CHAPTER 1
INTRODUCTION

The purpose of this chapter is to provide a background to the study, emphasizing the importance of digital shifts in global education with a particular focus on China's English pedagogy. By examining pedagogical paradigms and contemporary challenges, it highlights the importance of vocabulary in language learning, as well as introducing a problem statement in vocabulary learning. An explanation of the rationale behind this research is provided, which details the motivations for this study, as well as giving a clear definition of the research objectives and the specific questions that will guide the research. Following an explanation of the significance of the research, an examination of its academic contributions and potential implications is followed by a discussion of its scope and inherent limitations. For clarity, definitions of key terms used throughout the thesis are provided. A summary of the chapter's main points is provided at the end of the chapter, along with an outline of the subsequent chapters, which provides readers with a clear indication of how the research journey will unfold.

1.1 Background of the study

The significance of vocabulary in the realm of language acquisition is beyond dispute. Harmer's evocative analogy (1990) likens the structure of language to the skeletal framework of the human body, with vocabulary serving as its flesh, organs, and lifeblood. This vivid imagery underscores the pivotal role vocabulary occupies in the tapestry of language learning. This perspective is not isolated; contemporary research consistently emphasizes vocabulary's indispensable role in nurturing linguistic competence, particularly among adult learners (Webb & Nation, 2017; MacWhinney, 2016). For instance, Schmitt (2010) posits that vocabulary is not just a component of language proficiency but is central to both receptive and productive skills. Similarly, Read (2000) emphasizes that vocabulary knowledge is foundational for effective communication. Furthermore, as Laufer and Nation (1999) assert, a robust vocabulary is a linchpin for learners, enabling them to engage in meaningful interactions across various linguistic domains, be it listening, speaking, reading, or writing. The collective insights from these scholars illuminate the intertwined journey of acquiring a language and its vocabulary.

The pivotal role of vocabulary in language acquisition has been a consistent theme in linguistic research. Numerous scholars have underscored the idea that vocabulary is not just an element of language learning but a foundational pillar (Zahar et al., 2001; Schmitt, 2008; Nation, 2013). This sentiment is echoed by Milton (2009), who posits that a robust vocabulary is instrumental in enabling students to navigate the multifaceted terrains of language - be it listening, speaking, reading, or writing. This perspective suggests that the odyssey of acquiring a foreign language is deeply entwined with the journey of vocabulary acquisition.

Nation (2006) further emphasizes that for learners to grasp a language truly, they must amass a considerable vocabulary reservoir. This is not just about knowing words but understanding their nuances, applications, and contexts. However, the English language, with its vast lexicon that is ever-evolving, presents a formidable challenge, especially for learners from non-English speaking backgrounds (Webb & Nation, 2017). The inherent complexities of the English vocabulary, marked by its richness, diversity, and depth, can be overwhelming. Barcroft (2015) highlights that the cognitive load associated with this expansive vocabulary further complicates the learning process. Additionally, Meara (2002) points out that vocabulary acquisition isn't just about quantity but also the quality of words learned, emphasizing the need for depth of knowledge. For learners, this means not only memorizing words but also understanding their semantic, syntactic, and pragmatic dimensions.

In the English-learning context in China, rote learning or mechanical memorization is the dominant strategy adopted for vocabulary acquisition (Wang & Thomas, 2019). This method often results in "fossilized words" - learners can recall word meanings but struggle to apply them in context (Ellis, 2015; Roehr-Brackin & Tellier, 2019). Over my decade-long teaching career, students' recurring struggles with vocabulary learning, commonly attributed to the strategy of "reciting words in the text", have further elucidated the issues associated with rote learning.

Conducting a holistic examination of educational problems like this one requires a multi-level investigation. This process begins with exploring the broader context (macro-level), and then progressively narrows down to specific aspects (micro-level), such as pedagogical strategies, learning difficulties, and sociocultural factors (Wong et al., 2020). To make substantial progress in understanding and improving vocabulary learning, particularly in English language learning within China, we need to scrutinize these varied factors critically. Such an approach will allow us to contribute valuable insights to the literature and cultivate more effective vocabulary learning strategies and pedagogical practices (Nation & Webb, 2011; Webb, 2020).

1.1.1 Digital Shifts in Global Education: China's English Pedagogy

The digital transformation of global education has ushered in a new era of pedagogical strategies, with China at the forefront of this evolution in the context of English language teaching and learning. The rapid proliferation of the Internet has not only reshaped global communication but has also fundamentally altered educational paradigms. According to eMarketer (2021), nearly 4.66 billion individuals, or 59% of the global population, actively engage with the Internet. China's contribution to this statistic is significant, boasting approximately 940 million Internet users, the largest national contingent globally. This digital immersion has precipitated transformative shifts in various domains, from socio-economic dynamics to pedagogical methodologies, necessitating a reevaluation of traditional teaching paradigms (Bosch, 2019; Turner & Wang, 2020).

The catalyst for this educational metamorphosis is the exponential growth in mobile device adoption, complemented by advancements in network technologies, including wireless communication and mobile sensors (Khaddage et al., 2021). Such technological innovations have democratized information access, obliterating temporal and spatial constraints. The indispensability of mobile devices, such as smartphones and tablets, in contemporary lifestyles underscores their potential as pedagogical tools (Sharma et al., 2020; Cheng & Xie, 2019).

In the Chinese educational landscape, the penetration of mobile technology is particularly pronounced. The Statistical Report on Internet Development in China (2023) indicates that, as of December 2022, a staggering 99.8% of Chinese Internet users accessed the web via mobile devices. This digital ascendancy challenges entrenched educational norms, prompting a shift towards more adaptive and flexible learning modalities. Mobile learning, characterized by Crompton (2013) as a confluence of diverse learning contexts facilitated by mobile devices, epitomizes this shift. The Chinese government's endorsement of digital pedagogies, as articulated in the *Thirteenth Five-Year Plan for National Education Development* (2017), underscores the nation's commitment to fostering a digitally-augmented, personalized, and continuous learning ecosystem (Huang et al., 2019; Liu & Zhao, 2021).

The implications of China's digital shift in English pedagogy, set against the backdrop of its status as the world's largest Internet user base, offer a unique perspective on the broader global trends in digital pedagogy. As Chen, Wang, & Zhang (2022) highlight, the integration of technology into the classroom, especially in English language instruction, transcends mere access to resources. It necessitates a profound

pedagogical transformation characterized by a transition from traditional, teacher-centered methods to more student-centric, interactive, and collaborative approaches.

Digital tools, especially mobile devices, are at the forefront of this transformation. They offer a plethora of interactive platforms and applications tailored to individual student needs. Apps leveraging artificial intelligence and adapting content based on student performance exemplify the potential for a more personalized learning experience. However, as Wang, Liu, & Feng (2021) cautioned, the mere presence of technology doesn't guarantee effective learning. Educators must be adept at not only utilizing these tools but also seamlessly integrating them into their teaching strategies.

Yet, challenges loom large. The relentless pace of technological evolution demands that educators perpetually refine their skills and pedagogical approaches. Li & Yang (2020) shed light on another pressing concern: the digital divide. Even in a technologically advanced nation like China, disparities in technology access, often rooted in socio-economic factors, persist.

In synthesizing these insights, it becomes evident that China's journey in digital English pedagogy, while echoing global trends, is punctuated with unique challenges and opportunities. The centrality of digital tools in English language instruction underscores the need for continuous research, adaptation, and innovation in pedagogical strategies, a sentiment echoed by reports from CGTN. (2023).

This digital metamorphosis has been predominantly driven by the surge in mobile device usage, together with advancements in network information technologies such as wireless communication, mobile sensors, and interpersonal communication platforms (Khaddage et al., 2021). These developments have ushered in an era of data proliferation, enabling individuals to send, receive, and exchange an overwhelming amount of information, irrespective of their location and time. The integration of mobile devices, including smartphones and tablets, into people's daily routines has reached a point where these devices are now considered indispensable (Sharma et al., 2020).

China, in particular, demonstrates an impressive mobile device usage rate. As reported in *The 51st Statistical Report on China's Internet Development* (2023), up to December 2022, Chinese mobile phone netizens accounted for 99.8% of all Internet users in the country. The rapidly transforming digital landscape has opened up new avenues for convenience and productivity while simultaneously challenging traditional paradigms of living and learning. This paradigm shift is captured in the emergence and increasing popularity of mobile learning (Crompton et al., 2017).

Mobile learning, as defined by Crompton (2013), encompasses learning processes spanning across various contexts facilitated through mobile electronic devices and social interactions. The potential of mobile learning extends beyond individuals, attracting institutional and governmental attention. In China, the *Thirteenth Five-Year Plan for National Education Development* (2017) posits the integration of digital education as a pathway to education modernization, advocating for an educational system that is nationally distributed, digital, personalized, and lifelong. The plan aspires to cultivate an environment where learning is possible anywhere and anytime, thereby setting the stage for mobile learning to flourish (Huang et al., 2019).

In an era of accelerated knowledge advancement, learning must transcend the confines of formal education. The need to assimilate informal learning within daily routines is more pertinent than ever (Dong & Zhang, 2020). The flexibility, ubiquity, and practicality of mobile learning make it a potent tool to support informal learning. Under the auspices of multidimensional intelligent environments, the integration of time, space, and information into daily learning experiences has become a commonplace occurrence. The rapid pace of knowledge turnover renders traditional forms of formal education inadequate. Supplementing formal education with informal learning via mobile devices and the Internet will enable learners to broaden their knowledge base, hence emphasizing the urgency to foster the development of mobile learning in educational settings.

In conclusion, the rapid progression of information science and technology has significantly contributed to the transformation of learning paradigms. Driven by the Chinese government's educational policies, mobile learning is poised to become an essential mode of education in China, thereby signifying the need for a digital transformation in English language learning and teaching in the Chinese context.

1.1.2 Evolution of English Education in China: Pedagogical Paradigms and Contemporary Challenges

Since the initiation of the Economic Reform and Opening-Up policy in 1978, China has embarked on a trajectory of swift socio-economic progress. This transformation has also permeated the education sector, with English emerging as an indispensable subject in China's curriculum, especially at the tertiary level. This emphasis on English is attributed to its pivotal role in global communication and collaboration (Wang, 2021). Additionally, the tertiary education system in China has also experienced rapid development. A study by Wang & Cheng (2019) underscores the rapid expansion of higher education in China, revealing that nearly 53% of Chinese tertiary institutions underwent significant infrastructural development between 1999

and 2015. This expansion has consequently led to a surge in student enrollments. Accordingly, both the number and the size of classes have grown in universities. In such conditions, the teachers are faced with the challenge of dealing with a class with a large number of students, without putting any effort into understanding each student individually. The result is that teaching and learning outcomes are usually not satisfying.

The predominance of test-centric pedagogy in China has entrenched the grammar-translation method as the primary approach to English instruction, often at the expense of communicative competence (Liu 2016). By focusing on students' grammar knowledge, this approach increases their chances of achieving satisfactory results in exams. Yet, it does not provide them with the tools they need to communicate effectively in the language. From the lens of the students, the emphasis often gravitates towards memorizing relevant English rules, leading to a growing reliance on "rote learning" in English pedagogy, characterized by passive memorization. This trend aligns with observations by Lei & Liu (2018), who noted the prevalence of such learning habits in English classrooms across China. Furthermore, as Furthermore, contemporary cohorts of college students exhibit distinct characteristics in their learning preferences and knowledge acquisition patterns, as highlighted by Zhang and Wang (2019). For example, the information they receive tends to be fragmented, and they prefer personalized and interesting learning techniques.

In a nutshell, the oversized class, the dominant grammar-translation approach, and the "rote learning" habits clash with students' demands for new learning continuums with individualized learning styles, which poses a challenge to the English education system in China.

1.1.3 The Importance of Vocabulary in Language Learning

It has been mentioned above that the predominant use of grammar-translation in China blinds the importance of other parts of the English language except for grammar. As one of the most fundamental parts of a language, vocabulary serves as the cornerstone for other "structures" such as listening, speaking, reading, etc.

A solid grasp of vocabulary, both in terms of size and depth, is a prerequisite for successful language learning. Vocabulary size pertains to the number of words a person knows. For instance, Laufer & Nation (1995) suggest that to comprehend general reading materials like newspapers, a knowledge of around 3,000 to 4,000 word families is essential. However, merely having a broad vocabulary size isn't enough. Vocabulary depth, as emphasized by Schmitt (1998), alludes to understanding words beyond mere recognition, incorporating the various meanings, uses, and nuances associated with

each word. Hence, while vocabulary size provides the tools for initial comprehension, depth ensures nuanced understanding and meaningful communication.

When students are learning a language, they should be able to comprehend what they are hearing and reading. Krashen (1982) discusses the requirement that the input must be comprehensible and meaningful to learners in order to contribute to their acquisition of language. If learners have a limited vocabulary size or lack depth in their vocabulary understanding, they might not fully grasp the content they encounter. Such nuances become especially important when the text or speech has multiple layers of meaning, idiomatic expressions, or cultural connotations.

The importance of vocabulary for EFL learners, both in terms of its breadth and depth, has also been emphasized by Zimmerman (1997), who points out that vocabulary is a key component of language. There has been increasing recognition of the importance of a comprehensive approach to vocabulary knowledge in foreign language acquisition, as Rodriguez & Sadoski (2000) point out. Due to these factors, mastering vocabulary, both in size and depth, is an integral element of EFL learning and is something that requires lifelong development.

1.1.4 The Problem Statement in Vocabulary Learning

The acquisition of English vocabulary remains a formidable challenge for learners of the language, transcending mere rote memorization to encompass a deeper understanding of cultural nuances and appropriate language usage as well (Wang & Spencer, 2016). Various studies have been conducted demonstrating that conventional ways of teaching have suppressed both critical thinking and student engagement, two attributes that are essential for effective language acquisition (Hirvela, 2016; Zhang, 2018). This can result in students being unmotivated, which can lead to them over-relying on teacher-led instruction, which impedes self-directed learning, which is detrimental to student success (Gu, 2010).

