching or learning environment is deeply dependent on how engaged and committed the related parties are, where reports show how teachers are no longer “the physical or intellectual front of the class” due to the decentralization produced by computer technology (*Civello, 1999; Timucin, 2006*). Notwithstanding, teachers may fear the “loss of control” in the classroom, due to the broad use of computers, which may result in teaching stricter linguistic rules and definitions due to the lack of knowledge on how they function, directly hit by a negative view of new technologies (*Pickard, 1994*) or, it may be perceived in a beneficial way, as students will assist the professor in any troubles that may arise in the use of technologies, allowing the latter to focus on its pedagogic functions, contributing to a healthy implementation of technology in the pedagogical curriculum (*Nellen, 1999*).

2.3.3. Technology in Language Learning

The use of technology, and its subsequent development in the practice of Language teaching and Learning, may be coined as CALL (*Computer Assisted Language Learning*), although the definition and

meaning of this umbrella term is highly debatable (Levy & Hubbard, 2005). The *Longman Dictionary of Language Teaching and Applied Linguistics*, describes CALL as not only “the use of a computer in the teaching and learning of a second or foreign language” but also the learning through activities that includes the use of other types of media (although a computer is needed for other uses), classroom activities that uses computer programs that helps students in different categories, such as writing by helping students choosing a theme and “by checking a composition for vocabulary, grammar and topic development” and also, CALL exclusive activities (Richards & Schmidt, 2013).

Essentially, the main themes that have emerged from CALL study and practice revolve around the educational opportunities that come with using technology (Chapelle, 2005).

2.3.4. Distance Learning

The expansion of Internet use, the notable growth of use in social computing, the continuous research of CALL, and the inherent interest in teaching languages, allowed the creation of another term that is substantially important in these “new learning environments”: Distance Learning (DL) (Blake, 2009). Research involving this topic describes DL as a learning type that occurs anytime there is a temporal or spatial separation between the learner and its teacher, that may be subdivided into different genres, such as “online learning, e-learning, open learning, distributed learning, teleconference or video-conference learning, blended or hybrid learning, life-long learning, or independent study” (Olson, 2015) although it may be also differentiated by the use of their own media (*i.e.* print, audio, computer-based, Internet-media source) as well as, the existence of reported differences in whether the class has literal technological improved media or if it is just a mixture between scheduled presential classes in the classroom and online lessons (this may be used as synonym, by some researchers) (Blake, 2009).

2.3.5. Types of Technology in FL Learning

Researchers have been measuring the relative impact and effectiveness of different natures of technology in L2, whether they are practically established in our society like PC and smartphones, or are still in its maturing phase, such as natural language processing (NLP) (Golonka *et al.*, 2014).

Technology’s progression has naturally influenced the Language Teaching field by its different types, shown by several studies, where the most prominent and modern are included in different categories, arising Network-Based Language Teaching (NBLT), which is the process of teaching a language that uses “local or global networks”, via computers connected to themselves opening the access of learning to the world, with a multitude of language learning tools (Kern & Warschauer, 2000). The studies associated with NBLT involve the understanding of learners and their relationship with speakers of the language and media, through “computer-mediated contexts of interaction” (Kern *et al.*, 2017) .

This term may be divided into synchronous computer-mediated communication (CMC), where there is interaction with another person in real time (Blake, 2009) that includes online chats – beneficial as it was observed that learners would be more eager to correct themselves when producing a message than in face-to-face dialogues, as an example (Lai & Zhao, 2006; Yamada, 2009) and video conferencing, considered the most widespread known type for distance learning is the connection between computers, requiring a screen, a camara and loud speakers, with some types attached: Desktop videoconferencing, where the communication is one-to-one, although it also contains an interaction “Teacher-to-Class”, with a personal computer connected (O’Dowd, 2006). Synchronous CMC will

enhance collaborative learning environments - teaching techniques that encourage group collaboration among students to produce the best possible learning result (*Sun & Yuan, 2018*) – and forced students to communicate to their peers (with different native languages), in the research developed with children of different countries where English was a L2, learners would introduce themselves in English or would participate in a cooperative way for a common objective, in order to ensure “real purpose for the students to use the target language (communicating real ideas)” (*Dooly & Sadler, 2016*); and into asynchronous CMC, with a long research with its involvement in DL, freeing everyone involved from space/ time constraints (*Allen & Seaman, 2006; Blake, 2009*), as the most prominent current tool is social media: Instant messaging application studies, such as *WhatsApp* which proved this method efficacy in time saving among students as well as permitting both asynchronous and synchronous communication and ease to process and deliver information, in a study of group magazine co-creation (*Avci & Adiguzel, 2017*), personal *Blogs* where students were engaged to “build on their writing skills” as observed in a study in Spain, conducted by Ruby Vurdien where they have developed awareness and precaution in task planning and in error correction (*Vurdien, 2013*) , and *Facebook* as it is capable of interaction with users from others countries and fund their interest in the language formulation (*Lantz-Andersson et al., 2013*) although long time use was to reported to affect students positive perception on “ease of access” and the search of “school-related information” (*Gamble & Wilkins, 2014*).

2.3.6. Mobile Learning

Additionally, the significant growth of “portable and wireless devices and technologies” (examples are mobile phones, laptops, Wi-Fi, Bluetooth, 3G to 5G) over the years have permitted individuals to access pedagogical content for “anytime, anywhere learning” (*Arvanitis & Krystalli, 2021; Golonka et al., 2014*). Although Mobile Learning (*m-Learning*) is rather difficult to describe due to its evolution over time, which leads to the upper-mentioned *Longman Dictionary of Language Teaching and Applied Linguistics* pointing it as the learning that takes advantage of portable technologies, that may occur across locations, whether with the use of portable devices for Language Learning or group participation in the classroom through mobile devices (*Richards & Schmidt, 2013*), although 5 characteristics were compressed and presented in the early years of Mobile Learning Research: Permanency, Accessibility, Immediacy, Interactivity and Situating of Instructional activities (*Ogata & Yano, 2004*). Permanency relates to the learners’ perpetual work record, if there is no purposeful deletion of the content; access to their education is provided with their request; with access to their education anywhere means the Accessibility, whereas getting information anytime it is requested, is in the Immediacy domain, Interactivity describes the capacity to interact with peers or teachers, whether in a synchronous or asynchronous form, and the Situating of instructional activities translates in the immersion of the learning process in the daily life, in an authentic form (*Chen et al., 2002; Ogata & Yano, 2004*).

Over the years, mobile technology research has been gaining relevance, standing as the “the most frequently investigated”, due to the advantages that are associated to it, including the remarkable accessibility, the flexibility in learning style and the extra content with advantageous characteristics (*Zhang & Zou, 2022*).

The evolution of mobile devices is reflected on the studies proceeded on Mobile Learning, where *Chinnery (2006)* introduced the expression MALL (*Mobile-Assisted Language Learning*), first dominated by the Personal Digital Assistants (PDAs) which were primarily used as a translator, but also due to

access to Internet, sharing documents between the students/ learner environment was available (Chinnery, 2006). A review of several studies in mobile learning segment, reported that this tool was only useful in “reading and writing activities” (Golonka et al., 2014)

Portable media players, such as iPods, could transmit high-quality sound, highly rated by students and “downloadable software” including Language Learning ones, where its use was documented in class and university environments, but with no “empirical evidence” of the effectiveness of this system (Chinnery, 2006; Golonka et al., 2014). However, iPod popularized Podcasts, where students feel prone to use this type of media as a pedagogical tool and, consequently they assess this use as a benefit, when faced by it, for a myriad of reasons ordered by the professor (Abdous et al., 2009).

2.3.7. Language Learning Apps (LLAs)

The state-of-the-art, on the mobile learning environment, begins with the principal approach of mobile applications of Language Learning, which is ranked as the most studied type of technology for Language Learning, throughout recent years, whose major purposes of the research are, in a descending order: Promoting Practises, Delivering Instructional Content, Facilitating Interactions and Restructuring Teaching Approaches (Zhang & Zou, 2022).

Mobile Assisted Language Learning (MALL) benefits students by enabling learning anywhere and anytime with their mobile devices. In addition, it is possible to, from previous research, extrapolate advantages in mobile technology applied to Learning: adaptability, consistency, immediate feedback, socialisation, personalisation, active engagement, peer coaching, self-evaluation, outdoors inspiration sources, and cultural authenticity (Kukulska-Hulme & Viberg, 2018). Previous researches have been focusing primarily on the English Language as a L2, and in the acquisition of vocabulary (Hwang & Fu, 2019), showing that “62.8% of the measurements showed positive results”, on mobile language learning.

Furthermore, Research questions found emphasises in which type of games existed, which mobile devices do people use and the use of research of methodologies and what were the employed learning strategies (Cheng, 2023).

It was also possible to observe that individualized feedback on performance is something many learners rarely get outside formal tuition, getting answers correct in quizzes, or using apps to memorize verb forms and vocabulary, are rewarding activities, and users are satisfied of knowing they got something right. While some apps continue to offer drilling with little teaching and lack of meaningful feedback or support, some examples of good practice are now available, particularly among apps that offer a full language-learning experience (e.g. Duolingo, Busuu) (Rosell-Aguilar, 2017).

Applications may also be used for online dictionaries that allow learners to improve their pronunciation and expand their vocabulary (Nariyati et al., 2020). It is usual for apps to combine both functions, as translators and dictionaries including *Google Translate*, *DeepL*, *WordReference*, the *Cambridge*, *Oxford* and *Collins* dictionaries, and applications like *Forvo*, which acts as repository of various pronunciations, including varieties and dialects.

The utility of LLA also include the motivation for learning using technology familiar to students such as smartphones and tablets, giving the opportunity for them to develop all six communication skills: “comprehension and production of written speech, comprehension and production of spoken

language, aural interaction and aural and written mediation” and the encouragement and support to use the target language as the unique mean of communication (*Arvanitis & Krystalli, 2021*), although a learning programme exclusively smartphone oriented as it may exclude many learners (*Godwin-Jones, 2011*).

It was found that LLAs teach vocabulary in rather “isolated units” than in normal contexts, are unadaptable to individual needs and interests, and seldom exhibit explanatory corrective feedback to learners (*Heil et al., 2016*), which may be disastrous since learning “becomes more real” if there are references to the learner itself, where mobile phone performs a crucial role, due to its ability of going beyond the academic environment (*Godwin-Jones, 2011*)

2.4. RELATED WORK ON THE USE OF LLA FOR LANGUAGE TEACHING

Research on the effectiveness of MALL in SLA is “limited”, existing only a few works studying it through “quantitative data ” or “experimental design”, but when it is possible to measure it, MALL reveals “learning advantages” for a myriad of areas like reading and listening (*Loewen et al., 2019; Shadiev et al., 2017*).

However, the effectiveness of commercial programs for online language learning is uncertain due to the existence of studies testing several technologies including Duolingo whose “improvement was statistically significant” (*Vesselinov & Grego, 2012*), although some reservations are made regarding these results, and the absence of data available , “for commercial products”, which turn the results dubious (*Loewen et al., 2019; Van Deusen-Scholl, 2015*).

Loewen et al. (2019) developed a similar study, with 12 students on the effectiveness of Duolingo, but to study Turkish which results have come “somewhat mixed”, where students knew Turkish on the end of the course but not enough to pass the test presented (*Loewen et al., 2019*).

In a qualitative analysis on the effectiveness of Duolingo, it was claimed that DL is an “easy, free and practical learning process” where the results confidence was high, although it was reported that despite some students liked learning vocabulary and pronunciation, others complain about the Grammar and how needs improvement (*Psychogyiou & Karasimos, 2019*)

The comparison between Asynchronous CMC and Synchronous CMC with traditional curriculum (control group) was researched by *Abrams* (2003) who examined and tried to confirm the effectiveness of CMC in “face-to-face interactions” and the differences between both CMC in oral production. The researcher found that the group involving Synchronous CMC produced better than the other two groups, and that surprisingly the control group went better than the asynchronous CMC (*Abrams, 2003*).

It was found in a survey, that although most students enjoyed using a LLA (in this case *Busuu*), 64% revealed that acquiring a foreign language only by LLA is impossible, recognizing it as more of a “helpful tool” (*Kétyi, 2013*). In terms of motivation, a researcher found there was an intrinsic motivation with the students involved, when using a specific LLA (*Gamlo, 2019*).