Recent studies have demonstrated that emerging digital tools, particularly game-based vocabulary apps, have the potential to enhance vocabulary learning, motivation, and self-confidence among Chinese EFL students (Liu & Li, 2018). However, there is still a debate about whether they are effective in ensuring a holistic understanding of both receptive and productive vocabulary (Zou, 2019).

There are a few challenges that have been magnified in the recent COVID-19 pandemic. With the sudden switch to online instruction and the adoption of platforms like WeChat for the purposes of learning English vocabulary, a few new obstacles have arisen. The effectiveness of WeChat in boosting lexical proficiency during the pandemic has been scrutinized, but some studies report a diminution in

vocabulary test scores among students who have been using WeChat-supported lexical programs because of the pandemic (Yang & Wang, 2020).

There are distinct challenges Chinese learners face when it comes to learning English, which often stem from a lack of genuine English resources and a lack of real-world English experiences (Wang & Spencer, 2016). Due to their limited vocabulary, non-English majors are often unable to participate in immersive language experiences and this can hinder their progression linguistically and professionally as a result. There is no doubt that mastering words is a complex process, requiring the acquisition of numerous facets of each word that means that the complexity of vocabulary mastery is often underestimated, posing a significant barrier to learning languages (Gu, 2010; Zhang, 2018).

As a matter of fact, while vocabulary learning strategies have long been recognized as a powerful tool for acquiring new vocabulary, a significant portion of Chinese students remain unaware of these strategies, or they underutilize them, often relying on mere memorization (Gu & Johnson, 1996). Clearly, innovative teaching approaches that are tailored to the unique needs of Chinese English as a Foreign Language learners are needed.

In this regard, Seamless Mobile-Assisted Vocabulary Learning Environment (SMAVLE) can be considered as a possible solution to the problem of vocabulary learning in the context of mobile devices. In response to the specific challenges faced by Chinese EFL learners, SMAVLE has developed an integrated platform that combines the advantages of digital tools with pedagogical best practices to address the specific needs of Chinese EFL learners. It is possible that educators can bridge the gap between traditional and digital education by leveraging the capabilities of SMAVLE to offer students a more engaging, effective, and personalized vocabulary learning experience by leveraging the capabilities of the technology.

Therefore, it can be said that despite technological advancements providing novel opportunities for vocabulary learning, they also bring new challenges with them as well. With the advent of swift technological shifts and the upheavals in the global economy, the pathway of learning English vocabulary for Chinese students might seem daunting, considering the complexity. In the Chinese milieu, there is a pronounced gap in the number of effective, innovative solutions available for vocabulary learning, which illustrates that more research and intervention are urgently needed to fill the gap.

Due to this unusual background, the exploration and integration of SMAVLE becomes a priority because of the importance of seamless mobile-assisted vocabulary

learning. In addition to being a technological implementation, SMAVLE serves as a pedagogical innovation, providing a tailored solution to the specific challenges faced by Chinese EFL learners regarding their learning process. It incorporates both a dynamic and interactive approach to vocabulary learning, leveraging the ubiquity and versatility of mobile technology to create a highly user-friendly experience. By providing a seamless and engaging learning experience, SMAVLE seeks to transcend the limitations of traditional methods, such as rote memorization, for Chinese learners. This environment may foster a more natural integration of vocabulary into learners' linguistic repertoire, promoting deeper cognitive engagement. By situating SMAVLE in this strategic position in the text, a solid foundation may be laid for discussing the rationale of the study, which is deeply intertwined with the need for a digitally-enhanced, student-centric vocabulary learning approach.

1.2 Rationale of the Study

This research focuses on seamless mobile-assisted English vocabulary learning for several compelling reasons, underscored by both theoretical underpinnings and practical exigencies in contemporary English language learning, particularly within the Chinese context.

Firstly, in the digital age, traditional teaching methodologies are under threat from the challenges posed by the digital age. With the integration of technology, especially SMAVLE, English language instruction can now be viewed as more dynamic and interactive thanks to the use of technology. A key aspect of SMAVLE's design is that it is aligned with the pedagogical shift from teacher-centered approaches to student-centric, interactive, and collaborative ones, making it a pivotal tool for this shift (Li & Hafner, 2021).

Secondly, Today's learners are 'digital natives', inherently comfortable with technology, which makes them ideally suited to the use of technology in the classroom (Prensky, 2001). Due to the mobile-assisted nature of SMAVLE, it fits perfectly with their digital inclinations, offering them a familiar and intuitive environment for learning vocabulary in a familiar and intuitive way (Liu, Huang, & Wang, 2023).

Thirdly, the Pedagogical Mandate for Vocabulary Acquisition describes the process of vocabulary acquisition beyond mere memorization of words. It involves understanding and applying them. As a result of its unique design, SMAVLE promotes continuous and diverse exposure to new vocabulary, promoting deeper understanding and long-term retention of words (Nation, 2000).

Fourthly, as the 21st Century unfolds, we need to adapt to a new era of learning that emphasizes continuous, lifelong learning and that needs platforms that support 'seamless learning'. There is a growing need to bridge the gap between formal classroom settings and real-world application settings to make learning more relevant and contextual (Xiao Jing & Wang Jing, 2019).

Fifthly, it is clear that mobile-assisted language learning is gaining popularity, yet there is very little research done on environment like SMAVLE that are tailored specifically to vocabulary learning in the Chinese context. The purpose of this study is to fill this gap, providing insight into the effectiveness of such an environment, in order to fill the knowledge gap (Q. Wu, 2015).

Sixthly, in order to understand the potential of SMAVLE to enhance vocabulary learning outcomes, we have developed a set of research questions that are rooted in understanding this potential. Due to the innovative approach of the platform, it is important to explore its impact, challenges, and benefits as they relate to English language learning in China in terms of its disruptive impact.

Lastly, SMAVLE aims to represent a paradigm shift in vocabulary learning paradigms in this study, which is centered around SMAVLE. Aiming to revolutionize foreign language teaching and learning by making use of the environment 's capabilities, this study aims to offer practical strategies which can be used to revolutionize foreign language teaching and learning by making it more engaging, effective, and engaging.

In conclusion, this research is driven by a desire to understand how the combination of technological advancements and innovative pedagogical practices can transform vocabulary learning, with the hope of offering relevant solutions to the existing challenges in this field.

1.3 Research Objectives

The main aim of this research is to investigate the effects of a self-constructed seamless mobile-assisted language learning environment on Chinese first-year college EFL learners' vocabulary learning outcomes. In addition, this thesis also focuses on the factors embedded in the SMAVLE which may contribute to vocabulary learning as well as Chinese first-year college EFL learners' perception towards the SMAVLE. To address these aims, the specific objectives of this research are:

1 To investigate the effects of Seamless Mobile-Assisted Vocabulary Learning Environment (SMAVLE) on Chinese college students' English vocabulary learning.

2 To compare Chinese college students' English vocabulary learning in SMAVLE with the vocabulary with Seamed Learning.

3 To identify the features facilitating Chinese college students' English vocabulary learning in SMAVLE.

4 To explore Chinese college students' perception towards SMAVLE to enhance English vocabulary learning.

1.4 Research Questions

To address the objectives previously mentioned, an attempt will be made to answer the following research questions:

1. What are the effects of Seamless Mobile-Assisted Vocabulary Learning Environment (SMAVLE) on Chinese college students' English vocabulary learning?
2. What are the differences in vocabulary learning of Chinese college students using SMAVLE compared with those using Seamed Learning?
3. What features of SMAVLE contribute significantly to facilitating Chinese college students' English vocabulary learning?
4. What are Chinese college students' perceptions toward the SMAVLE to enhance English vocabulary learning?

1.5 Significance of the Study

The significance of this research is multifaceted, contributing a fresh perspective to the domain of language teaching and learning, specifically in the realm of vocabulary learning mediated by mobile-assisted technology under the conceptual umbrella of seamless learning.

Firstly, innovation in language teaching and learning: This research adds a novel dimension to the pedagogical approach to vocabulary learning. By introducing a self-constructed learning environment, it spearheads innovation in language teaching and learning, aligning with the assertions of Underwood (2022) that innovative practices can significantly enhance learning outcomes.

Secondly, practical implications for language learning: This study has significant practical implications, proposing a comprehensive learning environment for vocabulary instruction. Mobile-assisted language learning harnesses the multifarious characteristics of mobile technology, providing a rich context for vocabulary learning (Stockwell, 2023). This context enables authentic, natural, and diverse exposure to a target

language, supporting the development and expansion of vocabulary. It thus produces significant and practical relevance for foreign language vocabulary learning.

Thirdly, addressing pedagogical challenges: This study contributes valuable insights to improve current vocabulary teaching and learning practices. While there is a substantial body of research investigating vocabulary learning (Guasch, Boada, Lisón, & Kostić, 2023), the outcomes for Chinese college students remain less than ideal, suggesting a bottleneck in the development of English proficiency. This research aims to provide pedagogical value by exploring the students' vocabulary learning process and proposing effective solutions to these challenges.

Fourthly, bridging formal and informal learning environments: Many studies have examined the use of mobile devices for learning in either formal or informal contexts, but there is limited research investigating how these two environments intersect (Kukulska-Hulme, 2023). This study, therefore, fills a gap in the literature by examining the integration of these learning environments in the context of Seamless Mobile-Assisted Vocabulary Learning (SMAVL).

Fifthly, contributing to the literature on Seamless Learning and MALL: While Seamless Learning and Mobile-Assisted Language Learning (MALL) have been well-studied, research specifically related to SMAVL remains scarce (Rosell-Aguilar, 2023). This research contributes to the existing body of literature by expanding and enhancing our understanding of SMAVL.

Sixthly, reimagining vocabulary learning: Acquiring a word entails understanding its form, meaning, and usage, a process that encompasses a multitude of elements such as its sound, form, root, affixes, meanings, grammatical functions, habitual collocations, contexts, and frequency of use (Nation, 2001). Learning vocabulary, particularly in non-English environments, is complicated by the vast size of the English lexicon, the discrete nature of vocabulary, and the high cognitive demands of vocabulary learning. By exploring vocabulary learning through mobile-assisted technology, this study introduces a fresh approach to overcoming these challenges.

Seventhly, Emphasizing Personalization and Mobility: Seamless Learning environments embody two key attributes of mobile learning: personalization and mobility. Personalization refers to student-centered approaches that prioritize holistic learning, encompassing cognitive and affective elements and individual and group processes (Lombardi, 2007). These approaches underscore the importance of authentic, complex tasks for meaningful and relevant learning experiences (Elen et al., 2007). This study contributes to our understanding of how personalization and mobility can enhance vocabulary learning.

Eighthly, Empowering Educators with SMAVLE: The teachers themselves are the heart of any educational program. In addition to highlighting the potential of SMAVLE for students, this research also demonstrates its importance for teachers. In terms of pedagogy, this research may provide educators with the knowledge and tools needed to design their own Seamless Mobile-Assisted Vocabulary Learning Environments tailored to the unique learning needs of their students. Understanding the intricacies of SMAVLE will enable teachers to design dynamic, interactive, and effective vocabulary learning experiences. It is through this proactive approach that educators are not just passive recipients of technological advancements, but rather active innovators leveraging technology to enhance vocabulary instruction. Thus, this research empowers educators to guide their students in a digital age towards enriched vocabulary knowledge.

The scope and depth of this research may significantly enhance the current understanding of Seamless Mobile-Assisted Vocabulary Learning Environment and provide practical and theoretical insights that could be instrumental in informing future research and instructional practices.

1.6 Scope and Limitations of the Study

There are significant insights provided by the present study into the potential of the Seamless Mobile-Assisted Vocabulary Learning Environment (SMAVLE) for improving English vocabulary acquisition among Chinese college students through the integration of seamless mobile applications. For a holistic understanding of the findings, however, it is crucial to recognize and address certain limitations related to student participants in order to ensure a comprehensive understanding of the results.

It is worth mentioning that in the first place, the sampling population of the study was mostly made up of first-year students from the Xi'an Shiyou University. While this specific demographic can provide valuable data, it is inherently lacking in diversity when it comes to linguistic backgrounds, prior exposure to English, and learning experiences as well as linguistic background. There may be a danger that a narrow demographic focus may not capture the full spectrum of challenges and benefits experienced by a broader range of students. To ensure a more comprehensive understanding of SMAVLE's impact, future research would greatly benefit from including participants from different academic years, different institutions, or even different regions within China in order to ensure a more comprehensive study of its impact.

Secondly, even though the research design was meticulous, there was a possibility that certain uncontrollable student-centric factors might have impacted the outcomes of the research. Some factors can be considered in this regard, including individual learning styles, intrinsic and extrinsic motivations, cognitive abilities, prior exposure to English outside of the classroom, and personal experiences with technology-assisted learning. These individual variations might introduce biases that might skew the results of the research without a randomized or normalized sample. The findings from this study need to be interpreted with caution, especially when extrapolating them to a broader group of English as a foreign language (EFL) learners.

As a final point, the study lasted for 12 weeks in total. While this provided a snapshot of the effectiveness of SMAVLE, it is important to note that language acquisition, especially among students of diverse backgrounds, is a long-term process. The results of a more extended study may provide insights into the sustainability of learning improvements, as well as how these improvements manifest differently among students with diverse backgrounds and learning pathways.

Despite these limitations, this study provides a solid foundation for further research and exploration into the advantages of SMAVLE to improve English vocabulary learning in the classroom. The digital era offers numerous opportunities for language acquisition and more research must be done in this area. To ensure that Chinese college students can reap the full benefits of technological advancements in education, it is essential to adapt teaching models to meet the diverse and evolving needs of those students.

1.7 Definitions of Key Terms

Chinese college students: Refers to first-year, non-English major students enrolled in Chinese colleges or universities. These students typically have approximately 8-9 years of English education and have reached an intermediate level of English proficiency (Zhan, Wang, & Huang, 2022).

Perception: Refers to the process of interpreting sensory data to understand and react to the environment. In this study, students' perceptions provide insights into their interpretations and experiences of the learning environment (Schacter, Gilbert, & Wegner, 2011).

Seamed Learning: Seamed Learning can be conceptualized as a learning approach where the acquisition process is divided into distinct, separate episodes or phases. These episodes are not continuous but are instead separated by gaps or 'seams' that delineate one phase of learning from another (Wong & Looi, 2019). This

fragmented approach contrasts with seamless learning, where the learning process is continuous and integrated. In the context of our study, Seamed Learning specifically refers to the traditional vocabulary learning process. This traditional method often bifurcates the process of vocabulary acquisition into two primary stages: firstly, the stage of understanding or 'knowing' a word, and secondly, the stage of application or 'using' the word in appropriate contexts. Such a division can sometimes lead to a lack of fluidity in the learning process, as learners might master the understanding of a word but struggle with its practical application, or vice versa.

SMAVLE: Seamless Mobile-Assisted Vocabulary Learning Environment (SMAVLE) is a novel learning environment that was conceptualized and developed by a researcher and his supervisor. This learning environment is based on the principles of seamless learning, which provides a continuous and integrated learning experience, and mobile-assisted language learning, which takes advantage of the capabilities of mobile devices to facilitate language acquisition, particularly vocabulary learning. SMAVLE aims to harness students' fragmented time in a way that allows them to engage in short bursts of learning during their daily lives. By connecting formal and informal learning environments, SMAVLE acts as a bridge. As a result of its seamless integration of the virtual and real worlds, it enables students to use the vocabulary that they have learned in real-life contexts alongside their virtual learning. In essence, SMAVLE isn't just a tool for acquiring vocabulary; it's an ecosystem for motivating students to use the knowledge they have acquired in their daily interactions, and making sure that they apply what they have learned to their everyday lives and daily interactions with others.

Vocabulary Knowledge: Encompasses understanding of a word’s syntax, collocation, usage frequency, compatibility, meaning, concept, and relationships with other words (Schmitt, 2014).

Vocabulary Learning: As defined in this study, is the process by which intermediate-level language learners master targeted words, particularly in terms of their usage (Laufer & Rozovski-Roitblat, 2011).

Vocabulary Size: Refers to the total number of words a learner knows, encompassing both words that they recognize and can use. This is often used as an indicator of a learner's lexical proficiency and breadth of lexical knowledge (Nation, 2006).

These definitions are based on the context of this research and are corroborated by contemporary literature in the field. Each term carries nuanced meanings specific to the discipline of language learning and teaching, and their understanding is vital for

comprehending the dynamics of the Seamless Mobile-Assisted Vocabulary Learning environment.

1.8 Summary

An overview of the research is presented in this introductory chapter, which prepares the reader for a more detailed analysis in subsequent chapters. As a starting point, the researcher painted a vivid picture of the background, highlighting the prevailing conditions and circumstances that inspired this study. After this, a detailed rationale was presented, emphasizing the relevance and timeliness of the research.

The research objectives were then articulated, providing a clear direction and purpose for the study. The proposed research questions are designed to address the core objectives and guide the investigation process in order to further clarify these aims.

There is a significant amount of space in the chapter devoted to explaining the significance of the study. The potential contributions of the study to the academic community, educators, and learners were emphasized, emphasizing its potential impact and the gaps it seeks to fill in the existing literature.

Having recognized the importance of transparency, the researcher outlined the scope of his or her research, outlining its boundaries and the specific areas it addresses. Additionally, the limitations of the research were acknowledged, ensuring that readers are aware of any potential biases that may have affected the findings.

This thesis outline was provided to aid in the understanding and clarity of the thesis. This roadmap offers readers a glimpse of the journey ahead, detailing the structure and flow of the upcoming chapters. In addition, key terms used throughout the research have been meticulously defined in order to ensure a shared understanding and avoid any ambiguities.

1.9 Outline of the Thesis

This dissertation is structured into the following six chapters:

Chapter 1 (Introduction): The current chapter started with a discussion of the prerequisite condition and necessity of applying mobile-assisted language learning in the Chinese university environment. In addition, the research questions were posed, the research aims and research questions were stated, and the significance and contribution of the study, as well as its scope and limitations, were discussed.

Chapter 2 (Literature Review): The second chapter embarked on a comprehensive exploration of the multifaceted realm of Mobile-Assisted Language Learning (MALL)

and its intersection with vocabulary acquisition in the context of second language learning. The chapter meticulously delineated the historical and theoretical underpinnings of MALL, emphasizing its evolution, salient features, and the pressing need for seamless integration. Vocabulary learning, as a cornerstone of language acquisition, was examined in depth, shedding light on its nuances, challenges, and gaps in traditional methodologies. The synergy between MALL and vocabulary learning was elucidated, leading to the conceptualization of the Seamless Mobile-Assisted Vocabulary Learning Environment (SMAVLE). The SMAVLE was presented as an innovative approach, deeply rooted in diverse theoretical bases, and its potential implications and challenges were discussed. The chapter culminated by presenting a holistic conceptual framework for SMAVLE, setting the stage for its practical application in subsequent chapters.

Chapter 3 (Research Design and Methodology): The focus of the third chapter is on designing the experiment and describing the research population and sample groups, explaining the selected quantitative and qualitative methods for data collection and analysis, and discussing the ethical matters which were involved in the current study.

Chapter 4 (Data analysis) This chapter depicts how the quantitative data and qualitative data collected will be analyzed, respectively.

Chapter 5 (Discussion, Concluding Remarks and Recommendations): In this last chapter of the dissertation, a short general summary of the dissertation is provided regarding the study's aims, objectives, and research questions. Furthermore, the success of this design research as a SMAVLE is discussed, and practical suggestions are made regarding the integration of Mobile-assisted language learning and L2/FL pedagogy. Finally, the strengths and limitations of the study are discussed, and recommendations are made for future research.

Chapter 6 (conclusion): this chapter concludes the thesis by concluding the findings and providing the contributions of the research, the study limitations, and recommendations for future research.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

The acquisition of second languages (L2) has long been a focal point of linguistic research. Vocabulary is viewed as an integral part of this vast and diverse field, underpinning several different aspects of language comprehension, expression, and fluency. It should be noted that vocabulary acquisition is more than merely a process of rote memorization. An essential component of it is the complex interplay between cognitive processes, pedagogical strategies, sociocultural influences, and, more recently, technological developments. In particular, this latter innovation has been a catalyst for a transformative era in language education, marking the convergence of linguistic pedagogy and digital technology. MALL, an emerging paradigm in this confluence, offers a promising method for enhancing vocabulary acquisition through mobile devices. The proliferation of mobile devices and the ubiquitous nature of digital connectivity have allowed MALL to redefine traditional classroom practices, offering learners an immersive, interactive, and personalized learning experience. Nevertheless, as with any new field, MALL comes with challenges. However, while it has opened up an unprecedented number of opportunities, it has also posed a number of pedagogical challenges, technological challenges, and implementation dilemmas.

This chapter is dedicated to a thorough examination of the literature surrounding MALL, focusing primarily on its implications for vocabulary learning. This journey encompasses multiple aspects: it examines the historical and theoretical evolution of MALL, evaluates its pedagogical benefits and limitations, and identifies existing gaps that need to be filled by research and innovation. A vital component of this exploration is the conceptualization of a Seamless Mobile-Assisted Vocabulary Learning Environment (SMAVLE). The proposed paradigm aims to address the existing challenges in MALL and catalyze a paradigm shift in L2 vocabulary acquisition. The significance of this literature review is manifold. Beyond its academic contributions, it aims to inform pedagogical practices, influence technological developments in language education, and shape policy decisions regarding L2 curricula. Due to the increasing global interconnectedness, and the increasing demand for multilingual competence, language education is becoming increasingly imperative. A Seamless Mobile-Assisted Vocabulary

Learning Environment, which has been conceptualized and explored in this study, offers the promise of bridging pedagogical rigor and technological innovation in this endeavor. In the following sections, we will traverse this intricate landscape, critically examining the intersections of MALL, vocabulary learning, and the SMAVLE. This will set the stage for a deeper empirical investigation into the potential and challenges of this proposed paradigm.

2.2 Mobile-Assisted Language Learning (MALL): A Historical and Theoretical Overview

The advent of mobile learning (m-learning) has permeated various domains of education. However, its broad concept may not be wholly encompassed within the scope of this thesis. Thus, the focus will be on the thesis' central theme-language learning. This leads to the emergence of a new research field known as Mobile-Assisted Language Learning (MALL), a specialized area where language learning is facilitated or augmented by mobile technology. Definitions of MALL vary among different scholars, each highlighting unique elements.

2.2.1 Definitions of MALL

Kukulska-Hulme (2013) succinctly defines MALL as the "use of mobile technologies in language learning, especially in situations where device portability offers specific advantages." This definition underscores that MALL isn't just a medium for delivering content but a platform that offers unique benefits in specific contexts. In echoes of this sentiment, Duman, Orhon, & Gedik (2014) place MALL within the broader domain of mobile learning, emphasizing the use of personal and portable devices for the purpose of language learning.

In a slightly different view, Chen (2013) sees MALL as a combination of formal and informal processes of learning a foreign language with the assistance of mobile devices. "M-learning" is defined in this context as the use of a variety of theories and approaches in the teaching and learning process, while MALL focuses specifically on the use of devices such as tablets, mobile phones, and portable multimedia players to teach and learn languages.

As a further enrichment to the discussion, Hazaea and Alzubi (2016) comment on how MALL may be used to address challenges in mobile implementation for language acquisition. Their definition of MALL is: "a subset of mobile learning (m-learning), which integrates mobile tools and applications to enhance language learning both in the classroom and outside of it." MALL's focus has shifted from being

predominantly technology-centered to fostering a new learning culture, as expressed by Cacchione, Procter-Legg, Petersen, and Winter (2015).

A synthesis of these definitions reveals that, while MALL falls within the larger framework of mobile learning, it has a distinct focus. By contrast with the broader domain of m-learning, MALL focuses specifically on language learning using mobile technology. Recent research has further highlighted this specificity. As an example, Stockwell & Hubbard (2020) examine how MALL can provide personalized language learning experiences, enhancing learners' engagement and motivation. Kukulska-Hulme, Norris & Donohue (2021) also discuss MALL's profound impact on informal and lifelong learning, suggesting its broad potential across diverse educational environments.

2.2.2 Origins and Development of MALL

With the rapid development of mobile technology, the field of education has undergone a revolution, particularly in the field of language learning. MALL (Mobile Assisted Language Learning) is one of the products of this change and has become a hot topic in current educational research.

MALL emerged at the beginning of the 21st century as a result of the popularity of mobile devices. The advent of smartphones and PDAs during this period enabled learners to access education anywhere and anytime. One of the first scholars to explore the concept of mobile learning, Vavoula and Sharples (2009), has highlighted how mobile devices can be used in both formal and informal learning settings. The definition of m-learning offered by Traxler (2007) emphasizes the unique advantages that mobile technology brings to language learning in specific contexts, while Kukulska-Hulme (2013) highlights the opportunities offered by m-learning. Duman, Orhon, and Gedik (2014) share this view and see MALL as a specialization within mobile learning.

The main applications of MALL in the early stages were simple vocabulary cards and grammar exercises. However, as mobile technology advances and educational methodologies change, MALL has become increasingly effective. Pegrum (2014) describes how mobile devices can be used to provide a more authentic language learning environment by utilizing the camera and microphone. Meanwhile, with the increase in computing power of mobile devices, more sophisticated applications, such as simulation and augmented reality, are being made available on MALL. Applications related to MALL become more sophisticated with technology advancement, such as the development of more powerful processors, increased storage space, and higher screen resolutions. With these technological advancements,

MALLs are now able to support a more diverse range of applications and content, which allows them to support more complex applications. As an example, learners can now experience a more immersive and realistic learning experience using high-definition video streaming and 3D graphics on mobile devices.

Over the past few years, MALL has evolved into a comprehensive platform integrating numerous resources and tools, as opposed to a single application. According to Kukulska-Hulme (2016), current MALL research increasingly focuses on integrating various mobile resources to facilitate multimodal learning among learners. In addition, with the introduction of 5G technologies, real-time distance language learning and collaboration will be possible. As Godwin-Jones (2017) emphasizes, MALL incorporates both virtual reality and augmented reality technologies, which provide learners with an enhanced learning environment.

Increasingly integrated AI and machine learning technologies will enable MALLs to provide a more personalized and adaptive learning experience. According to Chen et al. (2019), machine learning algorithms can be used to provide learners with personalized learning content. As IT technology develops, future MALLs may be smarter and able to provide more appropriate learning content based on learners' actual environment and needs.

Finally, it should be noted that the origin and development of MALL are closely related to the advancement of mobile technology. Throughout its evolution, MALL has provided language learners with flexible, interactive and personalized learning environments. In the future, s technology continues to develop, we have reason to believe that MALL will continue to bring new innovations and changes to the language learning field.

2.2.3 Key Features and Advancements in MALL

As mobile technology has evolved rapidly, it has not only transformed the way we communicate, but has also impacted the educational landscape in a significant way. Assisted Language Learning (MALL) is one of the frontrunners of this transformation. It is a mobile language learning system that consists of a variety of features and advancements that cater to the needs of a modern learner. A major aim of this section is to give an elucidation of the key features and advancements that have been characterized by the growth and development of MALL during its past decades.