When testing the appreciation, Researchers found LLA to have a crucial factor: its “ubiquity”, so students will have a more permanent contact with the language, due to the mobility of a smartphone, which have also proved the stimulation due to “self-learning” and “gaming aspects” characteristics (Gafni et al., 2017). Although, in the same study, Internet dependence was also stated as a disadvantage.

3. METHODOLOGY

To achieve the proposed research objectives, as shown in Table 1, the Study will be composed of three major phases: exploration, analytical, conclusive. These phases are essential to an overarching development on the research focused on the Duolingo effectiveness, on students learning a language from the absolute beginning, assisting the process of decision-making in the conclusion of the thesis.

Exploration Phase	Step 1 - Literature review
	Step 2 - Methodology review and improvement
Analytical Phase	Step 3 - Build a experimental framework
	Step 4 - Execute the experience
	Step 5 - Retrieve experimental results
Conclusive Phase	Step 6 - Results evaluation and discussion
	Step 7 - Conclusions and results apresentation
	Step 8 - Final revisions

Table 1 - Three-Step Methodology

In the first phase, the theme will be explored by reviewing existent papers, on LL methodologies, overviewing the theories around the processes of teaching a new language and how technology is influencing SLA. How learning can be affected and what influences its success will be researched, by comparing early studies to understand the characteristics of each approach and their interaction.

The literature review will influence how the methodology will occur, by assessing the experimental framework used in analogous studies, therefore implementing more appropriate processes, measures and procedures on the present study.

The analytical phase constitutes the construction of the Experimental Framework which englobes the Pre-Study Phase where there is Selection of the material that will be aim of study and the Participant's Recruitment. During this phase, the prior knowledge of the students will be assessed and consequently assigned into the study in a random approach.

The research execution, step 4 in the Analytical phase, will contain the pedagogical period, where the students will learn a language uniquely by one of the approaches. Lastly, the students will complete the course throughout a month, which is the time spent on the learning endeavour that will be monitored and controlled. On the LLAs, compliance will be followed by the opening and closure of the app, while on the classroom the presence will be recorded.

The experience outcome data will be mainly collected by the administration of a complete and broad final test, testing several components, important to understand how the evolution on language learning proceeded and to test differences in various aspects of the language chosen. A brief interview will be proposed to some students, to understand how motivation have changed and the feedback on the approach chosen.

Finally, the conclusive phase is composed by the crucial step of results evaluation and discussion, where the data collected is analysed, comparing both approaches on their final grades and within different questions, as well as the calculation of the efficacy. It is also in this part that it is disclosed students' feedback. The conclusions and results presentation step are then supported to summarise relevant scores and consequent findings, specifying what learners may expect when learning with each approach, as well as addressing the limitations and constraints existent on the study and how further study may build on this study.

The last step present in the study is final revisions, consisting of the preparation of the report and reviewing the coherence on the research discoveries, exhibition material to educators and to learners.

4. EMPIRICAL STUDY

The present Chapter is dedicated to the planning, building and execution of the study that will be undertaken to assess the effectiveness of teaching a completely new language, to students, through the most downloaded language learning app, Duolingo and compare its results with a traditional approach in teaching a language through a virtual classroom, in both writing and oral domains.

4.1. EXPERIMENTAL DESIGN

4.1.1. Participants

The study involved 30 participants, all above the age of 18. Participants were recruited through online invitations and direct contacts to establish randomness and variety in the demographics. To ensure that the participants have no prior knowledge of the Chinese Mandarin language, a preliminary questionnaire will be administered. Only those who indicate they have no prior knowledge of Chinese Mandarin will be accepted into the study.

4.1.2. Group Assignment

Participants will be randomly assigned to one of two groups, with each group consisting of, approximately, 15 individuals. The random assignment will be conducted to ensure that any differences observed between the groups can be attributed to the learning methods rather than other factors.

4.1.3. Learning Methods

In the Traditional Approach Group participants will learn Chinese Mandarin through traditional instruction, virtually with a teacher. The teaching will follow a structured curriculum designed by a qualified language instructor, incorporating lessons on speaking, listening, reading, and writing in Chinese Mandarin.

Whereas, in the Duolingo Approach Group participants will learn Chinese Mandarin exclusively using the Duolingo app. The app will be used to practice daily, with the learning progress monitored through Duolingo's streak function to ensure consistent usage.

4.1.4. Study Duration and Daily Commitment

The duration of the study will be *3 to 4 weeks*, where participants will be asked to dedicate a specified amount of time each day to their learning activities, ensuring consistency across both groups. The exact daily time commitment will be determined prior to the start of the study.

4.1.5. Control and Monitoring

For the Traditional group, attendance and participation in the classroom or virtual sessions will be recorded, as in the Duolingo App Group, students will send screenshots of the classes done and the main page to monitor daily engagement and progress.

4.1.6. Relevant Factors Assessment & Interviews

Motivation aspects will be evaluated through a questionnaire randomly administered in the end of the study to assess participants' motivation in the learning process, to calculate expectations and deliver feedback.

4.1.7. Data Collection

There will be gathering of information in 3 parts of the study. Firstly, pre-study assessments will be administered to establish a baseline for each participant's knowledge of Chinese Mandarin, then feedback questions will be conducted throughout the study to measure progress and motivation levels to understand significant differences between both approaches.

A final exam at the end of the study will assess the overall language proficiency gained by the participants in each group, divided in three sections with the reading and writing part, with open cloze exercises fill in the blank ones and multiple choices, a listening part with pre-recorded audio and live questions and a speaking part where will be evaluated the pronunciation and dialogue capabilities, with a Chinese native speaking person. Both, Listening and Speaking were comprised in the Oral Part.

4.2. EXECUTION

To evaluate a successful Learning of Chinese Language, it is necessary to undertake a correct evaluation and subsequent comparison of the aimed approaches, which involves the construction of material sectioned into: Choice of Language and App, tests and survey's administration and the content.

4.2.1. Pre study

4.2.1.1. Research Sample

Language learning is a topic that may be available to everyone, and people with different demographics and backgrounds can start learning a new language from scratch, greatly assisted by Duolingo free-to-use version but it is also inserted in the Portuguese school curriculum, so the diagnostic test was accessible to everyone, although only individuals with the age of 18 or above, were selected to participate in the diagnostic test, mainly, to maintain a better comparative model, by accepting adults which already have a solid and mature cognitive development, contrary to underage students where brain development is undergoing a critical period (Silveri, 2012).

4.2.1.2. Choice of Language

The target language of the study had to follow important criteria:

- (1) *International recognition*: Relevance whether in business or cultural areas, turning it a useful skill to master, fuelling motivation.
- (2) *Lack of Presence*: Most of the population in Portugal would have little to no contact with, so both the introduction to the language could be legitimately studied and the prior knowledge of the language would be standard, starting the study from the same point, allowing a more controlled environment on the research.
- (3) *Complexity*: In a Language, challenging elements whether in the writing or in the pronunciation, may help evaluating the language learning methodologies and approaches.
- (4) *Availability of the Language*: Duolingo app has the Chinese language available, for English speakers and there is the availability of a Mandarin Chinese professor from Confucius Institute of University of Lisbon.

4.2.1.3. Choice of App

Following its worldwide popularity, Portugal has followed the trend of having Duolingo as the most popular Educational App in both Google Play Store and Apple App Store, settling as the only education category app ranking in the top 50, in both Portugal and United States, with over 500M downloads, and a course portfolio of 40 languages (Belevan & Dalsime, 2022). So, to recreate a natural real-life environment we opted to use the app that is widely known and put it to the test.

4.2.1.4. Diagnostic Test

Before the study development, it was necessary to select people who were interested in taking classes of Chinese Mandarin Language, but with no experience of the language, which could be proved through a Beginner Level Diagnostic Exam that was developed, consisting of 10 questions divided in 3 parts, essential to the learning success of Mandarin: *Pinyin, Tones and Pronunciation; Vocabulary* and; *Syntax*, through multiple choice answers, each question valuing 1 point, in a grade scale of 0 to 10.

The option “*I don’t know*” was available in all questions, to ensure veracity in the results of the potential participants. If the participants scored 4 or more in the test, they were excluded from the study, exhibiting a minimal knowledge of Chinese Mandarin, whereas everyone who had a grade of 0 to 3, was contacted to be a participant of the study, due to its absolute lack of knowledge, but also it was given a margin for those who tried to complete the exam at random.

*What is the correct pinyin for the Chinese Character: 水 ?

- huǒ
- shuǐ
- shì
- I don't know

Figure 1 - Example of a Diagnostic Exam’s question

The exam was created in both Portuguese and English Language, through the Qualtrics platform, electronically distributed, through social networks, open for a space of *13 days*, resulting in *60 responses* of participants whose age is 18 or above, where it was also asked the name initially, so the contact could be made so the participation in the study could be possible. To answer the survey, participants had to agree with the Declaration of Consent stating that they are 18 years or older, that understands the goal of the research, and that the participation is voluntary and that may stop its completion at any time, where the answers are solely for academic purposes.

4.2.2. Study

After the acceptance into the research, people were contacted to confirm their interest in taking part of the experience, randomly selected into each approach. So, the number have dropped into 44 future learners which were divided into two groups: Duolingo approach ($n=23$) or Classes Approach ($n=21$).

4.2.2.1. Duolingo Group

Participants assigned into the Duolingo Approach, received a message with instructions to download the app Duolingo, available in the English Language, with guidelines to set-up the account to uniformise the starting point: Select the “*Other Option*” when asked the reason why they have chosen the language and select the “*I’m new to Chinese*” button, when asked “How much Chinese do you know?” and to *Start from scratch*, when deciding where to start with the classes.

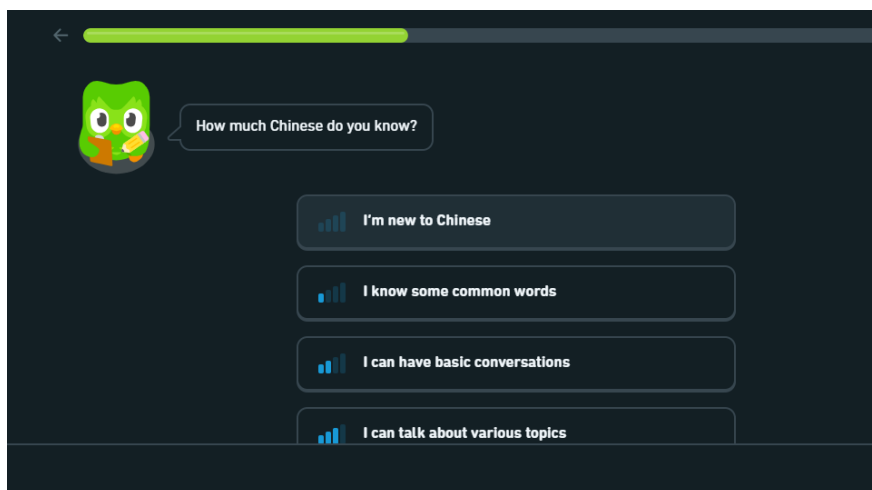


Figure 2 - One of the questions asked when configuring Duolingo's Chinese class

Students were asked to practice *10 to 15 minutes*, daily, throughout *28 days*, in order to match the entire duration of classes with the intention of testing the evolution of time spent on the app, where they may develop an increase of interest throughout the experiment, stretching the duration within the app, to longer minutes. Sessions' duration was monitored with screenshots taken by students, in the moment of opening and exiting of the app, following the hours whether on the screen or registered by themselves (See Appendix A for examples of these screenshots received, anonymised, and the Duolingo's Home page). Everyday all students received a message to encourage the daily practice. All hours were manually registered by the researcher in a spreadsheet, associating a name with a date, completing the starting time, the final one and the consequent duration of it.

4.2.2.2. Traditional Approach

The students that were accepted to be part of a Chinese Language Virtual Classroom, were sent an informative message to indicate the schedule with dates and hours of the classes, previously agreed with the Professor, and were asked to take notes and to participate whenever teacher asked to. The classes comprehended a total of *6 hours* divided in *4 weeks*, given in English, in classes of *1h or 1h30m*, where complete autonomy and freedom was given to the professor, to simulate a real-life teaching environment, in terms of content and way of teaching, whose participation, interaction and dialogue were highly incentivised and used throughout the experiment by the Professor.