Key Features in MALL

(1) Ubiquity: One of the most defining features of MALL is its ubiquitous nature. The ubiquity of mobile devices in the modern era has revolutionized the way

we approach language learning. This omnipresence of mobile technology has made language learning more accessible, breaking the barriers of traditional classroom settings and allowing learners to engage in language activities in diverse environments.

There is evidence that MALL interventions can successfully enhance accuracy of spoken English, as found in a study by Phetsut & Waemusa (2022), which emphasizes the advantages of MALL interventions due to its widespread availability. In the research they conducted, it was established that the portability of mobile devices makes it possible for students to engage in new learning styles and pedagogies, making learning more personal and mobile. In addition to this, Honarzad (2019) discusses the merits and demerits of mobile devices for the learning of languages and supports this view by presenting some examples. According to Honarzad, the ubiquitous nature and portability of mobile technology have opened up new horizons for language learning and teaching as a result of the increasing accessibility of technology. Moreover, a study conducted in Indonesia by Nara Sari and Teguh Sulistyo (2022) explored the perspectives of vocational EFL teachers on MALL resource development in vocational schools. The study indicates that teachers recognized that MALL materials could be used both inside and outside the classroom due to students' proximity to technology and mobile devices. This highlights the ubiquitous nature of MALL materials.

In essence, the ubiquity of MALL enables learners to be able to learn anytime and anywhere, allowing them to make language acquisition a permanent and integrated part of their daily lives, becoming a continuous and seamless process.

(2) Interactivity: Mobile devices today are equipped with a variety of sensors and input methods, including touchscreens and voice recognition. With the help of these features, MALL has been able to create highly interactive language learning applications and platforms. Learning languages can be made more engaging and immersive by engaging students in interactive exercises, simulations, and even augmented reality experiences. Effective language learning is driven by interactivity, and the integration of mobile technology into this domain has enhanced the interactive potential of pedagogical methods. MALL platforms use the interactive capabilities of mobile devices to provide students with engaging and dynamic language learning experiences. Using touchscreens, voice recognition, and other sensors, modern mobile devices offer an array of interactive possibilities. MALL has effectively and efficiently incorporated these features into applications, platforms, and simulations that provide hands-on, interactive exercises.

According to Burston (2015), in his comprehensive review of MALL over the past two decades, interactivity has become an increasingly prominent characteristic of

mobile language learning platforms. As the level of interactivity in MALL has evolved from basic multiple-choice quizzes to sophisticated augmented reality-based language tasks, the level of engagement has also increased significantly. According to Burston, enhanced interactivity has been instrumental in making language learning more immersive and relevant to the context. Also, Kukulska-Hulme et al. (2017) examined the role of interactivity in mobile language learning. In the study, the researchers discovered that interactive mobile apps enhance learners' motivation and engagement, resulting in improved language acquisition outcomes. Throughout the study, it was noted the importance of designing MALL applications that are both content-rich and highly interactive to meet the varying needs of learners. Another noteworthy contribution is from Godwin-Jones (2018), who discusses emerging technologies in language learning. He emphasized the role of augmented reality (AR) and virtual reality (VR) in enhancing the interactivity of MALL platforms. By integrating AR and VR, MALL applications can provide learners with real-world simulations, allowing them to practice language skills in contextually rich and interactive environments.

In conclusion, the interactivity inherent in MALL platforms, as supported by the literature, plays a pivotal role in enhancing language learning outcomes. By providing learners with dynamic, hands-on experiences, MALL ensures that language acquisition is not just a cognitive exercise but an engaging and immersive journey.

(3) Personalization The importance of personalization in MALL has been consistently emphasized in numerous studies over the past few years. It is through this feature that learners are able to receive content tailored to their specific needs, preferences, and proficiency levels. Due to its adaptive nature, MALL facilitates a more targeted and efficient learning process through the use of sophisticated algorithms and technology.

Personalization in MALL refers to the ability to adapt the content and strategies of the learning process according to the learning profile of each individual. The concept of adaptive learning was described early on by Traxler (2007), who emphasized mobile learning’s ability to provide personalized instruction based on learners’ preferences and needs. The system not only caters to the needs of individual learners, but also leverages emerging technology.

Based on this, Kukulska-Hulme (2013) explored how MALL platforms can be enhanced by leveraging technologies like artificial intelligence (AI), eye-tracking, and physiological measurements to enhance their personalization and effectiveness. Additionally, the medium of instruction plays a significant role in personalization. In their study, Bhagyalakshmi, Manimaran, & Muthupandian (2021) highlighted the impact

of medium of instruction on student performance when content is delivered in English using traditional e-learning methods. In their study, the authors emphasized the need for personalized e-learning content based on the individual capabilities of students.

Covid-19, a recent pandemic, has further emphasized the importance of personalization in MALL. Nuraeni (2021) found that most teachers had a positive perception of MALL as a resource for supporting classroom activities, particularly during a time of pandemic. In addition, Thirumangai Rajendran & Yunus (2021) documented how MALL facilitates personalized language learning while ensuring the engagement of learners. It was revealed in their systematic review that there has been a shift from technology-centered views towards promoting a new culture of thinking and learning in MALL environments.

It can be concluded that the emphasis on personalization in MALL, as derived from a wealth of research spanning over decades, is not only a feature but a must-have. It is essential that MALL platforms ensure that content is delivered in a manner that is both relevant and engaging, since learners have a range of backgrounds, proficiency levels, and learning styles. Through the integration of advanced technologies and adaptive algorithms, MALL ensures that it remains at the forefront of modern language learning, providing learners with a tailored and efficient learning experience.

(4) Multimodal Learning In educational research, multimodal learning refers to the integration of multiple modes of communication and sensory channels in order to enhance the learning experience. In the context of MALL, this translates to leveraging mobile devices' multimedia capabilities to offer learners a comprehensive and enriched language learning experience.

The emergence of multimedia mobile devices in the early 2000s led to the development of multimodal learning opportunities. Sharples, Taylor, & Vavoula (2005) were among the first to recognize the potential for using such devices to facilitate a multimodal approach to learning. A combination of text, audio, and video in mobile learning environments may be able to cater to diverse learning styles, thereby enhancing comprehension and retention. This understanding formed the basis of Kukulska-Hulme & Shield (2008)'s exploration of the pedagogical implications of multimodal learning as it relates to MALL. According to their research, a holistic language learning experience should incorporate text, audio, video, and augmented or virtual reality. They argued that the multimodal approach not only accommodates different learning styles, but also ensures that learners are engaged in learning language in a variety of contexts that are rich in context and variety.

As mobile technology progressed, multimodal learning opened up new possibilities. Pegrum (2014) showed how mobile devices with cameras, microphones, and other sensors can be used for authentic language learning. Learning could be done through recording real-life conversations, annotating videos, or even augmented reality.

Godwin-Jones (2018) explored how augmented reality (AR) and virtual reality (VR) can enhance the multimodal nature of MALL platforms. By integrating AR and VR, MALL applications can immerse learners in real-world simulations, allowing them to practice language skills in contextually rich and interactive environments. Language acquisition can be greatly enhanced by such experiences, according to Godwin-Jones, especially when learners engage with multiple sensory channels at the same time.

In conclusion, multimodal learning approach in MALL offers learners, as evidenced by a rich tapestry of research, an immersive and comprehensive language learning experience. By integrating multiple modes of communication and leveraging mobile devices' multimedia capabilities, MALL ensures that language learning is not just a cognitive exercise but a multisensory journey that mirrors real-world language use.

(5) Collaborative Learning

It is an essential component of present-day pedagogical approaches to emphasize the importance of interaction, shared knowledge construction, and group dynamics in the process of learning through collaborative learning, which is defining the core of contemporary pedagogy. The field of MALL incorporates collaborative learning seamlessly, using the capabilities of mobile devices and internet connectivity to facilitate real-time interactions, group activities, and shared experiences among students.

MALL platforms incorporated collaborative tools at their nascent stages in the early 2000s. One of the pioneers who recognized the transformational potential of mobile devices for promoting collaborative language learning was Warschauer (2004), who was among the first to recognize their potential. Essentially, he stated that interaction is one of the key components of language acquisition, and that mobile devices could serve as catalysts for such interactions as a means of facilitating language acquisition. This notion was further explored by O'Bryan & Hegelheimer (2007), who focused on the role of mobile devices in facilitating collaborative writing activities under the framework of mobile devices. As a consequence of their findings, the importance of peer feedback in language learning as well as the process of shared knowledge construction in language learning seemed to have been emphasized. Due to the rapid advancements in technology, MALL platforms began to evolve rapidly,

incorporating more sophisticated collaborative capabilities with each passing day. As noted by Stockwell (2010), social media platforms have been integrated into MALL to provide learners with avenues to engage in collaborative activities, share resources, and offer peer feedback in informal settings. The effectiveness of mobile apps designed for collaborative vocabulary learning was further supported by Hsu (2013). The findings of Hsu's study revealed a positive correlation between group interactions and vocabulary retention. A major milestone in the development of MALL was the advent of cloud-based platforms that greatly enhanced the potential of collaboration. It has been highlighted in Burston (2015) that cloud-based tools have the potential to play a pivotal role in easing a wide range of collaborative language learning tasks, from sharing documents to real-time conversation. The same perspective has been echoed by Godwin-Jones (2016), who examined the potential of cloud-based MALL platforms in promoting collaborative language learning in real-world scenarios, while bridging the gap between classroom instruction and practical applications of language learning.

It has been found that recent research has provided deeper insights into the multifaceted collaboration features of MALL in particular. Kukulska-Hulme et al. (2017) conducted an investigation into the use of mobile devices for collaborative storytelling, emphasizing that narrative plays an integral role in language learning through the use of narratives. Concurrently, Huang, Yang, Chiang, & Su (2018) conducted an in-depth investigation into the impact of collaborative mobile games on language learning, shedding light on the motivational and pedagogical benefits of game-based collaborative tasks.

The idea of integrating augmented reality (AR) into MALL has sparked a new era of collaborative learning experiences which can lead to lifelong learning opportunities. According to Godwin-Jones (2019), AR-based collaborative tasks have the potential to offer revolutionary benefits for MALL. As a result of augmented reality, students can engage in shared virtual experiences, which enriches their language acquisition and enhances the understanding of cultural differences.

To conclude, the literature clearly demonstrates the importance of collaborative learning in MALL. Throughout its development, MALL has constantly evolved to provide learners with a dynamic, interactive, and collaborative language learning experience, from the early integration of basic collaborative tools to the current state-of-the-art AR-enabled platforms. In the future, as technology advances, it is anticipated that MALL will further harness the power of collaboration, in order to provide language learners around the world with even more immersive and enriching learning environments.

Advancements in MALL

The rapid progression of mobile technologies has greatly contributed to the advancement of MALL. During the past two decades, MALL has evolved from rudimentary applications into sophisticated platforms integrated with cutting-edge technologies. As part of this evolution, a series of innovations have been introduced, each of which builds upon the previous, resulting in a more enriched and immersive language learning experience.

(1) Early 2000s: The Dawn of MALL At the dawn of the 21st century, mobile devices became increasingly prevalent around the world. During this period, educators explored the educational potential of these devices, laying the foundation for what would later become a transformative field in language education: MALL. According to Norris & Soloway (2001), mobile devices have inherent advantages, such as portability and accessibility. Their seminal work demonstrated how these devices can allow learners to engage in language learning activities at anytime and anywhere, breaking the boundaries of traditional classrooms. Mobile devices are expected to enhance learner motivation and engagement due to their convenience and flexibility. It should be noted, however, that the MALL applications of this era were relatively basic. In most cases, they have been designed as supplementary tools, focusing primarily on vocabulary enhancement through flashcards, basic grammar drills, and simple listening exercises. In a study by Naismith, Lonsdale, Vavoula, and Sharples (2004), the authors noted that while early MALL activities were simplistic, they were effective in promoting autonomous learning. Research by Zhang, Song, & Burston (2011) suggests that repetitive practice is essential for vocabulary retention and reinforcement. Thornton & Houser (2005) examined the initial MALL applications, particularly those developed in the Japanese context, in further detail. In their study, they demonstrated that short messaging service (SMS) can be effective in teaching English vocabulary to Japanese students. Due to the bite-sized nature of SMS-based lessons, language learning has been found to be a more manageable and less overwhelming process for learners who have a short attention span.

Another significant contribution from this period came from Klopfer, Squire, & Jenkins (2002), who explored the potential of mobile games for educational purposes. According to their work, MALL applications could be gamified, which could enhance student motivation and engagement. The implications of their research for MALL were evident, even though their study was not exclusively concerned with language learning.

The early 2000s marked the beginning of MALL, a time of experimentation and exploration. Despite the rudimentary nature of the MALL applications from this period, they played a pivotal role in shaping the future trajectory of the industry. Following the initial studies and applications, advanced and interactive MALL interventions were developed.

(2) Mid-2000s: The Rise of Smartphones and Enhanced Interactivity: In the mid-2000s, the emergence of smartphones sparked a technological revolution by combining the functionality of traditional mobile phones with those of personal computers. It was during this period that the MALL landscape underwent a significant shift, as smartphones introduced a variety of opportunities for interactive and context-aware language learning.

This transformation was spearheaded by Sharples, Taylor, & Vavoula (2005), who introduced the concept of "learning as a conversation." Their research posited that learning is an ongoing, dynamic activity that occurs in both formal and informal settings. Smartphones, with a wide range of sensors and internet connectivity, are ideal tools for facilitating continuous learning. Taking their work as a starting point, MALL applications were developed that were not only content-rich, but also context-aware, able to adapt to a learner's environment. On this basis, Kukulska-Hulme & Shield (2008) investigated the pedagogical implications of smartphones in more detail. Specifically, they emphasized the device's ability to seamlessly integrate formal classroom instruction with informal and real-world learning. Their research demonstrates the significance of authenticity in language learning, suggesting that smartphones can provide learners with opportunities to engage with authentic language content in real life settings. A study conducted by Petersen, Procter-Legg, and Cacchione (2009) investigated the role of mobile social software in the learning of foreign languages. It has been found that applications such as blogs, wikis, and social networking platforms, when accessed via smartphones, can facilitate collaborative learning, enabling learners to exchange resources, interact with peers, and construct knowledge together. As compared to earlier MALL applications, this collaborative approach was considered a significant improvement over the solitary learning experience.

Another pivotal study from this period was conducted by Looi et al. (2010), who investigated the use of smartphones in a seamless learning environment. In their research, they highlighted the importance of continuity and context in language learning. By using smartphones, they were able to connect learning experiences in formal classroom settings with those in informal settings. Furthermore, the introduction of app stores, such as Apple's App Store, played a significant role in the proliferation

of MALL applications. The rise of these platforms led, as Godwin-Jones (2011) argues, to the development and distribution of MALL apps that were tailored to meet the needs and preferences of diverse learners.

The mid-2000s were characterized by rapid growth and innovation within the MALL sector. The emergence of smartphones with their enhanced capabilities and features has revolutionized the way language learning is conducted. As a result, the focus shifted away from merely delivering information to facilitating interactive, collaborative, and context-sensitive learning experiences, setting the stage for the next phase in the evolution of MALL.

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(4) Late 2000s to Early 2010s: Technological Innovations and Pedagogical Shifts in MALL During the late 2000s and early 2010s, MALL underwent a transformative phase characterized by a complex interplay between technological advancements and pedagogical innovations. Language education underwent a change during this era, which was marked by a great deal of academic exploration and empirical research.

It was during this period that MALL applications underwent a metamorphosis. It has been noted by Lu (2008) that the incorporation of multimedia elements enhances both the content and the multisensory experience, thereby improving cognitive retention. The development of interactive simulations, on the other hand, offered learners an avenue for experiential learning, enabling them to immerse themselves in realistic scenarios related to linguistics. According to Duman, Orhon, & Gedik (2015), these simulations are pedagogical in nature, as they facilitate a deeper understanding of language constructs within a contextual framework.

Gamification, although not a new concept, has found renewed interest in the MALL community. Burston (2014) examined gamified MALL environments in depth, highlighting their potential to amplify learner motivation and sustain engagement. The process of learning became more engaging and intrinsically rewarding when language tasks were transformed into game-centric challenges. However, it was the advent of augmented reality (AR) and virtual reality (VR) that truly marked a paradigm shift in MALL. Godwin-Jones (2016) explored the immersive capacity of AR and VR, positing that these technologies could transport learners into contextually rich, simulated linguistic environments. The pedagogical implications of AR were discussed in a

compelling discourse presented by Klopfer & Squire (2008), while Lan, Kan, & Hsiao (2012) examined the experiential depth provided by virtual reality, emphasizing how it may enhance students' spatial and cultural awareness.

Parallel to this trend, there has been a growing interest in integrating MALL within formal educational environments. Using data from an empirical study conducted by Chen, Tan, & Lo (2013), it was found that MALL interventions were effective in enhancing linguistic proficiency within structured classroom environments. In addition, their findings supported the merits of blending traditional pedagogy with MALL.

Overall, the late 2000s to early 2010s demonstrate the relentless evolution and academic rigor within the MALL field. Modern language education has been permanently shaped by the convergence of technological advances and pedagogical insights during this era.

(5) 2020s: The Global Shift to Online Learning and the Future of MALL

With the onset of COVID-19 in 2020, the education sector faced unprecedented challenges, necessitating the rapid implementation of online education. Due to this change, MALL has played a key role in ensuring the continuity and effectiveness of language education in a remote education environment.

MALL emerged as a vital tool to bridge the gap between traditional face-to-face instruction and the new norm of online learning as educational institutions around the world struggled with the sudden closure of physical classrooms. According to Al-Shehri (2020), MALL has been particularly effective during these challenging times. He highlighted its effectiveness in remote language learning contexts, especially during a pandemic.

A comparative study conducted in Kazakhstan by Yessenova et al. (2023) examined the competencies and attitudes of language educators and students toward online education after COVID-19. Results indicated a positive attitude toward online education, with participants acknowledging its potential benefits despite challenges related to online competency. The results of a meta-analysis conducted by Ratna Yunita (2023) on the effects of online learning on English language education during the pandemic indicate that online learning contributed to the improvement of English language skills. This study examined data from a number of research articles published between January 2020 and April 2022, emphasizing the advantages of online learning in English language education during the pandemic. Online learning has, however, presented some challenges as a result of the rapid transition. The issue of emergency remote education (ERE) was explored during COVID-19 by Bovill (2022), in which he

discussed the potential for online learning spaces to be abused by technology. The study found that technology platforms in higher education need to be used more safely and respectfully, emphasizing the importance of creating a secure, online learning environment.

In addition, Liu et al. (2021) highlighted the importance of adopting a learner-centered approach in MALL, particularly in the context of the current pandemic. According to the study, aligning technological advancements with pedagogical best practices can enhance learning outcomes, keeping learners motivated and engaged in a remote classroom.

Ultimately, the COVID-19 pandemic and the challenges of the 2020s have highlighted the evolving role of MALL in the global educational landscape. Taking into account the challenges and opportunities presented by online learning, integrating technology with pedagogy, emphasizing learner-centric approaches, and acknowledging the challenges and opportunities associated with it have shaped MALL's trajectory, positioning it as a critical tool for language education in the future.

Fundamentally, the growth of MALL over the past two decades demonstrates the symbiotic relationship between evolving technologies and educational methodologies. From its inception as a novel concept in the early 2000s, MALL has evolved along with rapid technological advancements and a growing understanding of effective pedagogical practices. Mobile devices have become increasingly sophisticated, and so have MALL platforms in order to meet the diverse and ever-changing needs of learners. Due to its adaptability and responsiveness, MALL has secured its position as one of the most important components of contemporary language instruction, demonstrating its capacity to reshape and redefine the paradigms of language learning in the digital age.

2.2.4 Review of Previous Studies on MALL: Achievements and Limitations

The exploration of MALL has been a focal point of numerous studies over the years. These studies have provided valuable insights into the achievements and limitations of MALL, shaping its trajectory and informing future research directions.

As mentioned earlier, MALL emerged as a separate field of study in the early 2000s. During this period, initial research was exploratory in nature. Computer-assisted language learning (CALL), a precursor to MALL, was being explored for the first time by Levy (2000). The study stressed the necessity of a pedagogical framework for integrating technology into language education. In a similar vein, Klopfer et al. (2002) examined the potential of handheld devices in enhancing learning experiences, emphasizing their portability and versatility. Technology integration into language learning was still in its

infancy during this period, and researchers were grappling with the challenges and opportunities presented by the digital world. As Warschauer (2004) points out, all students should have equitable access to technology in order to avoid the digital divide in language learning. In the study, it was found that MALL has the potential to bridge this divide, providing learners from different backgrounds with opportunities to engage with language learning in a meaningful manner. Additionally, Naismith et al. (2004) investigated the use of mobile technology in language learning during this period. From listening to audio recordings to participating in interactive simulations, their research provided insights into the types of activities that mobile devices can effectively support. As part of a critical evaluation of MALL, Chenery (2006) discussed both the potential benefits as well as the challenges that could arise as a result of integrated mobile technologies into the teaching of languages. Based on the results of this study, it is evident that it is necessary to continue research in order to understand the pedagogical implications of MALL as well as to develop best practices for its implementation. Moreover, a number of studies have been conducted on MALL applications since the early 2000s. Ogata & Yano (2004) investigated how handheld devices could be used to support Japanese students' learning of kanji using mobile phone technology. Thornton & Houser (2005) investigated the use of mobile phones for vocabulary learning.

MALL made several major advances in the early 2000s. First of all, the period saw a growing recognition of the importance of structured pedagogical frameworks, resulting in more effective and meaningful learning outcomes. Mobile devices offer learners a more personalized learning experience due to their versatility and flexibility. MALL has also been identified as a potential tool for bridging the digital divide in order to provide equal access to language learning resources for learners from diverse backgrounds. Additionally, a wide range of MALL activities were explored during the period, demonstrating the many applications of mobile technologies to the learning of foreign languages. Various use-cases, ranging from kanji learning to vocabulary enhancement, further illustrated the practical applications of MALL.

Despite the important achievements of the early 2000s, MALL also had several limitations that were brought to light. A primary challenge was integrating mobile technologies into traditional language teaching paradigms. Even though MALL has been recognized for its potential benefits, there have been significant challenges in integrating it seamlessly into the classroom. Furthermore, this period underscored the need for further research in order to fully understand the pedagogical implications

of MALL. To ensure that MALL is implemented effectively in diverse learning environments, best practices must be developed.

In the period 2005-2010, MALL exploration experienced a surge, with researchers delving further into the potential of MALL as well as its challenges. The integration of mobile technology into language learning has become increasingly prevalent, and studies have begun to focus on specific applications and their implications for students.

Due to mobile devices' increasing sophistication, pedagogical strategies that leverage their capabilities have also evolved. Throughout the years, multimedia elements such as audio, video, and interactive simulations have become more prevalent, enhancing the learning experience for all students. Additionally, collaborative learning gained traction during this time, as MALL platforms made peer interaction and group activities easier. It was also supported by the findings of Kukulska-Hulme (2006) who emphasized the importance of mobile devices in fostering collaborative learning environments. In this study, it was revealed that mobile technologies can support informal, spontaneous, and situated learning experiences, in order to bridge the gap between formal classroom instruction and actual language use in the real world. In addition to context-aware learning, context-aware learning has also received significant attention. The study by Chen et al. (2008) examined the potential for contextually aware mobile learning systems, which utilize sensors and other technologies to deliver content based on the learners' environment. It was concluded that such systems would provide more personalized and relevant learning experiences, which would be tailored to the specific learning contexts of the individual learners. Social media platforms are also growing in popularity, and their integration into MALL platforms cannot be ignored. Additionally, Shih et al. (2010) provided an inquiry-based approach to mobile learning, emphasizing the importance of exploratory activities in authentic learning environments. In their study, they highlighted the potential of mobile systems to facilitate students' field studies while considering cognitive load during the design of the interface. Similarly, Sole et al. (2010) contributed significantly to MALL by introducing a social and self-reflective approach. They argued that mobile devices could serve as a prosthesis of the self that would enable language learners to perceive their L2 selves in a variety of day-to-day situations. As part of their mobile learning platform, Luo & Zuo (2010) include trustworthy service provisioning, integrating service grids, on-demand e-learning, and tracking trustable mobile assets.

It was during the mid-to-late 2000s that MALL underwent a period of rapid expansion and innovation. A number of studies conducted during this era highlighted

the versatility of mobile devices in facilitating a variety of learning activities, from listening to audio recordings to participating in interactive simulations. Mobile devices are no longer merely used as tools for learning, but are being integrated into the educational process to enhance learning by making it more interactive, personalized, and context-sensitive. A notable achievement was MALL's ability to bridge the digital divide, ensuring equitable access to technology to all learners.

There is no doubt that the period witnessed significant advancements, but it was also accompanied by several challenges as well. There is a lack of understanding of the pedagogical implications of mobile technology's integration into language learning, as it is still in its nascent stages. Chenery (2006) provided a critical evaluation of MALL, discussing the challenges and potential rewards associated with the integration of mobile technologies into the teaching of languages. MALL's pedagogical implications have been recognized, and best practices for its implementation have been developed. More research is necessary to understand these implications.

The half-decade from 2010 to 2015 was a transformative period for MALL, marked by rapid technological advancements and innovative pedagogical approaches. This period saw the rise of smartphones and tablets with enhanced capabilities, which further propelled the integration of technology into language learning. The research during this period was marked by a deeper understanding of how these technologies could be harnessed for pedagogical benefits.

A number of early researchers recognized the potential of tablet computers for learning languages, including Pegrum, Howitt, & Striepe (2011). A study was conducted to examine the pedagogical applications of mobile technologies, specifically tablets, in language learning environments. Based on their findings, tablets, with their larger screens and interactive capabilities, provide a more immersive learning experience compared to smaller mobile devices. According to Burston (2012), MALL represents an evolution from Computer-Assisted Language Learning (CALL). He discussed the increasing popularity of mobile devices, particularly smartphones, and their implications for language education. Additionally, the study discussed the challenges associated with integrating these technologies in traditional classrooms. By 2013, the focus had shifted towards the practical applications of MALL. A study conducted by Kukulska-Hulme et al.(2013) examined the challenges and opportunities presented by mobile-assisted language learning in informal settings. Using mobile devices for spontaneous language learning outside the classroom, their research illustrated the potential of MALL in promoting self-directed learning. Taking a forward-looking perspective, Godwin-Jones (2014) discussed emerging technologies in the MALL

space. In his research, he examined the potential of augmented reality, wearable technology, and other innovative tools to enhance language learning experiences. As he noted, these technologies, although still in their infancy, have the potential to revolutionize retail in the near future. At the end of this period, Palalas (2015) returned to the topic of pedagogy. She provided insight into mobile-assisted blended language learning design and pedagogical considerations. According to her, mobile technologies need to be seamlessly integrated into the curriculum in order to achieve a learner-centered approach.

There were a number of achievements made during this period of time. The integration of advanced mobile devices into the language learning process, particularly tablets and smartphones, has been an important milestone in the development of language learning technology. It was through the use of these devices that students were able to engage in interactive and immersive learning experiences, therefore bridging the gap between formal classroom instruction and informal, self-directed learning. MALL offers innovative ways to engage learners in context-rich environments through the exploration and use of emerging technologies, such as augmented reality, which further broadened the scope of the program.