Professor used her own slideshow to present and assist her teaching. A quick notebook with the content of the class was provided in the end of each class, to allow students to review and suppress the distance between some classes and to assist students that have failed a lesson.

The presence in the class was registered, through the list of participants in the Zoom Session.

4.2.2.3. Content & Methodology

The material taught in both domains is significantly different, due to different objectives in the teaching method which resulted in a major update in the Duolingo's Chinese Course in 2024, turning its teaching method into a more direct sentence-oriented teaching vocabulary from the start (i.e. first lesson teaches "*water and coffee*"). On the other hand, Traditional approach first focused, on the pronunciation aspect and the introduction of pinyin.

Throughout the course, Duolingo units are divided into: Basic Food and Drinks, Nationalities, Professions, Preferences, Family, and adverbs of frequency delivering its content by repeating a myriad of exercises, from matching pairs (Characters & *Pinyin* to its translation), multiple choice questions, and writing the sentence listened to the most frequent type of question which is organising the translation of a sentence either to Chinese or to English, in small lesson.

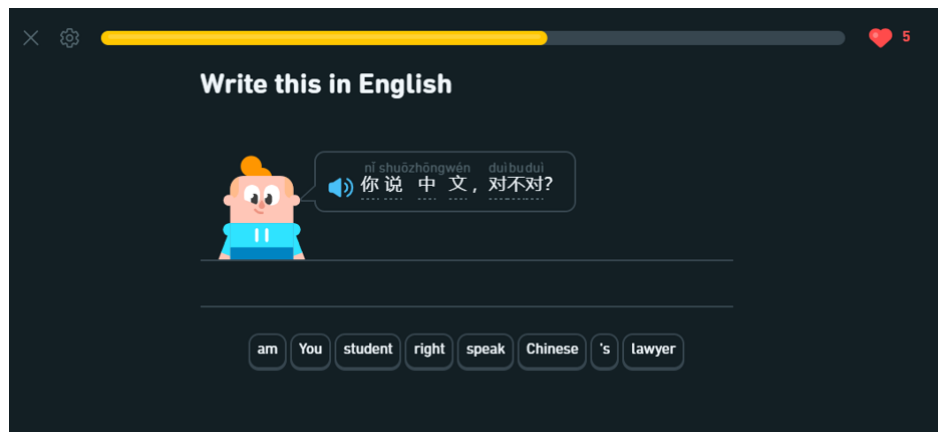


Figure 3 - Screenshot from Duolingo's exercise of sentence organisation

Professors usually follow a pre-chosen student workbook, which it is fused with teachers own material, exhibiting a slide show, for example. The Professor will introduce the Mandarin language, by explaining and correcting students' speaking (*Pinyin* and tones pronunciation), which was followed by: Greetings, Introduction to Syntax, Words (verbs, nouns, adverbs...), Interrogative structure, Numbers, Dialogue training, Introduction to Character's Writing, Food, Shopping and Currency. Units were accompanied by Chinese Cultural references and explanations, to a further understanding of the language contextualising life in China, and the interaction by teacher's asking students to participate by repeating new words and sentences, until the correct pronunciation was spoken as well as, the dialogues between students, encouraged to give elements a certain degree of freedom, reducing the online barrier, keeping students engaged and focused on the class which also simulates a real-world environment.



Figure 4 - Slideshow presented during a Traditional Approach Class

4.2.2.4. Student's Learning Process

Learners on the Duolingo completed several lessons so they could pass from unit to unit, initially averaging *12 minutes* on the app or until they have lost all hearts - Duolingo as a freemium platform only allows 5 total errors in the lessons, disallowing the student to continue learning in the free version, refilling each one every *5 hours* - which represented, on the initial days *12.5%* of the total of the participants. This problem although brutally suppressed, over time, have existed throughout the whole experiment, where if it happened twice in a row, students' motivation would clearly drop.

Traditional approach's students were directly accompanied by the Professor and the researcher during classes, where several difficulties were observable during the first hours of the classes, mainly the pronunciation of pinyin and the understanding of tones.

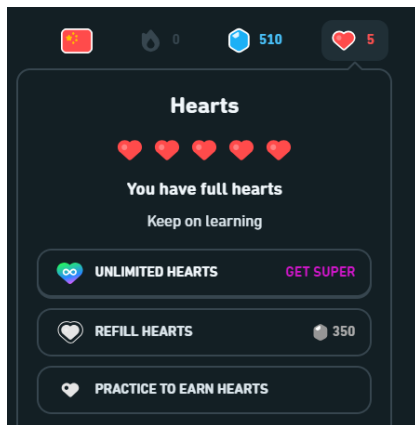


Figure 5 - Full Hearts in Duolingo

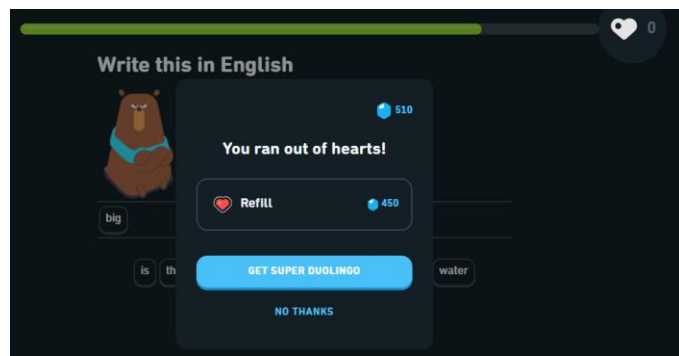


Figure 6 - Losing all hearts in the middle of a lesson

4.2.2.5. Final Assessment

The final exam was separated in a writing part and an oral part. The writing part was divided into 2 main parts, to evaluate both approaches fairly, starting with 9 questions with content that matched both learning approaches, following the types of exercise proposed by *Xiwen et al. (2019)*, where it was studied in an online environment, how the learner's study between each of "*the components of Chinese word acquisition (sounds, meanings and characters)*" could influence students' final results. Besides, exercises focused on sounds, meanings and characters, as formerly mentioned, it was also included *Pinyin* focused exercises. The second part of the Writing Exam included 4 questions exclusive to the approach of the student (Duolingo or Classes with Teacher), to evaluate the progress in the respective approaches.

All questions were of multiple choice, always with an option of "*I don't know*", counting *0 points*. If the learner, chooses the correct answer will be awarded with a point (*1*), but if it chooses the incorrect one, a point will be deducted from the final grade (*-1*). The maximum grade is *13*.

The following images (Images 7 and 8) exemplify the questions that were used in the Final Assessment, in its Portuguese Version, showing the diversity of the components evaluated, but also the quiz overall simplicity. (see Appendix B to see other examples of questions on the Exam)

*Ouve o seguinte áudio:



A frase expressada em Pinyin é...

- wǒ hěn gāoxìng
- nǐ shì gāoxìng
- nǐ hěn gāoxìng
- Não Sei

Figure 7 - Example of questions representing sounds

*Qual das opções traduz a seguinte frase:

这是米饭。(zhè shì mǐfàn)

- Isto é arroz.
- Aquilo é arroz.
- Aquilo não é arroz.
- Não sei

*O Pinyin de China é ...

- Měiguó
- Zhōngguó
- Riběn
- Não sei

Figure 8 - Example of questions representing Characters and Meaning

To ensure an accurate result from the test takers, reflecting the importance of avoiding errors, students will have its points deducted if they choose an incorrect answer, which may help determine proficiency between students, ensuring a fair assessment, reducing the impact of random decisions.

The exam had a duration of 7 *minutes*, plus extra time, if necessary, whose only access was a pre-scheduled Zoom session, with the researcher, to monitor the exam, and ensure results' reliability and trustworthiness of the final grades. The questionnaire also included a section for students to put their own names.

The oral part is done after the end of the writing part. It is composed, initially, by 5 main questions, which were divided, involving the pronunciation of words, the reading of sentences in both characters and *Pinyin*, and the translation of spoken sentences. Afterwards, the students are asked, according to their approach, questions to develop a dialogue, which were 3 for the traditional approach (T1, T2 and T3), and only one for the Duolingo class (D1), due to the lack of content in this domain. (See Appendix C, for the criteria proposed on the Oral Exam)

The Oral Exam was directed as followed:

- 1) How do you pronounce water in Chinese?
- 2) Are you able to read "你是中国人"? (You are Chinese)
 - 2.1) Do you know what it means?
 - 2.2) If unable to complete 2), may you read its pinyin "nǐ shì zhōngguó rén"?
- 3) Can you translate the sentence "我是老师 - wǒ shì lǎoshī." when spoken?
(I am a teacher)
- 4) Can you say "Nice to meet you" in Mandarin?

4.1) Read the following pinyin "Wǒ hěn gāoxìng rènshí nǐ".

5) If it is said “这是米饭”, can you translate it? (This is rice)

T1) 你叫什么名字? (What is your name?)

T2) 你爱吃什么? (What do you love eating?)

T3) 咖啡多少钱? (How much does it cost the coffee)

D1) 你喜欢茶吗? (Do you like tea?)

The scoring of the written exam was automatic, through a Qualtrics survey, which was transposed into a spreadsheet, with the grade in each question, and the respective name of the student, whereas the questions in the oral evaluation, were graded from 0 to 5, conducted in two ways: a direct evaluation, involving direct questions like translations, character reading and question answering and; an interpretation assessment, where the pronunciation was graded by more than one native Mandarin speaker who have graded towards an ID number that was provided to ensure secrecy and anonymity of the student.

The final grade for each student was 50% for the written part and 50% for the oral part.

To finish the evaluation, students were randomly asked some questions in the end, whether if they were satisfied and motivated and if they have any recommendation for future language learning apps.

5. RESULTS AND DISCUSSION

The analysis of the collected data from the study and its following results, comparing how *ab initio* students who exclusively learnt the Chinese Mandarin language through the Duolingo app with students who learnt from traditional approach with a professor on a virtual environment, will focus not only on specific exercises score, final grades, the time spent on learning, and effectiveness of the learning methods, but also on a qualitative analysis with the feedback provided by the participants.

5.1. TIME SPENT LEARNING

Originally, it was requested that students in the classroom, should attend all classes, totalling 6 hours, whereas Duolingo students were requested to perform a total of 4 hours and 40 minutes to 7 hours within 28 days. (To see the course completion, please see the following image and Appendix D)

However, there were instances of class absences and skipped days on Duolingo, which may accurately reflect real-life learning environments. Due to the need of self-management, that has come across as rather difficult to maintain, the Duolingo's students recorded, on average, a lower time spent learning, of 03:56 hours (3.94), with Classes' students averaging, an hour more: 4:57 hours (4.96).

To be accepted in the results, students must have completed, at least a full hour.

In the Duolingo domain, due to its freedom, comparatively with a scheduled class with a professor, it was possible to observe the striking differences of time between learners, ranging from 01h18m to a striking 9h30m, of real time spent on the app.

Assiduidade						Horas Feitas
05/jun	07/jun	14/jun	19/jun	24/jun		
P	P	P	P	P		6
P	P	P	P	F		5
P	P	P	F	F		3,5
P	P	P	P	P		6
P	P	P	P	P		6
F	P	P	F	F		2,5
P	F	P	P	P		5
P	P	F	P	P		4,5
F	F	P	P	P		4
F	P	F	P	P		3,5
P	P	P	P	P		6
P	P	P	P	P		6
P	P	F	P	P		4,5
F	F	P	P	P		4
F	F	P	P	P		4
F	F	P	P	P		4
F	P	P	P	P		5

Table 2 - Attendance registration for the Traditional Approach students

5.2. PARTICIPATION

The participation in the final exam was slightly higher from member in the Duolingo side ($n=17$), than the ones who have had classes with the Chinese Professor ($n=14$).

5.3. FINAL EXAM RESULTS

The final grade of each student is the value that sums, the grade in both writing and oral exam, where each skill represents 50% of the grade. The maximum grade achievable is 29, withstanding the maximum mark of 13 in the Writing exam and the 45 *points* in the oral part.