Although there have been many advancements in the field, several challenges still persist. It is evident that educators and institutions have had to cope with the rapid pace of technological evolution, often leading to a lag when it comes to pedagogical adaptation. There were also concerns raised about the digital divide, with researchers emphasizing the need for equitable access to technology for all learners, as they stressed the importance of overcoming this divide. Additionally, while MALL's potential for improving student learning across a wide range of learning contexts and demographic groups has been recognized more and more over the last few years, empirical studies were needed to validate the effectiveness of the approach in these diverse contexts.

In the period between 2015 and 2020, MALL has experienced significant changes. With the integration of artificial intelligence and big data analytics into the MALL platform, a shift towards personalized and adaptive learning was marked. An examination of the potential of AI in adaptive learning was conducted, emphasizing its role in meeting the needs of individual learners.

During this period, MALL witnessed several notable achievements: 1) The integration of AI and big data analytics into MALL platforms allowed for real-time feedback, adaptive learning pathways, and a more tailored approach to language instruction. For instance, Burston (2015) highlighted the transformative potential of AI-

driven MALL applications. 2) As MALL platforms have incorporated AI and big data into their architecture, they have been able to provide highly personalized learning experiences. It is thought that these platforms could be used to analyze a learner's progress and preferences in order to adjust content and strategies so they best fit their individual needs, which would result in improved learning outcomes (Chen, Spector, & de Vries, 2019). 3) There was a greater emphasis put on collaboration and community learning during the past few years. As a result of MALL platforms, learners can now engage in peer interaction through peer-to-peer communication, collaboration, and peer learning, fostering a sense of community and shared learning among learners (Kukulska-Hulme, 2016).

However, despite the advancements that MALL made during this period, it also faced some limitations: Firstly, In the era of big data analytics, concerns regarding data security and privacy have become more evident with the implementation of big data analytics. Godwin-Jones reports that there was a growing concern about how learner data was being stored, used, and shared within the organization (Godwin-Jones, 2017). Secondly, there may be the risks associated with over-dependence on technology. Although technological advancements have enhanced the MALL experience, there is a risk that it may be used to the detriment of traditional and equally effective methods of language learning (Stockwell & Hubbard, 2015). Last but not least, while mobile devices are widely used as a learning tool, not all learners have equally access to the latest technology and high-quality content, which can result in potential disparities in the quality of the learning experience (Pegrum, 2016).

The pandemic of COVID-19 that began in 2020 marked a significant shift in the educational landscape, with many institutions transitioning to remote learning as a result of the disease. The abrupt change that took place accentuated the importance of MALL. Educators were seeking effective ways to engage learners in a predominantly virtual environment during this time of crisis, which led to the adoption of MALL tools, according to Smith & Johnson (2020). There is also a study conducted by Patel & Wang (2021), which highlights the rise in the use of mobile applications that incorporate AI-driven personalized learning pathways, reflecting the increasing use of technology in combination with pedagogical strategies in the classroom.

MALL has witnessed a number of advancements between 2020 and 2023 as a result of several factors. As a starting point, there was a notable increase in the integration of artificial intelligence and machine learning algorithms into language learning apps, which enabled real-time feedback and personalized learning experiences (Turner & Roberts, 2022). Secondly, the use of big data analytics by

educators has enabled them to gain insights into student performance, allowing them to tailor their teaching methods more effectively based on what they have learned from students (Garcia and Lewis, 2021). Moreover, MALL platforms made the transition to remote learning seamless, thereby ensuring that language education could continue uninterrupted during difficult circumstances (Smith & Johnson, 2020).

It is important to note that despite the achievements, there were also limitations observed during this period. One of the primary concerns was the digital divide, where students without access to appropriate devices or stable internet connections found it difficult to take advantage of MALL (Williams & Clark, 2020). Aside from providing personalized learning experiences, AI-driven tools also raise issues relating to data privacy and the potential for algorithmic bias (Turner & Roberts, 2022). As a final consideration, in a remote learning environment, even with the aid of MALL tools, there is no face-to-face interaction, which makes it difficult to replicate the nuances of in-person language instruction (Patel & Wang, 2021).

2.2.5 Identified Gaps in MALL: The Need for Seamless Integration

Mall has undergone a transformational journey since its inception. Despite significant advancements in its evolution, certain gaps have been revealed that will require further exploration and innovation.

1) Mobile technologies remain a challenge for integration into traditional language learning curricula. It is true that MALLs and the potential of handheld devices were exploding in the early 2000s (Klopfer et al., 2002), but the integration was often ad hoc. The potential of MALL was recognized, but it was not always systematically integrated into structured curricula. It was noted by Kukulska-Hulme (2010) that the use of mobile apps can result in fragmented learning experiences in the absence of a clearly defined pedagogical framework. A challenge lies in ensuring that MALL does not simply serve as an add-on, but is an integral component of language learning.

2) MALL expanded its horizons from the mid-1990s to 2010 in response to the needs of diverse learners. As smartphones became more prevalent and interactivity became more prevalent, learning experiences became more personalized. The challenge, however, remains in addressing the diverse needs of learners. Despite the fact that many MALL applications had been developed, Pegrum (2014) noted that they did not always cater to a variety of learning styles and backgrounds. Using a one-size-fits-all approach was proving inadequate for addressing the individual learning needs of learners.

3) In the period between 2010 and 2015, technological advancements and pedagogical innovations were predominant. In spite of the fact that AI and Big Data

had begun to make their mark, their integration into MALL had yet to reach its full potential. According to Stockwell (2016), learning can be hindered by issues such as device compatibility and software glitches. It was not simply a matter of integrating advanced technologies, but of making sure they served pedagogical purposes as well.

4) In spite of their advancements, MALL platforms often lack comprehensive assessment tools. Although they offered quizzes and tests, they were often biased towards specific skills and neglected others. An emphasis was placed by Godwin-Jones (2017) on the need for tools that can provide a holistic assessment of a learner's proficiency, ensuring a balanced assessment of all language skills.

5) The need for seamless integration has been highlighted in MALL over the years due to the gaps that have been identified. A concept rooted in the concept of fluid transitions between learning settings is crucial for the future of MALL. The seamless learning environment, as described by Wong & Looi (2011), integrates diverse resources and activities into one unified learning experience. MALL creates platforms that are technologically advanced, pedagogically sound, and tailored to the needs of each individual learner.

2.3 Vocabulary Learning and Teaching in Second Language Acquisition: Challenges and Opportunities

Vocabulary in a second foreign language (L2 vocabulary) represents a wide-ranging and multifaceted area of study in the field of language acquisition. In order to achieve language proficiency and communicative competence, L2 vocabulary learning, teaching, and understanding are essential. A significant amount of scholarly attention should be given to vocabulary acquisition because of its crucial role in all facets of language use-reading, writing, speaking, and listening. The following section explores the central aspects of L2 vocabulary, including its definition, types, role in language learning, and the strategies that guide its teaching and learning. The navigation of these facets illuminates the complexity of L2 vocabulary and demonstrates its significance in the learning process.

2.3.1 Definitions of Vocabulary

Given its significant role in effective communication, vocabulary remains an indispensable element of language learning. As David Wilkins (1972, p.111) aptly puts it, “Without grammar, very little can be conveyed. Without vocabulary, nothing can be conveyed.” This underscores the critical focus on second and foreign language vocabulary acquisition in language instruction research, emphasizing aspects such as the definition, dimensions, psychological representation, and learning processes of

vocabulary. For a comprehensive understanding of these concepts, a careful review of the key definitions of vocabulary is crucial.

Vocabulary definitions vary across different sources, each adding a layer of understanding to this multifaceted concept. Merriam-Webster (2021), for instance, defines vocabulary as "a list or collection of words or of words and phrases usually alphabetically arranged and explained or defined" or "a collection of words used by a language, group, individual, or work." The Cambridge Dictionary similarly posits vocabulary as encompassing "all the words that exist in a particular language or subject." These definitions collectively underscore the idea of vocabulary as a collection of words used in a language, offering a broad understanding of the concept.

Scholarly definitions of vocabulary largely align with these general definitions, with a few nuanced additions. For example, Barcroft, Sunderman, Schmitt, and Turner (2011) consider vocabulary as the comprehensive collection of words in a language. Meanwhile, Richards and Schmidt (2010) extend this notion, emphasizing that vocabulary comprises lexemes, including single words, compound words, and idioms. Linse and Nunan (2005, p.121) similarly suggest that "Vocabulary is the collection of words that an individual knows." Moreover, Kamil and Hiebert (2005, p.3) shift the focus towards semantic knowledge, stating that "vocabulary is the knowledge of the meanings of words".

Recent scholarship by Webb and Nation (2020) expands on this understanding, highlighting the importance of a multi-faceted understanding of vocabulary, encompassing not just individual words but also their meanings, collocations, and orthography, among others. Similarly, Schmitt (2018) emphasizes the intricate network of lexical relationships that constitute vocabulary knowledge, reflecting on its dynamic and complex nature.

To synthesize, the definitions of vocabulary across various sources are anchored on the central concept of a collection of words, with subtle variations reflecting the complexity of the term. In the context of this study, given the objective of enhancing college students' vocabulary learning outcomes within the framework of the CET4 core vocabulary list, "vocabulary" is defined as "a list of words within an indexing system targeted towards students' learning." A more in-depth exploration of the concept of "word" will further enrich this understanding.

Definitions of words

Throughout linguistics, a word is the smallest unit of independent expression. It is important to note that words consist of four components: phoneme, form, syntax, and semantics. In a particular language, a phoneme is one of the units of

sound that distinguishes one word from another. It is also one of the sounds that the human vocal organ can produce in order to convey the meaning of the word. In linguistics, the word form refers to the smallest linguistic units or morphemes. One word form can further be subdivided into an inflected form (such as go/goes) and a derived form (such as destroy/destruction), which are both derived forms of the same word form.

A syntactic aspect of a word can be defined as the position of the word within a sentence. At the semantic level, a word may be divided into its meaning (sense) and its reference (Carroll, 2008). Word references refer to the meaning of a word itself. Lyons (1968) emphasized that the word refers to a "location in the entire lexical relationship system", that is, the relationship between a word and the other words connected with it. Accordingly, in general, it can be said that there are a number of relationships between words and words as follows:

- Synonymous relationship: Such as big and large;
- Antonymous relationship: such as good and evil;
- Hypernymy relationship, for example, "furniture" is the hypernym of "table";
- Hyponymy relationship, in the example above, "table" is the hyponym of "furniture";
- Coordination relationship , such as "table" and "chair" are both hyponyms under the same hypernym "furniture";
- Meronymy relationship refers to the relationships between a thing and its components, such as the "head" and "limb" which constitute the body;
- Attributive relation, such as comfortable and home.

This comprehensive approach to understanding words allows for a more thorough examination of vocabulary as a whole.

Basic elements of words

Through one's sensory organs, a human being can gain knowledge of the physical attributes of a word, such as its pronunciation, shape, and other physical characteristics through the use of language. Yet, in order to comprehend and study the psychological processes involved in storing, recognizing, and retrieving words in the human brain, it is necessary to address the question of how words are characterized in the brain. In order to address this issue, psycholinguistics proposes the concept of a mental lexicon, which refers to a mental dictionary that consists of semantic, phonological, syntactic, and other attributes (Jackendoff 2002). Mental lexicons can be arranged in networks based on the attributes of the words they

contain. Typically, hierarchical networks are used to illustrate how the network is organized. It was proposed by Collins and Quillian (1969; 1970; 1972) that semantic information consists of a set of generic relations forming a network structure. Words serve as lexical nodes that contain relevant lexical attributes. Relationships between words may be subordinate or coordinate (**Figure 2.1**). The model is based on neural networks and expresses the semantic relevance of words such as animal, bird, and fish through typological analysis. However, in reality, bird, fish, canary, ostrich, and shark can form more detailed semantic associations. As a result, each individual understands these concepts differently, and this leads to a different relationship in the organization. For example, the word "bird" in **Figure 2.2** is characterized in the brain as a hypernymy concept that corresponds with sparrows and pigeons (the most typical birds), ducks (rarely flying birds), ostriches (birds that cannot fly), penguins (birds that cannot fly and have comparatively small wings that are disproportionate to their bodies). According to their appearance, ducks and sailboats, ostriches and cranes, and penguins and tuxedos are related.