The writing exam has exposed significant differences between candidates, in either approach. Duolingo's students have, averaged 6.82 *points*, slightly higher than the minimum positive grade, where 47% of the students have obtained a negative grade (6 *points or less*). In the other hand, the traditional approach has averaged, 8.93 *points* between its students, where two have reached the maximum punctuation. However, it is the latter who have registered the highest difference between the maximum value and the minimum value (2 and 13).

In the oral part, Teacher's method has surpassed with students, averaging a punctuation of 25.02, opposing the 20.24 *points* that the Duolingo student averaged. The difference accentuates between the top students from each approach, with a difference of 11 *points*, for the traditional side. On average, both approaches, have classified poorly, ranking next to the positive threshold.

The final grade follows the pattern of the previous results, where there is a lack of consistency on the points scored, with a significant difference between grades, where it is found that the Traditional approach students, on average, (16.86 *points*) surpasses the Duolingo ones (13.53 *points*) in 3.33 *points*.

For a complete and exhaustive score in both parts, for each student, please see Appendix E.

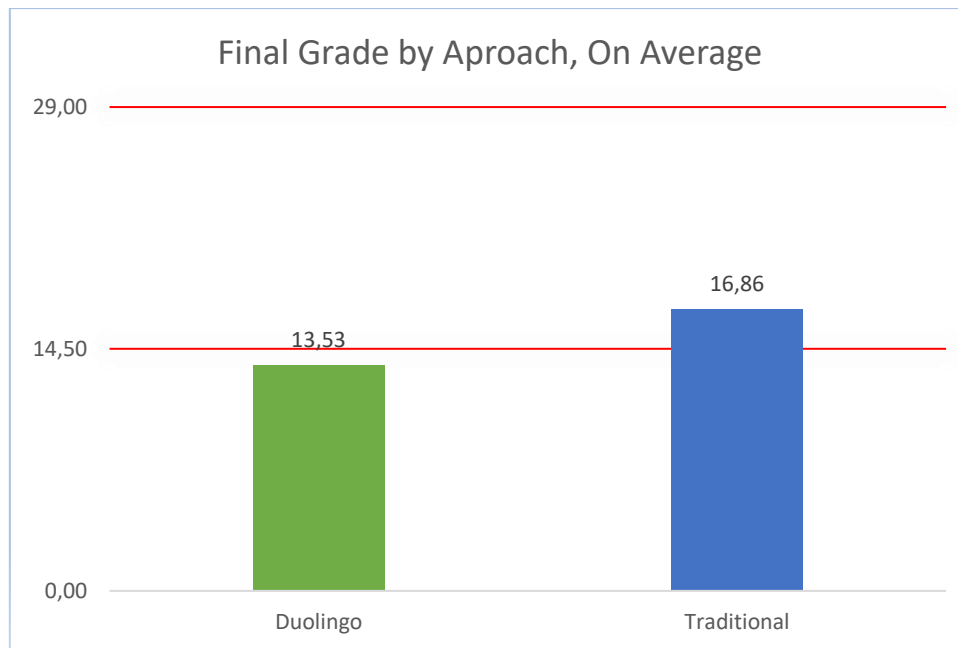


Figure 9 - Final Grade Average of Students for each Approach, in which green represents Duolingo, and blue represents Traditional Classes. Maximum 29 points. Minimum Positive Line in 14.5.

5.4. EFFECTIVENESS

Based on the Duolingo effectiveness formula, its measure accounts, not only the results, but also the time spent dedicated on the learning process, which will be a “fair measure” of the effectiveness of both Duolingo and Classrooms, measuring the ration between effect and efforts (Vesselinov & Grego, 2012):

$$Effectiveness = \frac{Effect}{Efforts} = \frac{Improvement\ of\ Language\ skills}{Study\ Time} = \frac{Final - Initial\ test\ score}{Hours\ of\ study}$$

Equation 1 – Effectiveness Formula

The results of the equation have put the effectiveness of Duolingo - 4.21 - above the effectiveness of Traditional methods - 3.36.

Although, the results on the exam have suggested a better average on the final exams, for the traditional approach, Duolingo has shown a better deliver of learning methods per hour of study.

Studentç				Evaluation				Effectiveness
ID	Approach	Real	Horas - Número	Initial	Writing	Oral	Final	
1	Duolingo	03:30	3,5	0	5	17	11,0	3,14
2	Duolingo	06:05	6,08	0	7	21	14,0	2,30
3	Duolingo	05:06	5,1	0	9	21	15,0	2,94
4	Duolingo	04:57	4,95	0	11	24	17,5	3,54
5	Duolingo	02:32	2,53	0	6	26	16,0	6,32
6	Duolingo	02:45	2,75	0	8	23	15,5	5,64
7	Traditional	04:00	4	0	10	20	15,2	3,79
8	Duolingo	02:17	6,08	0	7	12	9,5	1,56
9	Duolingo	04:00	4	1	9	20	14,5	3,38
10	Duolingo	03:29	4,95	0	10	26	18,0	3,64
11	Duolingo	03:14	2,53	0	2	16	9,0	3,56
12	Duolingo	05:25	2,75	0	6	25	15,5	5,64
13	Duolingo	03:50	3,83	0	7	25	16,0	4,18
14	Duolingo	01:29	1,3	0	5	20	12,5	9,62
15	Duolingo	09:31	9,51	0	10	21	15,5	1,63
16	Traditional	04:30	4,5	1	4	13	8,5	1,67
17	Traditional	04:30	4,5	0	12	17	14,5	3,22
18	Traditional	03:30	3,5	0	8	18	12,8	3,67
19	Duolingo	02:47	2,78	0	6	17	11,5	4,14
20	Traditional	05:00	5	1	11	32	21,7	4,13
21	Duolingo	01:56	1,93	0	5	22	13,5	6,99
22	Traditional	06:00	6	0	11	31	20,8	3,47
23	Traditional	06:00	6	0	13	37	25,0	4,17
24	Traditional	06:00	6	0	13	31	22,0	3,67
25	Traditional	05:00	5	0	9	28	18,7	3,73
26	Traditional	04:00	4	0	2	17	9,7	2,42
27	Duolingo	02:20	2,33	0	3	15	9,0	3,86
28	Traditional	04:00	4	1	11	26	18,5	4,38
29	Traditional	05:00	5	0	7	17	12,2	2,43
30	Traditional	06:00	6	0	7	32	19,3	3,22
31	Traditional	06:00	6	0	7	31	18,8	3,14

Table 3 - Effectiveness Calculation of each Student, and respective results in Writing and Oral part

5.5. SUBSKILLS EVALUATION

Throughout the final exam, as a mean to utterly evaluate the language acquisition, different questions were composed to identify 5 key components, essential to a successful proficiency on the Chinese Language: reading and comprehension of Chinese Characters, listening and translation of sentences, pronunciation skills, understanding of *Pinyin*, and capacity to produce dialogues and speech.

5.5.1. Chinese Characters

Both writing and oral parts, assessed students' knowledge on the Characters of the Chinese Language, also called, *Hanzi*, by asking 3 questions in the form of multiple choice, on the writing part whereas on the oral examination, students were asked to translate one sentence.

When the questions were approached in the writing exam, students on the Traditional approach have had a greater success, on answering correctly, with a success rate of 52.38% participants, against the 21.57% of Duolingo participants who have got the correct answers. Consequently, in the following part, it was asked, the translation of the sentence “你是中国人。”, meaning “*You are Chinese*”, taught in both approaches, which most of the students have comprehended the nature of the sentence: nationality, although no student could have developed which one, or structuring a complete correct answer out of it (5 points). The score 0 was granted to 74% of all participants, whose average grade was 0.35 and 0.64, for the Duolingo approach and traditional one, respectively.

Both teams have achieved extremely low results, especially when there are no options available, revealing the impact of the Language difference between a Latin language with the Chinese Mandarin language, especially in the writing part, which is completely different, turning, for beginners, *Hanzi* recognition extremely hard. Despite low grades, the Professor's students were able to achieve a better grade, on characters recognition, that could be associated with the emphasis placed by the teacher on this area, and without an external guidance, Duolingo learners did not understand its importance, and neglected the study of *Hanzi*.

5.5.2. Listening

On the other hand, listening overall results have been above the average, where students have also been questioned in both parts.

In the Writing part, students listened to two different audios and had to correspond to the correct *pinyin* and the correct translation. The success rate of each approach surpassed the 70% mark, on both questions. Students of the LLA had a success rate of 71%, while the student's professor had a rate of correct answers of 79%.

However, in the second part of the exam, in a scale of 0 to 5, Duolingo students have scored better results having on average, a score of 3.91 points, while Classroom's students had on average, a score of 3 points, on both questions given.

5.5.3. Pinyin

Similar to the listening evaluation, the comprehension of *Pinyin* was a considerable success. It was only present in the writing part, composed with 3 questions, that were basically *Pinyin* to its meaning, or meaning to its *Pinyin*.

On the total of the 3 questions, the success rate between each approach was minimal, where Duolingo approach have scored less than the traditional approach, with 88,2% and 92,9%, respectively. This success is also supported by the absolute number of people that have answered correctly to all three questions, which out of 17 people, 12 Duolingo learners were correct on *Pinyin* focused question, where out of the 14 students, representing the classroom students on the final exam, 11 have stood correct in all three questions.

These results have revealed how *Pinyin* is fundamental to Chinese language learning beginners, with a simpler and more familiar look, where a learner from the Latin language quickly associates with its own alphabet and sounds, overcoming the exigency and the difficulty of learning *Hanzi* from the start, allowing a steady learning.

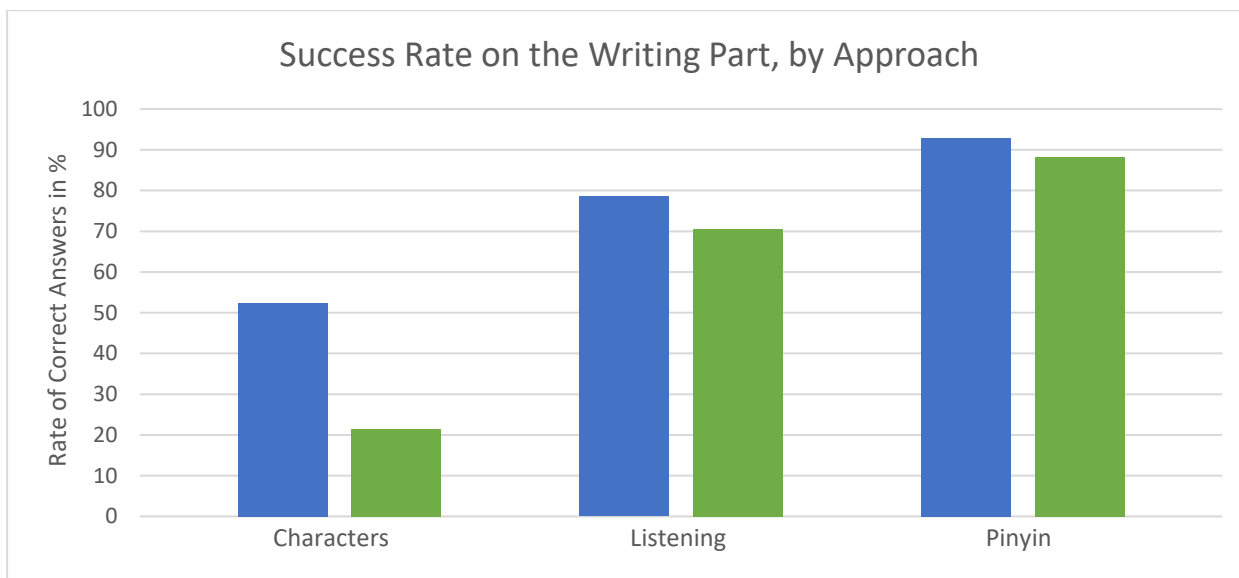


Figure 10 - Percentage of correct answers, between Duolingo (represented by the green colour) and Traditional Students (represented by the blue colour), by components of the Writing Exam

5.5.4. Pronunciation skills

The assessment of oral production and pronunciation of Chinese Mandarin is rather complex, due to the nature of its interpretation and subjectivity of the evaluator, influencing the grading process, despite the existence of guidelines for punctuation, and the similarity of different sounds. To overcome contextual differences and constraints, students were asked firstly to read a word given, then a simple sentence and in the end a complex sentence, all in *pinyin* to maintain fairness between contestants.

Across the three questions, which were all graded from 0 to 5, the traditional approach had on average, *3.40 points*, a minimal difference comparatively with Duolingo's students – *3.25 points*. Overall, the groups average was positive by a whole point (*3.32 points* against the *2.5 points* of minimal positive grade), transmitting how both approaches could be effective in this matter, although it may exhibit a greater interest and engagement in this area of knowledge.

The numbers also show a distinction on the recurrence of a grade, between both methods of learning: the mode score on the Duolingo approach was greater than the one in the Traditional segment, 4 and 3, respectively. Although, the statistical median was 3 on both.

The score 5 rate is the number of questions that were awarded with 5 points, by approach. *26,2%* of the questions answered by students of the Traditional side, had the perfect rating of 5, in pronunciation skills, whereas Duolingo candidates have answered *13.7%* of questions with an excellent mark.

Pronunciation skills, in the virtual classroom, are tested frequently, whether by direct asking or by the promotion of speaking activities between students where teacher may point mistakes straight away, delivering individual feedback about the accent, tones, and syllables. This allows significant improvements in engaged students and an overall consistent improvement of the class, which translates on the better average and in the quality of some answers by some students directly related to a higher score 5 rate. The higher mode on the Duolingo students, may be due to the repetitive listening of sounds on the exercises and the completion of speaking exercises, where although they

gain familiarity with the sounds, and how to produce them, the lack of feedback compromises a trustworthy speech.

The following graph demonstrates the difference between Duolingo approach (green colour, left side) and the Traditional approach (yellow colour, right side) on the evaluation of pronunciation exercises.

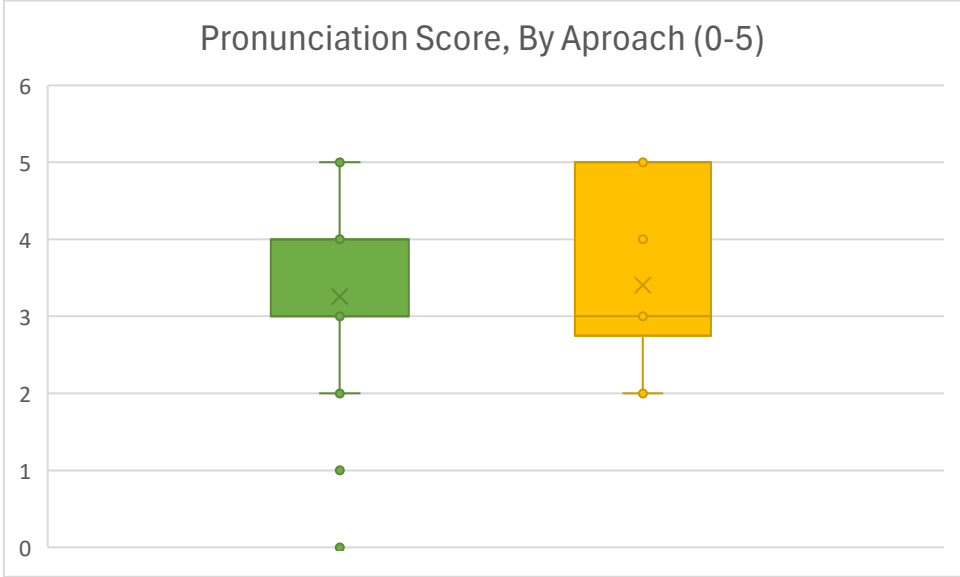


Figure 11 - Box Plot of Pronunciation, Duolingo & Traditional

The box plot, besides illustrating how Traditional approach students scored higher in terms of pronunciation, it shows how the classroom has a greater consistency, due to an absence of outliers, which may be observable in Duolingo students.

Pronunciation	Traditional	Duolingo
Average Points (0-5)	3,4	3,25
Mode of Points	3	4
Score 5 Success Rate	26,5%	13,7%

Table 4 - Pronunciation Results, summarised

5.5.5. Dialogue

The last skill specifically evaluated was how can a student interact with questions, and the capacity to listen, comprehend and deliver a proper answer, adequate to its own level, and vocabulary learnt.

Students that have experienced a professor, during the study, received 3 questions, orally: “你叫什么名字?” (*What is your name?*), “你爱吃什么?” (*What do you love to eat?*) and “咖啡多少钱” (*How much does the coffee cost?*). The content of questions was learnt in classes with a significant increase on difficulty. LLA students, alternatively, were questioned with only one simple question – “你喜欢茶吗?” (*Do you like tea?*) - due to course inability to offer students, material that is speech and conversation focused.

To ensure compliance in the results, the average of the 3 answers was calculated to compare to the results on the Duolingo dialogue-focused question. The significant difficulty on the Traditional approach questions, comparatively to the one proposed to the ones in Duolingo, was excelled by the scores. Duolingo students were hardly capable of answering the question, producing almost no answers, although the comprehension of the question was possible, which only three students were capable of formulate some type of answer, but never a correct one. This was a recurrent topic discussed and reported by the students about the inability to develop a conversation, knowing simply “*random words and sentences*”.

On the other hand, Traditional approaches students were capable to answer the questions, either directly by saying the answer immediately or by providing a full structured answer. This is represented on the average score where Duolingo students had 0.35, when the traditional methods reached 3.31 points.

The dialogue questionnaire did not evaluate the pronunciation, but the capacity to understand and to answer, in the preferred form, where every student could ask for a repetition of the question.

To understand better, the Oral scores, please see Appendix F.

5.6. QUALITATIVE ANALYSIS

Some students were briefly surveyed in the end of the exam, about the experience and how they felt about the teaching methods of their own approach. Students, in the traditional approach, appreciated the experience, recognising the ability of the teacher to engage and develop motivation to continue to go to classes, and that have may cause a certain interest to do some revisions on the content of the classes. They felt that the content was appropriate and were satisfied with the application in real life situations, in addition to the learning of some cultural aspects of China. The time between the last class and the exam, was mentioned, as could have impacted their results on the exam.

Duolingo students have had mix reviews, in general about the app, tending to a positive experience, as well, assessing it as a “*practical*” tool and “*fun to do*” and acknowledged the freedom of doing lessons whenever they wanted to, as was part of the routine. Although, some students lacked motivation, due to several reasons: Limitation on the number of mistakes that on can have per session, which in harder levels can really hinder motivation, as they are not able to complete lessons, and, consequently, the time in the app drops significantly and other reason is the content was not exciting as it could not develop dialogue or present themselves, lacking customization parts.

6. CONCLUSIONS AND FUTURE WORKS

6.1. SYNTHESIS OF THE DEVELOPED WORK

The aim of the present research was to compare Language Learning App methods with traditional methods, on introducing a completely new Language and to study its effectiveness, which was successfully achieved by, initially assessing students' knowledge in Chinese, subsequently the Learning approaches were implemented on learners whether by completing Duolingo lessons, or assisting live classes with a certified Chinese Professor, both strictly monitored. In the end of their participation, students completed a Final Exam, comprehending a Writing Part and an Oral Part, assessing a range of areas of interest, which were, analysed thoroughly.

Duolingo students had an overall moderately positive score, throughout specific categories, especially in the Speaking part, where the Listening and Pronunciation skills were highly favourable, which may be attributed to the repetition of words, during normal exercise completion. However, there was a lack of intention in learning characters, which is the base of the Mandarin syntax, resulting in poor results on this category, in both parts. The non-existent ability to produce speech and a dialogue, in the introduction of the language, results in students not being able to practice its learning material in a different environment, constraining motivation's growth. The absence of practice outside the app with a low comprehension of syntax rules may be disadvantageous in a longer term, due to Duolingo's teaching methodology of only presenting exercises to complete.

In the other hand, Traditional approach students, were consistently better than Duolingo's, averaging a positive grade in every category, which reflected its solid average Final Score. Learners in this approach, have exceeded expectations, in Character recognition, with a success rate just above the average threshold, in the questions proposed, which may be justified by Professor's insistence in its reading and comprehension in classes. Besides, that category, Traditional approach students, on average, had a better grading in questions of the Writing Part (Pinyin and Listening), as well as, the Final Score, above the positive score line, opposing to its study counterpart's average. The only students who were able to have an excellent mark (13/13) on the Exam had classes with the teacher. Furthermore, Classroom learners have practiced and learnt dialogue in the classes, engaging in role-plays of questions and answers, of diverse topics learnt, exhibiting a diverse range of knowledge in this area.

However, when calculating the Learning efficiency, by dividing the Effects - Final Results - by the Efforts - time spent learning -, we may conclude how Duolingo's students, have, on average, a better retention rate, in a short-term learning, comparing to the traditional students. The shorter daily practice of Chinese in Duolingo, compared to the gap between bigger classes may have resulted on the difference in efficiency calculated, favouring Duolingo students, and its successful SLA.

At this stage, with the information presented, both approaches currently have advantages and drawbacks, but LLA is not able to fully replace a teacher, although they complement each other, by ensuring a thorough learning of the target language, personalised teaching, and Culture engagement, with a Professor, with a constant reinforcement of Chinese after class with the introduction of new vocabulary, a learner may achieve not only a more effective but also efficient SLA.

6.2. LIMITATIONS

6.2.1. Study

The study initially included 44 active participants, who were steadily learning Chinese, distributed through either approach, but only 31 participants have been assessed on the Final Exam, which is not representative of a population although heterogeneity is preserved in both age and gender, where the age's range was from 18 years to 58 years old. Long-term Learning acquisition cannot be studied, due to the reduced research length, which lasted approximately one month.

6.2.2. Material

The participation on the study could be considered unreliable as, the data extracted from the Duolingo students, and their daily reports may not be accurate to the reality of their activities. Additionally, Duolingo's tracking was based solely on the time spent in the app, and not on actual learning activities and lessons.

The final exam, while trying to conjoin content from two different, separated approaches, may not assess fully language fluency.

6.2.3. Influences

Professor influences greatly the success of the classroom approach, whether is by the teaching methodology, the content taught, or other relevant factors, students may react differently, varying the effectiveness result. The use of one teacher may offer a biased result, towards the score of the results, as well as the existence of only a classroom, where interactions between students may alter the engagement in the class and the motivation. The results in the LLA approach may also be biased, where the use of only one app may not reflect all LLAs, although Duolingo is the most used app, it may not be the best one to evaluate its effectiveness.

Nevertheless, the experience of students with technology and its familiarity, where both approaches may be affected by this variable on the experience and therefore, alter the scoring.

Motivation, as a pillar for the success of Learning a Language, is difficult to control throughout an experiment, due to its multifactor characteristic, possibly hindering reliable results, as well as, other external factors, that are hardly controlled and might compromise the performance of the student on both class and Exam.

6.3. FUTURE WORK

As we have explored in this study, comparing a LLA with a traditional approach is complex research, which can be improved by gathering a larger sample size, which can improve the universality of results, as well as ensure heterogeneity to other demographic areas, extend the duration to a more considerable period, to comprehend how the introduction of a language impacts its learning in the future.

To assure reliability on the final results, and on the tracking, it should be use in-app tracker or a LLA usage tracker, which is capable to save time, but also to understand the progress of the students and

to analyse patterns and also a more extensive final exam, where more topics or categories can be assessed, or increase the quantity of assessments, throughout the study.

It is also suggested that should be a class dedicated to a conjoint approach, using Duolingo and assisting classes, for a more complex result.

Although motivation could be hard to assess, it should be interesting to test factors on students, leading to a more comprehensive result.