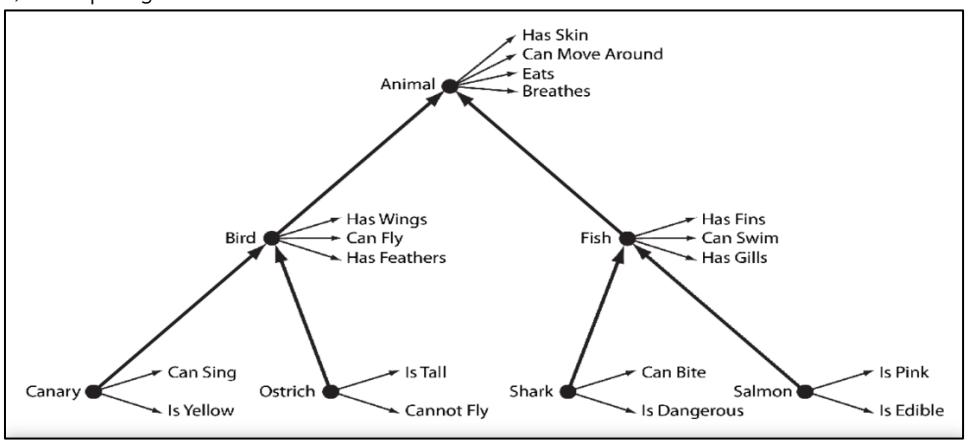


Figure 2.1 The semantic network model of Collins & Quillian (1969)

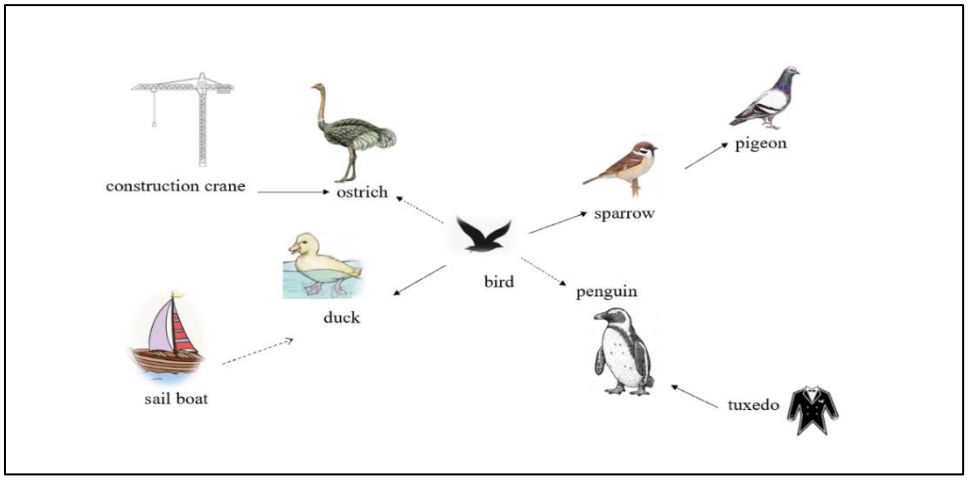


Figure 2.2 A semantic network related to the word "bird"

According to the information processing theory, Wu et al. (2000) proposed that lexical knowledge might be stored as declarative knowledge in long-term memory. Thus, declarative knowledge can be represented as *linear orderings*, *images*, and *propositions*. As the name suggests, linear ordering refers to the encoding of some elements in a sequential manner (Anderson, 1983, 1993). In linear ordering, the sequence can be spatial, such as “in front of”, “in the middle of”, and “behind”, or it can be temporal, such as “before”, “after”, or even a metric sequence, such as “light” and “heavy”. Linear ordering can be spatial, such as “in front of”, “in the middle of”, and “behind”, or temporal, like “before”, “after”, or even metric sequences, like “light” and “heavy”. A linear ordering system allows elements to be arranged in order and retrieved as a unit. For example, a beginner practicing spelling might repeat the word “banana” in the order of B-A-N-A-N-A, and then recall this word as a whole after hearing its pronunciation. This example shows that learners arranged phonemes linearly and retrieved it as a whole. Images, according to Anderson (1983, 1993), are graphical representations of objects located in space, representing their positional information. The *image* can contain extensive information, characterized either by the individual's visual representation of the external environment or non-visual information. The term “image” can also refer to the reproduction or reconstruction of what has been seen. During the learning process, learners may find it more convenient to characterize and store information in the form of images, which aids in memory and allows for retrieval of relevant information. For instance, by presenting the word “strawberry” alongside an image of it, learners may be more likely to remember the strawberry’s form.

The *proposition* denotes a representation of the semantic relationship between words, viewpoints, and concepts in language. Generally speaking, *proposition* involves a certain relationship and one or more arguments. The argument may be a subject who performs a certain behavior (subject), but it can also be an object of behavior or action (object), the goal of behavior, or the tools or means of behavior. Generally, only verbs, adjectives, and adverbs are able to express certain relationships, while relationships represent propositions (Anderson, 1983, 1993). To illustrate this, take the sentence “I gave Tony a pen.” as an example, which contains the relationship of “giving away” as well as three topics: “I” (Subject), “Tony” (Recipient), and “book” (Object). Another example is – “A boy in a white shirt writes down the words carefully.” In this sentence, four folds of relationships are present, namely four propositions: “a boy writes”, “a boy in a shirt”, “the shirt is white”, and “writes down words carefully.” In this sentence, each word represents a different relationship and, as such, could be

viewed as a node that is connected to form a declarative knowledge network. As can be seen in **Figure 2.1**, each node is associated with several small arrows that indicate its relationship to other nodes, thereby forming a schema that represents an organized declarative knowledge structure. As a matter of fact, each individual has his own division and organization regarding the term “animal” and its hypernymy concepts (e.g., bird, fish, canary, ostrich, shark, and salmon). For storing and retrieving information from the word, a more refined and organized understanding of declarative knowledge is required.

In spite of the fact that much has been discussed about the word from the standpoint of its semantic level, it is still necessary for us to discuss it further from another level in order to comprehend it more deeply. Since it is problematic to comprehensively depict the mental representation of the word by relying solely on the dimension of semantics, Bock & Levelt (1994) proposed a mental lexicon model that includes a conceptual level, a lemma level, and a lexeme level (see **Figure 2.3**). Among them, the conceptual layer contains nodes of representation. The connections between nodes represent their semantic relationship. A significant aspect of this model is the addition of lexical knowledge (e.g., speech, morphological knowledge of words) and knowledge of words (i.e., syntactic and semantic knowledge of words). For example, the English word "sheep" is a noun, while the French word “mouton” is not only a noun but also a masculine, reflecting its syntactic structure. It is pertinent to note that the pronunciation of the words “sheep” and “goat” and their phonemes reflect their phonetic characteristics. The graphical model illustrated here gives us a broad understanding of how mental lexicons are represented. However, considering that each word may have a vast array of syntax and semantic features, in addition to the complex semantic connection and collocation between words, we can understand how difficult it may be to represent the mental lexicon.

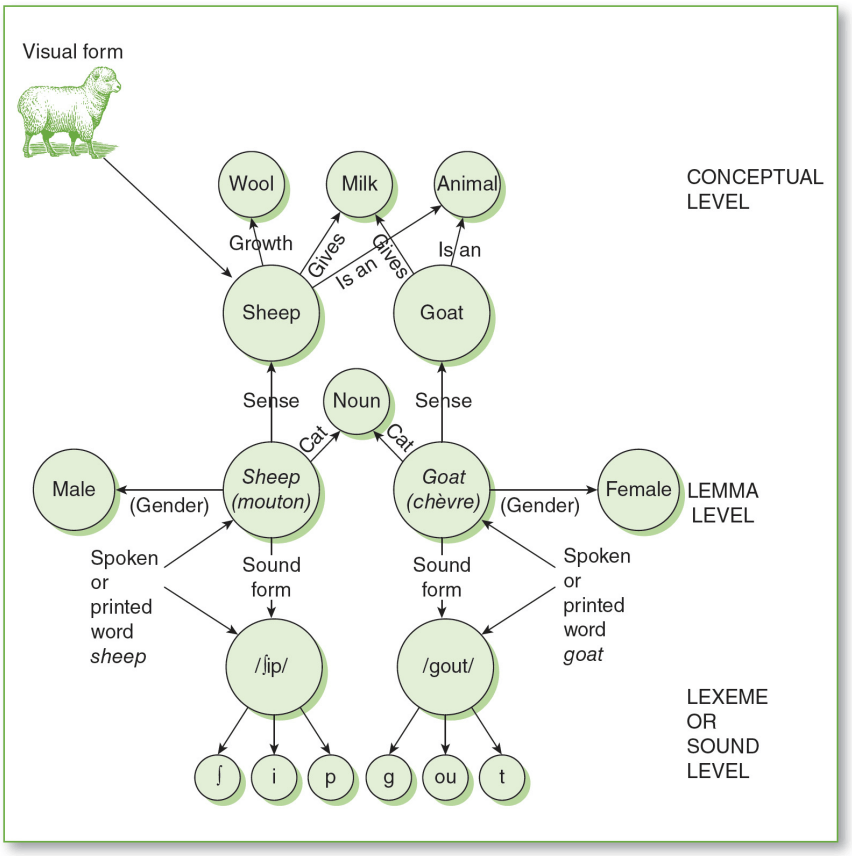


Figure 2.3 Bock and Levelt's Model (1994)

In fact, no matter what feature is going to be analyzed, a connection could be established between words regardless of the feature. As an example, in terms of semantics, the term "sheep", as well as its components including "wool", "horn", and "leg", are connected with it; as a hyponymy concept, the term "sheep" is related to its hypernymy concept "mammal". There is a parallel relationship between the words "sheep", "cow", "dog", and "cat" under the term mammal; as a head noun, a number of adjectives can modify it as attributes, such as "white", "meek", "big" and others. Its sound and form are related to "bleep", "sleep", "ship" etc. Likewise, the syntax is related to other nouns, such as "sheep skin". All of these words may be taken as nodes to build their own network from the angles of sound, form, semantic level, or other dimensions. The relationship between words may also be understood differently by individual speakers of different languages, which may result in discrepancies when constructing the network. The creation of a network-like connection can be achieved simply by focusing on any relationship, such as phonetics, word form, semantics, or syntax. Despite the fact that the relationships between these connections are inextricably linked, they remain interrelated. In this regard, lexical network structures

based on mental lexicons are personalized three-dimensional models that exhibit words as nodes and permeate various relationship types and are far more than fragmentary planar structures, as shown in **Figure 2.4**

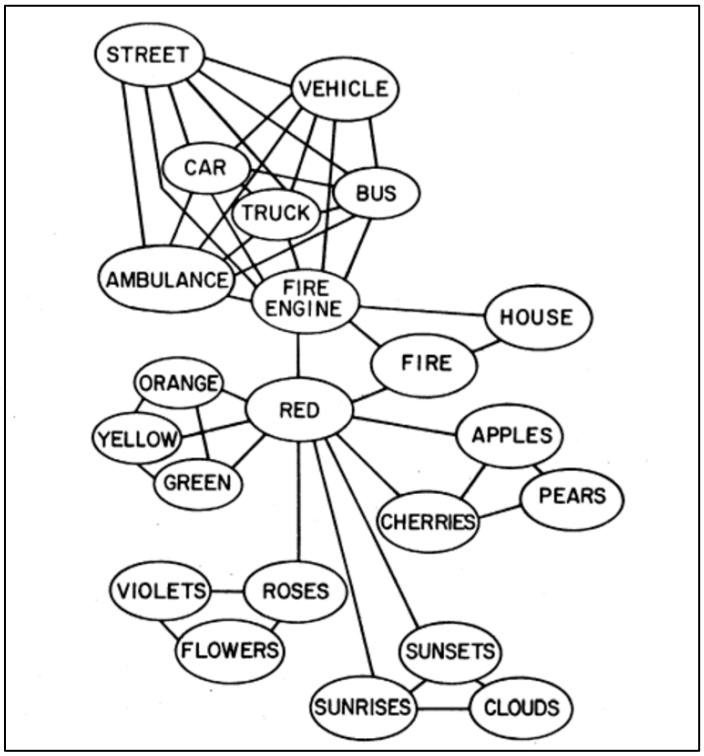


Figure 2.4 The spreading-activation semantic model (Collins & Loftus,1975)

So far, the researcher has only described and summarized the static representation structure of the mental lexicon, which refers to the forms of lexical representation. However, the practice of using words is related to a complex mental mechanism involving the processes of recognizing, understanding, and utilizing the words. The basis for understanding such a mechanism lies in the way how words are retrieved. From the perspective of retrieving words, the spreading-activation semantic model proposed by Collins and Loftus (1975) seems to be the widely accepted model. (see Figure 2.4) Collins & Loftus (1975) believe that mental lexicons are not organized in a strict hierarchical structure but something more like the interlaced connection between nodes. There are three types of relationships between nodes, namely, the taxonomic relation, the relation with typicality, and the relation with the degree of association. The taxonomic relation refers to the relationship between the upper and lower levels or at the same level; the relation with typicality denotes the degree of conformity to a certain genus, as discussed above in **Figure 2.2**, the word “sparrow” perfectly matches the characteristics of a bird, while the word “penguin” possesses the fewest features of a bird; the relation with the degree of association refers to the

degree of strength in the connection between the two words. For example, a clerk who is working in banks often uses “bank” associated with “cash”, so in his mental lexicon, the words such as “note”, “cash”, and “coins” etc. are closely related. When an individual notices, hears or thinks of a certain word, then that word is activated or retrieved. Consequently, other words associated with that word are activated and retrieved one by one according to the relevant paths. The order in which other words are activated and retrieved is based on the three types of relationships mentioned above. The number of words activated or the retrieval speed of a certain word relies on the number of words connected to the target words as well as the degree of strength in connection with the target word. In Figure 2.4, after “car” is activated, the words at the same level, such as “truck”, “ambulance”, and “bus” followed the suit, then “vehicle” as hypernym together with the theme-related word “street” are also activated. Besides, the word “car” can also activate “violets” and “flowers” via “fire engine”, “red”, and “roses”, but the process of activation will take more time. Again, this semantic network is just a way of connecting all the vocabulary it contains. Let us envisage that there is some language user who has just bought flowers or watched the sunset walked on a street where driving is prohibited, then the word “street” is activated in his mental lexicon, and after that the words retrieved probably are “flowers” or “sunsets”. In other words, the connection between words is characterized by a dynamic feature. The association triggered by a word is determined by both a relatively static vocabulary network and a real-time association activity. The semantic knowledge carried by a word is also subject to certain changes due to changes in the connection. When putting other factors into this network instead of the semantic elements of the vocabulary, we can imagine that the retrieval of words is a multi-dimensional process with changing psychological elements.

2.3.2 Types of Vocabulary Knowledge

The content discussed above covers the general description of the basic elements of a word, the representation of words as well as the retrieval process of a word. In the practice of study in second-language vocabulary acquisition or learning, the initial step is to define the specific dimensions of a word in order to explore how a second-language learner could master a word. Considering that there are numerous complicated methods for doing such research, this issue has always been the focus of linguists’ attention and debate. Generally speaking, in order to describe the static vocabulary knowledge, it is necessary to focus on the framework of vocabulary knowledge.