BIBLIOGRAPHICAL REFERENCES

- Abdous, M., Camarena, M. M., & Facer, B. R. (2009). MALL Technology: Use of Academic Podcasting in the Foreign Language Classroom. *ReCALL*, 21(1), 76–95.
<https://doi.org/10.1017/S0958344009000020>
- Abrams, Z. I. (2003). The Effect of Synchronous and Asynchronous CMC on Oral Performance in German. *The Modern Language Journal*, 87(2), 157–167. <https://doi.org/10.1111/1540-4781.00184>
- Allen, I. E., & Seaman, J. (2006). Growing by degrees: Online education in the United States, 2005. *Sloan Consortium (NJ1)*.
- Anczewski, J. (1987). *Second Language Research*, 3(2), 180–182. JSTOR.
- Anthony, E. M. (1963). Approach, Method, and Technique. *ELT Journal*, XVII(2), 63–67.
<https://doi.org/10.1093/elt/XVII.2.63>
- Arvanitis, P., & Krystalli, P. (2021). Mobile Assisted Language Learning (MALL): Trends from 2010 to 2020 Using Text Analysis Techniques. *European Journal of Education*, 4(1), 13–22.
<https://doi.org/10.26417/ejls-2019.v5i1-191>
- Avci, H., & Adiguzel, T. (2017). A case study on mobile-blended collaborative learning in an English as a foreign language (EFL) context. *International Review of Research in Open and Distributed Learning*, 18(7).
- Belevan, D., & Dalsime, S. (2022). *Duolingo Announces Record Bookings in First Quarter 2022 and Raises Full Year Guidance*. duolingo. <https://investors.duolingo.com/news-releases/news-release-details/duolingo-announces-record-bookings-first-quarter-2022-and-raises>
- Best, L. (1997). *The Nature of Teaching and Learning in the Multimedia Laboratory Classroom: Process, Activity, Problem-Solving, Engagement*.
- Birdsong, D. (2005). Interpreting age effects in second language acquisition. *Handbook of Bilingualism: Psycholinguistic Approaches*, 109, 127.

- Blake, R. J. (2009). The Use of Technology for Second Language Distance Learning. *The Modern Language Journal*, 93(s1), 822–835. <https://doi.org/10.1111/j.1540-4781.2009.00975.x>
- Blake, R. J. (2013). *Brave new digital classroom: Technology and foreign language learning* (Second edition). Georgetown University Press.
- Brown, J. S., Collins, A., & Duguid, P. (1989). Situated Cognition and the Culture of Learning. *Educational Researcher*, 18(1), 32–42. <https://doi.org/10.3102/0013189X018001032>
- Cenoz, J. (2013). Defining Multilingualism. *Annual Review of Applied Linguistics*, 33, 3–18. <https://doi.org/10.1017/S026719051300007X>
- Chapelle, C. A. (2005). Computer-assisted language learning. In *Handbook of research in second language teaching and learning* (pp. 743–755). Routledge.
- Chen, Y.-S., Kao, T.-C., Sheu, J.-P., & Chiang, C.-Y. (2002). *A mobile scaffolding-aid-based bird-watching learning system*. 15–22.
- Cheng, F. (2023). The Role of First Language in Second Language Acquisition. In B. Majoul, D. Pandya, & L. Wang (Eds.), *Proceedings of the 2022 4th International Conference on Literature, Art and Human Development (ICLAHD 2022)* (pp. 1236–1243). Atlantis Press SARL. https://doi.org/10.2991/978-2-494069-97-8_158
- Chinnery, G. M. (2006). Going to the MALL: Mobile Assisted Language Learning. *Emerging Technologies*, 10(1), 9–16.
- Civello, C. A. (1999). ‘Move over, Please’: The Decentralization of the Teacher in the Computer-Based Classroom. *The English Journal*, 88(4), 89. <https://doi.org/10.2307/822426>
- Clark, K. R. (2018). Learning Theories: Cognitivism. *Radiologic Technology*, 90(2), 176–179.
- Crystal, D. (2012). *English as a global language* (Canto classics edition). Cambridge University Press.
- Deci, E. L., & Ryan, R. M. (1985). *Intrinsic Motivation and Self-Determination in Human Behavior*. Springer US. <https://doi.org/10.1007/978-1-4899-2271-7>
- Dooly, M., & Sadler, R. (2016). Becoming Little Scientists: Technologically-Enhanced Project-Based Language Learning. *Language Learning*, 20(1), 54–78.

- Dörnyei, Z. (1998). Motivation in second and foreign language learning. *Language Teaching*, 31(3), 117–135. <https://doi.org/10.1017/S026144480001315X>
- Dörnyei, Z. (2005). *The psychology of the language learner: Individual differences in second language acquisition* (digital printing 2010). Routledge.
- Dörnyei, Z. (2009). 2. The L2 Motivational Self System. In Z. Dörnyei & E. Ushioda (Eds.), *Motivation, Language Identity and the L2 Self* (pp. 9–42). Multilingual Matters.
<https://doi.org/10.21832/9781847691293-003>
- Ertmer, P. A., & Newby, T. J. (2013). Behaviorism, Cognitivism, Constructivism: Comparing Critical Features From an Instructional Design Perspective. *Performance Improvement Quarterly*, 26(2), 43–71. <https://doi.org/10.1002/piq.21143>
- Finkel, D. L., & Monk, G. S. (1983). Teachers and learning groups: Dissolution of the atlas complex. *New Directions for Teaching and Learning*, 1983(14), 83–97.
<https://doi.org/10.1002/tl.37219831411>
- Fisher, S. E. (2005). On Genes, Speech, and Language. *New England Journal of Medicine*, 353(16), 1655–1657. <https://doi.org/10.1056/NEJMp058207>
- Friedmann, N., & Rusou, D. (2015). Critical period for first language: The crucial role of language input during the first year of life. *Current Opinion in Neurobiology*, 35, 27–34.
<https://doi.org/10.1016/j.conb.2015.06.003>
- Frigaard, A. (2002). *Does the Computer Lab Improve Student Performance on Vocabulary, Grammar, and Listening Comprehension?*
- Gafni, R., Achituv, D. B., & Rachmani, G. J. (2017). Learning Foreign Languages Using Mobile Applications. *Journal of Information Technology Education: Research*, 16, 301–317.
- Gamble, C., & Wilkins, M. (2014). Student Attitudes and Perceptions of Using Facebook for Language Learning. *Dimension*, 49, 72.
- Gamlo, N. (2019). The Impact of Mobile Game-Based Language Learning Apps on EFL Learners' Motivation. *English Language Teaching*, 12(4), 49. <https://doi.org/10.5539/elt.v12n4p49>

- Godwin-Jones, R. (2011). MOBILE APPS FOR LANGUAGE LEARNING. *Language Learning & Technology, 2*, 2–11.
- Golonka, E. M., Bowles, A. R., Frank, V. M., Richardson, D. L., & Freynik, S. (2014). Technologies for foreign language learning: A review of technology types and their effectiveness. *Computer Assisted Language Learning, 27*(1), 70–105. <https://doi.org/10.1080/09588221.2012.700315>
- Hu, R. (2016). The Age Factor in Second Language Learning. *Theory and Practice in Language Studies, 6*(11), 2164. <https://doi.org/10.17507/tpls.0611.13>
- Huang, B. H. (2016). A synthesis of empirical research on the linguistic outcomes of early foreign language instruction. *International Journal of Multilingualism, 13*(3), 257–273. <https://doi.org/10.1080/14790718.2015.1066792>
- Hummel, K. M. (2020). *Introducing second language acquisition: Perspectives and practices* (2nd edition). Wiley-Blackwell.
- Hurford, J. R. (2014). *Origins of Language: A Slim Guide*. OUP Oxford.
- Hwang, G.-J., & Fu, Q.-K. (2019). Trends in the research design and application of mobile language learning: A review of 2007–2016 publications in selected SSCI journals. *Interactive Learning Environments, 27*(4), 567–581. <https://doi.org/10.1080/10494820.2018.1486861>
- Jodai, H., Zafarghandi, A. M. V., & Tous, M. D. (2013). Motivation, Integrativeness, Organizational Influence, Anxiety, and English Achievement. *Glottology, 4*(2). <https://doi.org/10.1524/glot.2013.0012>
- Kern, R., Ware, P., & Warschauer, M. (2017). Network-Based Language Teaching. In N. Van Deusen-Scholl & S. May (Eds.), *Second and Foreign Language Education* (pp. 197–209). Springer International Publishing. https://doi.org/10.1007/978-3-319-02246-8_30
- Kern, R., & Warschauer, M. (2000). Introduction: Theory and practice of network-based language teaching. In M. Warschauer & R. Kern (Eds.), *Network-based Language Teaching* (pp. 1–19). Cambridge University Press. <https://doi.org/10.1017/CBO9781139524735.003>

- Kétyi, A. (2013). Using Smart Phones in Language Learning – A Pilot Study to Turn CALL into MALL. *20 Years of EUROCALL: Learning from the Past, Looking to the Future*, 129–134.
<https://doi.org/10.14705/rpnet.2013.000150>
- Krashen, S. D., Long, M. A., & Scarcella, R. C. (1979). Age, Rate and Eventual Attainment in Second Language Acquisition. *TESOL Quarterly*, *13*(4), 573. <https://doi.org/10.2307/3586451>
- Kretchmar, J. (2021). Constructivism. In *Salem Press Encyclopedia*.
<https://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,shib&db=ers&AN=89164134&lang=pt-pt&site=eds-live&scope=site>
- Kukulka-Hulme, A., & Viberg, O. (2018). Mobile collaborative language learning: State of the art. *British Journal of Educational Technology*, *49*(2), 207–218.
<https://doi.org/10.1111/bjet.12580>
- Lai, C., & Zhao, Y. (2006). Noticing and Text-Based Chat. *Language Learning & Technology*, *10*(3), 102–120.
- Lam, Y., & Lawrence, G. (2002). Teacher-Student Role Redefinition During a Computer-Based Second Language Project: Are Computers Catalysts for Empowering Change? *Computer Assisted Language Learning*, *15*(3), 295–315. <https://doi.org/10.1076/call.15.3.295.8185>
- Lantz-Andersson, A., Vigmo, S., & Bowen, R. (2013). Crossing boundaries in Facebook: Students' framing of language learning activities as extended spaces. *International Journal of Computer-Supported Collaborative Learning*, *8*(3), 293–312. <https://doi.org/10.1007/s11412-013-9177-0>
- Lee, J. F., & VanPatten, B. (2003). *Making communicative language teaching happen* (Second edition). McGraw-Hill; WorldCat. <https://www.jstor.org/stable/328644?origin=crossref>
- Lenneberg, E. H. (1967). The Biological Foundations of Language. *Hospital Practice*, *2*(12), 59–67.
<https://doi.org/10.1080/21548331.1967.11707799>
- Levy, M., & Hubbard, P. (2005). Why call CALL “CALL”? *Computer Assisted Language Learning*, *18*(3), 143–149. <https://doi.org/10.1080/09588220500208884>

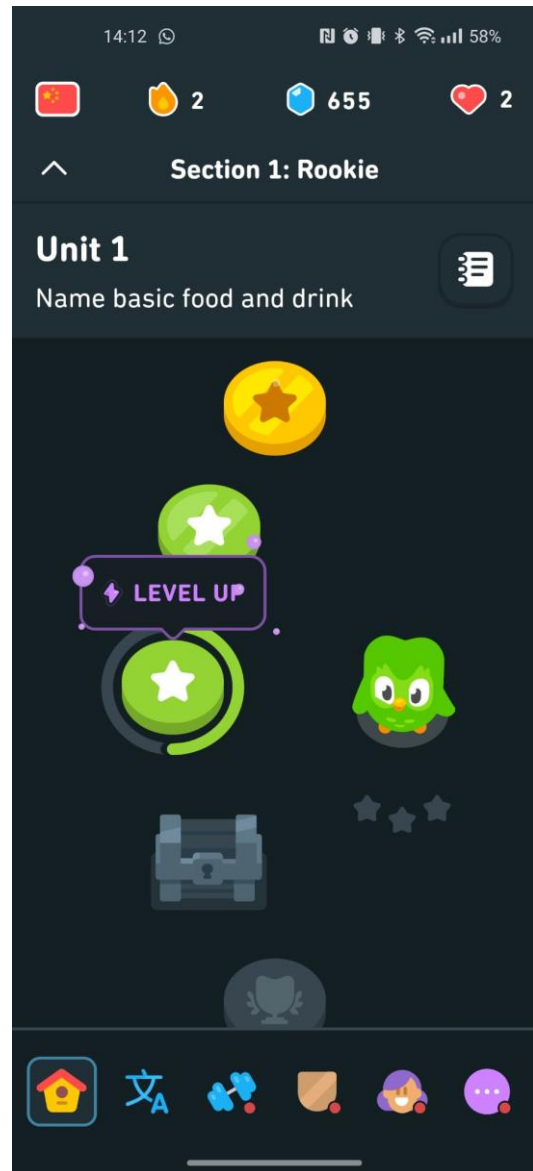
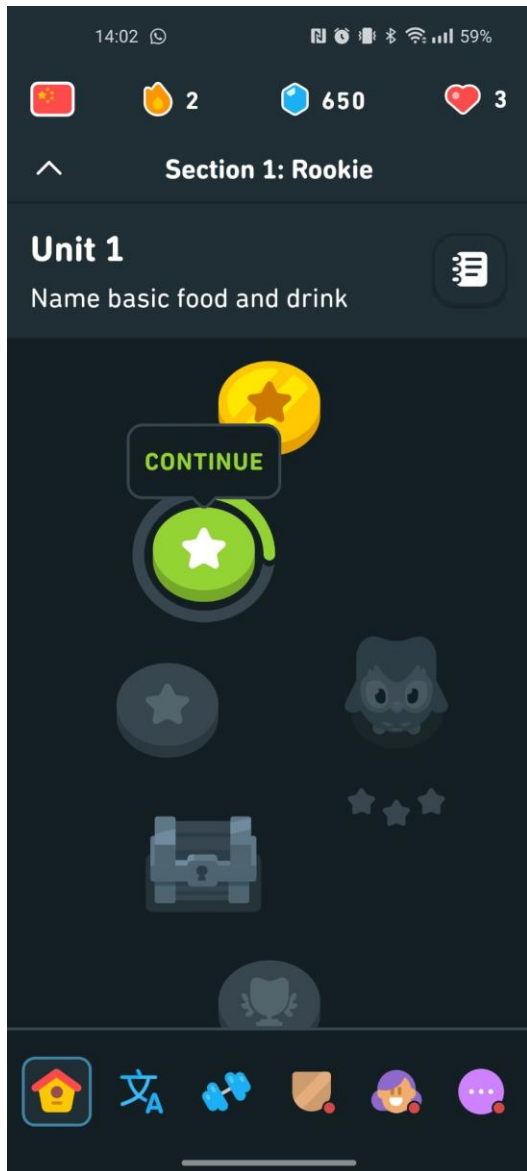
- Lightbown, P., & Spada, N. (2021). *How languages are learned* (Fifth edition). Oxford University Press.
- Loewen, S., Crowther, D., Isbell, D. R., Kim, K. M., Maloney, J., Miller, Z. F., & Rawal, H. (2019). Mobile-assisted language learning: A Duolingo case study. *ReCALL*, 31(3), 293–311. <https://doi.org/10.1017/S0958344019000065>
- Mihaljevic Djigunovic, J. (2012). Attitudes and motivation in early foreign language learning. *CEPS Journal*, 2(3), 55–74. <https://doi.org/10.25656/01:6787>
- Miller, G. A., & Gildea, P. M. (1987). How Children Learn Words. *Scientific American*, 257(3), 94–99. JSTOR.
- Muñoz, C. (2006). *Age and the rate of foreign language learning* (Vol. 19). Multilingual Matters.
- Nariyati, N. P. L., Sudirman, S., & Pratiwi, N. P. A. (2020). EFL Pre-Service Teachers's Perception toward the Use of Mobile Assisted Language Learning in Teaching English. *International Journal of Language Education*, 38–47. <https://doi.org/10.26858/ijole.v4i2.10052>
- Nellen, T. (1999). Morphing from Teacher to Cybrarian. *Multimedia Schools*, 6(1), 20–25.
- Null, J. W. (2004). Is Constructivism Traditional? Historical and Practical Perspectives on a Popular Advocacy. *The Educational Forum*, 68(2), 180–188. <https://doi.org/10.1080/00131720408984625>
- O'Dowd, R. (2006, January 1). *Telecollaboration and the development of intercultural communicative competence*. Langenscheidt. https://www.academia.edu/362172/Telecollaboration_and_the_development_of_intercultural_communicative_competence
- Ogata, H., & Yano, Y. (2004). Knowledge awareness for a computer-assisted language learning using handhelds. *International Journal of Continuing Engineering Education and Lifelong Learning*, 14(4/5), 435. <https://doi.org/10.1504/IJCEELL.2004.005731>
- Olson, H. (2015). *Key elements of effective hybrid English as a second language programs for adults*.
- O'Malley, J. M., & Chamot, A. U. (1990). *Learning Strategies in Second Language Acquisition* (1st ed.). Cambridge University Press. <https://doi.org/10.1017/CBO9781139524490>

- Oxford, R. L. (1990). *Language learning strategies: What every teacher should know*. Newbury House Publ.
- Oxford, R. L. (2002). Language Learning Strategies in a Nutshell: Update and ESL Suggestions. In J. C. Richards & W. A. Renandya (Eds.), *Methodology in Language Teaching* (1st ed., pp. 124–132). Cambridge University Press. <https://doi.org/10.1017/CBO9780511667190.018>
- Pickard, V. (1994). *Concordancing for Schools: Problems and Potential*.
- Psychogyiou, A., & Karasimos, A. (2019). The effectiveness of learning a foreign language via a distance learning tool: Testing the Duolingo application. *Selected Papers on Theoretical and Applied Linguistics, Vol 23*, 364-380 Pages. <https://doi.org/10.26262/ISTAL.V23I0.7354>
- Richards, J. C., & Rodgers, T. S. (2014). *Approaches and methods in language teaching*. Cambridge university press.
- Richards, J. C., & Schmidt, R. W. (2013). *Longman Dictionary of Language Teaching and Applied Linguistics* (0 ed.). Routledge. <https://doi.org/10.4324/9781315833835>
- Robins, R. H., & Crystal, D. (2024). Language. In *Encyclopedia Britannica*. <https://www.britannica.com/topic/language>
- Rosell-Aguilar, F. (2017). State of the App: A Taxonomy and Framework for Evaluating Language Learning Mobile Applications. *CALICO Journal, 34*(2). <https://doi.org/10.1558/cj.27623>
- Rubin, J. (1975). What the 'Good Language Learner' Can Teach Us. *TESOL Quarterly, 9*(1), 41. <https://doi.org/10.2307/3586011>
- Shadiev, R., Hwang, W.-Y., & Huang, Y.-M. (2017). Review of research on mobile language learning in authentic environments. *Computer Assisted Language Learning, 30*(3–4), 284–303. <https://doi.org/10.1080/09588221.2017.1308383>
- Silveri, M. M. (2012). Adolescent Brain Development and Underage Drinking in the United States: Identifying Risks of Alcohol Use in College Populations. *Harvard Review of Psychiatry, 20*(4), 189–200. <https://doi.org/10.3109/10673229.2012.714642>

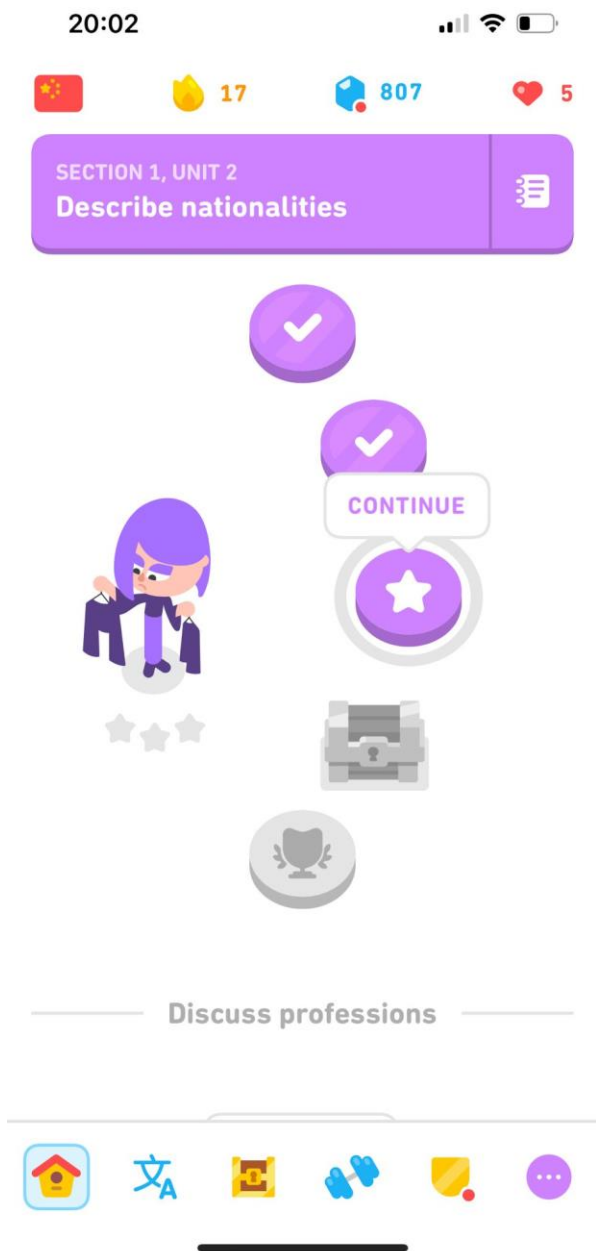
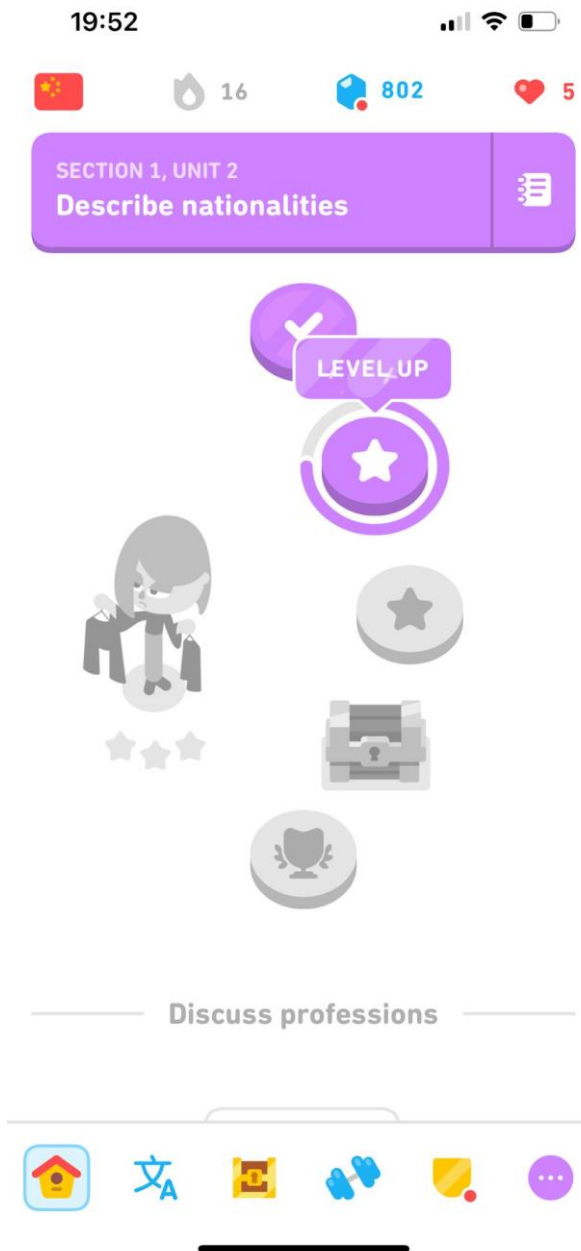
- Skehan, P. (2003). Focus on Form, Tasks, and Technology. *Computer Assisted Language Learning*, 16(5), 391–411. <https://doi.org/10.1076/call.16.5.391.29489>
- SKINNER, B. F. (1957). THE EXPERIMENTAL ANALYSIS OF BEHAVIOR. *American Scientist*, 45(4), 343–371. JSTOR.
- Sun, P. (Paul), & Yuan, R. (Eric). (2018). Understanding collaborative language learning in novice-level foreign language classrooms: Perceptions of teachers and students. *Interactive Learning Environments*, 26(2), 189–205. <https://doi.org/10.1080/10494820.2017.1285790>
- Timucin, M. (2006). Implementing CALL in an EFL context. *ELT Journal*, 60(3), 262–271. <https://doi.org/10.1093/elt/ccl006>
- United States Government Accountability Office. (2017). *DEPARTMENT OF STATE Foreign Language Proficiency Has Improved, but Efforts to Reduce Gaps Need Evaluation*.
- Ushioda, E. (2020). *Language learning motivation*. Oxford University Press.
- Van Deusen–Scholl, N. (2015). Assessing Outcomes in Online Foreign Language Education: What Are Key Measures for Success? *The Modern Language Journal*, 99(2), 398–400. https://doi.org/10.1111/modl.12234_2
- Vesselinov, R., & Grego, J. (2012). Duolingo effectiveness study. *City University of New York, USA*, 28(1–25).
- Vurdien, R. (2013). Enhancing writing skills through blogging in an advanced English as a Foreign Language class in Spain. *Computer Assisted Language Learning*, 26(2), 126–143. <https://doi.org/10.1080/09588221.2011.639784>
- Xu, L. (2023). The Age Effect in Second Language Acquisition and Its Study Design Method. *Journal of Education, Humanities and Social Sciences*, 8, 1215–1222. <https://doi.org/10.54097/ehss.v8i.4454>
- Yamada, M. (2009). The role of social presence in learner-centered communicative language learning using synchronous computer-mediated communication: Experimental study. *Computers & Education*, 52(4), 820–833. <https://doi.org/10.1016/j.compedu.2008.12.007>

Zhang, R., & Zou, D. (2022). Types, purposes, and effectiveness of state-of-the-art technologies for second and foreign language learning. *Computer Assisted Language Learning*, 35(4), 696–742. <https://doi.org/10.1080/09588221.2020.1744666>

APPENDIX A. DUOLINGO STUDENTS SCREENSHOTS



14:02 – 14:12 -- 10 minutes
2 days in a row
Unit 1



19:52 – 20:02 -- 10 minutes
17 days in a row
Unit 2

APPENDIX B. QUESTIONS FROM THE WRITTEN EXAM

* A frase 我认识你 (wǒ rènshi nǐ) poder-se-á traduzir para português como...

- Estou feliz
- Eu conheço-te
- Tu conheces-me
- Não sei

* 我是中国人。 Esta frase em Português quer dizer....

- Eu sou Americano
- Eu sou Chinês.
- Tu és Chinês.
- Não sei

* 你好 traduz-se para português como...

- Pai
- Arroz
- Olá
- Não Sei

APPENDIX C. ORAL EXAM CRITERIA

Scoring in oral Part is complex process and it is composed by several elements, from 0 points to a perfect 5:

5 - Identification and Clear and Correct Pronunciation of the word/ Sentence; Answer the question correctly.

4 - Understandable pronunciation of a word/ sentence to a native speaker, with some minor errors of pinyin or tones; Identification of some words without help, and partially answers correctly.

3 - Observable Pronunciation errors that may impede a normal understanding, which may require assistance with the question. Can identify some characters in a sentence, but it is unable to process the sentence or translate it correctly or totally.

2- Severe mistakes in pronunciation that hinder understanding; Understood the sentence with pinyin; Does not understand the meaning of the sentence, although it gets one key word right

1- Pronunciation errors that drastically blocks understanding and comprehension of the sentence/ word; Knows what a word could mean but doesn't know.

0- Didn't know how or what to say, unable to complete the task required

APPENDIX D. DUOLINGO REGISTRATION TABLE

10/jun			11/jun			12/06/2024, quarta			13/06/2024, quinta			14/06/2024, sexta			15/06/2024, sabado			16/06/2024, domingo				
Início	Fim	Duração	Início	Fim	Duração	Início	Fim	Duração	Início	Fim	Duração	Início	Fim	Duração	Início	Fim	Duração	Início	Fim	Duração		
22:19	22:30	00:11	02:40	02:45	00:05	23:01	23:11	00:10	17:56	18:06	00:10	20:06	20:20	00:14	00:49	00:59	00:10					
02:28	02:53	00:25	01:07	01:48	00:41														00:38	00:58	00:20	
						15:04	15:17	00:13	18:24	18:30	00:06	17:58	18:29	00:31	00:09	00:21	00:12	01:27	01:45	00:18		
20:33	20:41	00:08	21:34	21:44	00:41	21:05	21:13	00:08	21:15	21:24	00:09	01:13	01:23	00:10	22:05	22:15	00:10	18:30	18:38	00:08		
14:35	14:40	00:05	16:11	16:20	00:09				23:03	23:05	00:02	22:00	22:03	00:03	21:18	21:21	00:03	22:21	22:33	00:12		
12:02	12:14	00:12	23:14	23:23	00:09	16:22	16:25	00:03	22:46	22:53	00:07				12:00	12:43	00:43	22:45	22:52	00:07		
21:15	21:25	00:10	21:38	21:47	00:09	23:46	23:54		01:01	01:11	00:10	22:39	22:49	00:10	01:38	01:46	00:08	20:20	20:27	00:07		
			23:13	23:25	00:12	14:20	14:32	00:12	02:11	02:16	00:05				13:37	13:45	00:08	23:26	23:46	00:20		
09:35	09:47	00:12	10:19	10:31	00:12	08:36	08:46	00:10	10:17	10:29	00:12	12:43	12:53	00:10								
22:49	22:52	00:03	23:42	23:51	00:09	23:51	23:54	00:03	22:32	22:40	00:08				23:08	23:13	00:05	23:04	23:13	00:09		
00:51	01:04	00:13	23:45	23:52	00:07	23:45	23:52	00:07	23:54	00:04	00:10	23:53	00:02	00:08	00:13	00:29	00:16	23:56	00:07	00:11		
07:18	07:24	00:06	07:20	07:28	00:08	16:25	16:31	00:06	23:21	23:30	00:09	10:00	10:10	00:10	10:34	10:40	00:06	20:58	21:09	00:11		
21:16	21:28	00:12	00:48	00:57	00:09	00:45	00:57	00:12							01:25	01:45	00:20	22:31	22:40	00:09		
12:56	13:06	00:10	13:37	13:48	00:11	16:30	16:42	00:12	16:03	16:13	00:10	15:39	15:50	00:11	14:21	14:33	00:12	20:50	20:58	00:08		
10:11	10:21	00:10	10:11	10:21	00:10	10:44	10:54	00:10	09:35	09:45	00:10	13:13	13:24	00:11	14:32	14:42	00:10	10:59	11:09	00:10		
17/jun			18/jun			19/jun			20/jun			21/jun			22/jun			23/jun				
Início	Fim	Duração	Início	Fim	Duração	Início	Fim	Duração	Início	Fim	Duração	Início	Fim	Duração	Início	Fim	Duração	Início	Fim	Duração	Início	Fim
			10:36	10:53	00:17	10:07	10:18	00:11				00:31	00:52	00:21	01:28	01:45	00:17	00:14	00:26	00:12		
22:36	22:58	00:22				20:37	20:51	00:14				02:50	03:00	00:10	11:00	11:19	00:19					
00:09	00:23	00:14	00:55	01:03	00:08	03:19	03:27	00:08	02:50	03:00	00:10	11:00	11:19	00:19							19:10	19:33
18:40	19:03	00:23	22:49	23:26	00:37	09:59	10:17	00:18	10:38	11:15	00:37	21:14	21:27	00:13	10:47	11:11	00:24	19:10	19:33			
22:38	22:49	00:11	22:19	22:32	00:13	23:58	00:11	00:13	22:15	22:28	00:13				22:50	23:00	00:10	11:10	11:14			
22:21	22:33	00:12	22:10	22:12	00:02	22:08	22:10	00:02				08:45	08:48	00:03	09:08	09:12	00:04	22:31	22:36			
			22:43	22:51	00:08	22:14	22:23	00:09	00:49	00:58	00:09	22:46	23:00	00:14								
23:23	23:40	00:17	23:45	23:48	00:03	21:16	21:27	00:11	23:32	23:38	00:06				23:15	23:25	00:10	23:39	23:55			
13:28	13:39	00:11	08:00	08:13	00:13	23:07	23:17	00:10	10:40	10:50	00:10	08:01	08:11	00:10	20:45	21:30	00:45	22:39	22:47			
23:42	23:53	00:11	11:25	11:36	00:11	23:48	23:50	00:02	22:36	22:44	00:08	23:16	23:21	00:05	23:03	23:06	00:03	22:09	22:12			
23:47	00:02	00:05	23:54	00:02	00:08	23:57	00:01	00:04	23:59	00:09	00:10	23:56	00:04	00:08				23:54	23:59			
22:22	22:32	00:10				22:56	23:06	00:10	20:47	20:57	00:10	12:38	12:48	00:10	20:49	20:59	00:10					
22:24	22:34	00:10				22:55	23:03	00:08														
14:54	15:04	00:10	22:42	22:54	00:12	22:16	22:28	00:12	19:17	19:27	00:10	18:50	19:01	00:11	16:49	16:59	00:10	22:25	22:37			
11:11	11:21	00:10	17:17	17:27	00:10	16:51	17:01	00:10	16:40	16:50	00:10	19:05	19:11	00:06	16:19	16:29	00:10	17:09	17:19			
24/jun			25/jun			26/jun			27/jun			28/jun										
Início	Fim	Duração	Início	Fim	Duração	Início	Fim	Duração	Início	Fim	Duração	Início	Fim	Duração								
00:42	00:52	00:10																				
22:13	22:26	00:13	21:46	22:09	00:23	21:59	22:15	00:16				21:12	21:32	00:20								
23:17	00:33	01:16	10:54	12:00	01:06	15:12	15:25	00:13	01:19	01:33	00:14	08:04	08:55	00:51								
23:05	23:13	00:08	20:50	20:54	00:04																	
22:04	22:12	00:08	22:14	22:23	00:09	20:49	21:06	00:17	22:45	22:54	00:09	12:26	12:37	00:11								
22:00	22:56	00:56																				
23:01	23:11	00:10				22:37	23:57	01:20	21:58	22:25	00:27	10:36	11:22	00:46								
			21:27	21:41	00:14	23:49	00:01	00:12	22:59	23:09	00:10											
22:08	22:27	00:19	22:02	22:28	00:26	23:50	00:02	00:12				23:15	23:23	00:08								
23:16	23:25	00:09	23:32	23:36	00:04	23:29	23:34	00:05	23:26	23:37	00:11	23:20	23:36	00:16								
						00:10	00:12	00:02				00:35	00:41									
21:25	21:39	00:14	20:58	21:14	00:16	20:40	20:50	00:10	18:10	18:20	00:10	08:24	08:34	00:10								
			00:53	01:06	00:13				19:01	19:16	00:15											
17:58	18:10	00:12	22:55	23:04	00:09	23:25	23:37	00:12	17:58	18:10	00:12	22:55	23:04	00:09								
20:09	20:22	00:13	19:52	20:02	00:10	20:36	20:46	00:10	14:12	14:22	00:10	22:43	22:53	00:10								

APPENDIX E. STUDENTS GENERAL SCORES

Effectiveness		Writing		Oral		Tempo		Final - Overall	
Duolingo	Traditional	Duolingo	Traditional	Duolingo	Traditional	Duolingo	Traditional	Duolingo	Traditional
3,14	3,79	5	10	17	20	3,5	4	11,0	15,2
1,73	1,67	7	4	14	13	6,08	4,5	10,5	8,5
2,94	3,22	9	12	21	17	5,1	4,5	15,0	14,5
3,54	3,67	11	8	24	18	4,95	3,5	17,5	12,8
6,32	4,13	6	11	26	32	2,53	5	16,0	21,7
5,64	3,47	8	11	23	31	2,75	6	15,5	20,8
1,56	4,17	7	13	12	37	6,08	6	9,5	25,0
3,38	3,67	9	13	20	31	4	6	14,5	22,0
3,64	3,73	10	9	26	28	4,95	5	18,0	18,7
3,56	2,42	2	2	16	17	2,53	4	9,0	9,7
5,64	4,38	6	11	25	26	2,75	4	15,5	12,2
4,18	2,43	7	7	25	17	3,83	5	16,0	19,3
9,62	3,22	5	7	20	32	1,3	6	12,5	18,8
1,63	3,14	10	7	21	31	9,51	6	15,5	
4,14		6		17		2,78		11,5	
6,99		5		22		1,93		13,5	
3,86		3		15		2,33		9,0	