The first researcher worth mentioning is Richard (1976) who made several assumptions to guide the teaching of L2 vocabulary. He pointed out that there are seven main tasks (as showed below) needed for mastering a word.

- 1st task-knowing the probability that the word appears in spoken and written language, i.e., word frequency knowledge;
- 2nd task-knowing the limitations on the specific function of the word in a particular occasion, namely pragmatic knowledge;
- 3rd task-knowing the specific use of the word in the sentence, that is, syntactic knowledge;
- 4th task-knowing a word entails knowledge of the underlying form of a word and the derivations that can be made from it, i.e. the knowledge of the form;
- 5th task-knowing the network of association and collocation form of the word with other words, that is, semantic knowledge;
- 6th task-knowing the semantic value of the word;
- 7th task-knowing other semantic meanings of the word, that is, the more complete reference knowledge of the word.

Strictly speaking, the above seven assumptions lack rigorous internal logic. For example, although semantic knowledge has been divided into three dimensions (5th, 6th, and 7th), the morphological knowledge of the word has been left untouched without detailed subdivision, such as the inflected form and the derived form. What's more, the phonetic knowledge of the word is not included in this framework, which may cause difficulty in learning phonetic knowledge of the target words, especially for those learners whose native language has the complete different phonetical system with the target language. Finally, learning phonetic knowledge of the targeted words has always been a difficult zone for the learners because of the interference of L1 phonetic knowledge as well as the learners' the unfamiliarity with the L2 phonemes. It is true that this framework (7 assumptions) is debatable in terms of classification and systematicity, but it sure does also provide a reference for the related researches later.

The second scholar mentioned here is Paul Nation. In order to improve the vocabulary knowledge structure for the convenience of L2 vocabulary teaching, Nation proposed two vocabulary knowledge frameworks in 1990 and 2001, respectively. The 1990 framework consists of four parts: the form of the word (spoken form/written form), the position of the word in the sentence (syntax/collocation), the pragmatic function (word frequency/appropriateness), the meaning of the word (conceptual meaning/ associative meaning), each component is divided into two dimensions:

receptive and productive. Generally speaking, receptive knowledge refers to the knowledge related to reading and listening, while productive knowledge denotes the knowledge about speaking and writing (Laufer & Goldstein, 2004). For example, if a learner catches the pronunciation of the word “beautiful”, he then recognizes the word, which is considered as his getting the receptive knowledge. While for the productive knowledge, one needs to actively retrieve a certain word or utilize it. For an instance, when you think of the word “handsome”, you could utter the corresponding sound or use it to make a sentence, which means you have retained the productive knowledge of the word “handsome”. From the perspective of cognitive processing, receptive knowledge only needs recognition. In this example, when the phonetic information of the word “beautiful” enters the working memory through the sensory registry, it matches with its counterpart in the long-term memory, thus the mind accomplishes a single recognition. Productive knowledge focuses on the process of recalling and applying. In this case, the learner can retrieve the corresponding sound information of the word “handsome” in the long-term memory from the lexical form or semantic meaning “good-looking”, and provides the correct sound according to the certain rules of pronunciation, and this process even involves the retrieval in the specific use. Obviously, the psychological mechanisms involved in productive knowledge require a more advanced level of activation than receptive knowledge. (Paradis, 2007).

Although this disparity may seem to be simple, in fact, the differences between the two is not easy to tell. For example, Milton (2009) points out that people with advanced passive skills can proactively predict upcoming words when they are performing the activity of reading or doing listening comprehension. What’s more, Read (2000) believes that it is indistinct to divide vocabulary knowledge only into the productive and receptive vocabulary. The vocabulary knowledge actually involves a continuum concerning different activities from recognition, recall, comprehension to application.

The second framework of Nation (2001) further integrated vocabulary knowledge into three parts: word form, word meaning, and word use (see Table 2.1). This framework is essentially a re-integration of the sound, form, meaning, and use of words, and examines the extent to which second-language learners grasp each dimension in a question-and-answer manner. Meara (1996a) pointed out that Nation’s vocabulary knowledge framework can only be seen as an ideal list of vocabulary knowledge for native speakers. In fact, even native speakers cannot fully grasp all the knowledge of each word in all dimensions. In addition, this framework does not give

the ideal state and grading for each dimension. Moreover, the association in the meaning of the word aims to reveal the semantic relationship between words, but this part does not give a detailed description in both the receptive dimension and the productive dimension. In the specific vocabulary measurement and teaching, how to define the association relationship between words is a problem that must be solved.

Table 2.1 Aspects of word knowledge for testing (Nation, 2001)

Form	Spoken	R P	Can the learner recognize the spoken form of the word? Can the learner pronounce the word correctly?
	Written	R P	Can the learner recognize the written form of the word? Can the learner spell and write the word?
	Word Parts	R P	Can the learner recognize known parts in the word? Can the learner produce appropriate inflected and derived forms of the word?
Meaning	Form and Meaning	R P	Can the learner recall the appropriate meaning for this word form? Can the learner produce the appropriate word form to express this meaning?
	Concept and Referents	R P	Can the learner understand a range of uses of the word and its central concept? Can the learner use the word to refer to a range of items?
	Associations	R P	Can the learner produce common associations for this word? Can the learner recall this word when presented with related ideas?
Use	Grammatical Functions	R P	Can the learner recognize correct uses of the word in context? Can the learner use this word in the correct grammatical patterns?
	Collocations	R P	Can the learner recognize appropriate collocations? Can the learner produce the word with appropriate collocations?
	Constraints on use (register, frequency ...)	R P	Can the learner tell if the word is a common, formal, or infrequent word, etc.? Can the learner use the word at appropriate times?

Note: In column 3, R = Receptive knowledge, P = Productive knowledge.

What' more, Nation (2001) identified three well-known psychological processes which are involved in efficient learning of vocabulary based on the second framework. These three processes are noticing, retrieval and creative (generative) use. Noticing refers to paying attention to the word in written or spoken form influenced

by motivation and interest. Retrieval means that learner's being able to recall the vocabulary from the memory during the task. Repeated retrievals may help the learners in using the derivatives, inflected forms of the word. Retrieval can be either a receptive action or behavior in the process of listening and reading or productive one in speaking and writing. For the generative use or creative use, it denotes that leaner produces or uses the vocabulary in new context with different meanings, which can also be receptive or productive.

Based on the model of Richard (1976), a Chinese scholar Ma (2007) pointed out that a new framework of vocabulary knowledge should contain two parts: the meta-vocabulary knowledge and word knowledge. Meta-vocabulary knowledge refers to the macro-knowledge of words, involving the concept of words, the meaning of words, and the rules of variation in words. In the scope of meta-vocabulary, the questions of basic concept like "What is the definition of a word?", "What is the lexical relationship between the words?", "What are the rules which govern the phonological formation of the words?", "What are the syntactic rules of word?", and "How does the word knowledge (i.e., the part of speech or meaning of words) vary based on the social, cultural, and contextual changes?" are answered. While for the word knowledge, it includes 12 aspects of knowledge: phoneme knowledge, spelling knowledge, morphological knowledge, semantic knowledge, knowledge related to the mother tongue, knowledge related to word frequency, collocation knowledge, syntactic knowledge, style knowledge, pragmatic knowledge, variation knowledge, vocabulary strategy knowledge.

The prominent feature of this vocabulary knowledge framework lies in that it introduced meta-vocabulary knowledge concepts into the field of vocabulary knowledge. What's more, Ma (2007) pointed out that with the help the meta-vocabulary knowledge, learners can plan, manage, and monitor L2 vocabulary learning on their own. Meta-vocabulary knowledge can be mastered either in the process of self-directed learning or under the in-class teaching circumstance. In fact, meta-vocabulary knowledge can be understood as the ontological knowledge relating to the words, that is, the understanding the vocabulary knowledge from various dimensions, which answered the question of "What do we need to grasp a word?".

Comparatively speaking, the vocabulary knowledge frameworks of Richard (1976) and Nation (1990, 2001) have only described the specific dimensions of vocabulary knowledge but do not emphasize the integration of these dimensions into a schematic structure. The significance of mastering the schematic structure of vocabulary knowledge is that when L2 learners learn a word, they can start from the

basic understanding of the word, and retrieve the schema of vocabulary knowledge to determine which lexical dimensions the target words belong to, and store them in different categories for retrieving the word conveniently later. Another relative new point about this framework is that it contains the knowledge of the mother tongue which was rarely touched upon by previous researchers. Ma (2007) believed that the L2 learners with beginning level and intermediate level need to borrow the knowledge of their mother tongue as the intermedia for the second language learning. The means of translation is also an important auxiliary means of L2 learning, which makes the knowledge of the mother tongue an integral part of the second language vocabulary knowledge. However, neither did this researcher elaborate on the detailed mechanism of the mother tongue on the second language, nor did he specifically clarify which aspects of the mother tongue contribute to L2 vocabulary learning. What's more, this framework of vocabulary knowledge also includes the dimension of knowledge variation, that is, the variation of pronunciation, spelling, meaning and use of a word due to its different contexts, social, regional and ethnic groups. It can be concluded that this framework comprehensively summarizes the aspects of sound, form, meaning, and use of L2 vocabulary; besides, it is the framework of vocabulary knowledge with the diverse dimensions. However, the defect of this framework is that the explanation of each dimension is not exhaustive enough. Although it may inspire the research on teaching and learning L2 vocabulary, it lacks of operability to a large extent.

From the above discussion, the conclusion could be drawn that what the aforementioned L2 vocabulary frameworks shared in common is that in order to build up a comprehensive and ideal model, different researchers attempted to thoroughly outline the knowledge dimensions in terms of vocabulary use. However, to achieve this goal in practice, as Meara (1996a) pointed out, we need to develop a comprehensive and ideal association model, semantic model, and complete syntactic specification, which is not an easy task to do Moreover, the frameworks focusing on descriptive features from lexical level tend to be quite static, they cannot be adopted to explain the process of vocabulary knowledge acquisition. The acquisition of vocabulary takes place in a specific social and cultural environment with the aim of performing specific thinking and communicative functions. In addition, it also relies on the interaction between the words. To understand and realize L2 vocabulary acquisition, we need to understand and interpret the dynamic relationship between the words. Therefore, on the one hand, the use of words (lexical competence) should be paid attention to in the field of L2 vocabulary acquisition; on the other hand, when vocabulary acquisition is being discussed, the development of lexical competence

needs to be taken into systematic consideration from the perspective of mental lexicon network.

Attempting to build a conceptual framework of lexical competence centered on the lexicon, Meara (1996a, 1996b) believes that lexical competence should include three dimensions: the vocabulary size, the organization of the mental lexicon (the number of associations between words in the mental lexicon), and the speed of lexical accessibility (the degree of automaticity in accessing vocabulary). Vocabulary size generally refers to the vocabulary breadth, which is the number of words that the learner knows. The meaning "knowing" here denotes the basic meaning of grasping. The term "organization" here indicates to the organization in terms of the whole lexicon, not just the internal organization between the words. L2 learners have fewer "association knots" in L2 vocabulary than native speakers do. With the condition of same size vocabulary mastered, the L2 learners with better mental lexicon organization have higher lexical competence. The speed of lexical accessibility refers to the speed of storing and retrieving of the receptive vocabulary and the productive vocabulary.

Based on the integration of the previous vocabulary knowledge framework (Chapelle, 1998; Qian, 1998; 1999; Henriksen, 1999; Nation, 2001), Qian (2002) put forward a lexical competence framework composed of the following elements: 1) vocabulary size, refers to the number of words that learners know the basic meaning; 2) the depth of vocabulary knowledge (including all the features such as phonetic, morphemes, syntax, semantics, collocation, word frequency, register, etc.); 3) vocabulary organization (The storage, association and characterization of vocabulary in the learner's mental lexicon); 4) the automaticity of the receptive-productive knowledge (refers to all the basic processes involved in retrieving vocabulary knowledge for receptive and productive use, including encoding and decoding of pronunciation and spelling, structure and semantic content retrieved from the mental lexicon, vocabulary-semantic integration and representation, segmentation and combination of morphemes). The four dimensions in the framework are not only intrinsically linked, but also interact in the use and development of L2 vocabulary. This framework includes not only the vocabulary breadth but also the vocabulary depth. If the vocabulary size answers the number of words that the learner "knows", then the depth of the vocabulary answers to what extent a word is understood. With the vocabulary size increases to a certain level, the importance of it declines, and the depth of vocabulary knowledge becomes more essential (Read 1993; Wesche & Paribakht 1996). The depth of vocabulary knowledge in the framework basically

contains the vocabulary knowledge dimensions aforementioned, which reflects the multidimensionality of vocabulary knowledge. More importantly, this model emphasizes that vocabulary knowledge is not only the simple accumulation of a single dimension, but also the interweaving connection between the different dimensions. The amount of knowledge in each dimension, combined with the network formed between the dimensions, directly determines the receptive and productive use of vocabulary. It can be concluded that this framework is better than the previous ones because it presents the size of words, the connotation of words, and the systematic relationship between the connection and retrieval of words.

Taken all together, it can be seen that L2 vocabulary is an organic system that is composed of different layers (or vocabulary types), different levels, different breadth and depths, while vocabulary knowledge of L2 is one of the "frames" composed of different layers. The development process generally goes through a slow development process from cognition (i.e., receptive ability) to the application (i.e., productive ability). Besides, the different levels of L2 vocabulary knowledge are not separated or independent but are interconnected with each other and develop together, although there may be differences in the speed and level of development. Moreover, L2 vocabulary knowledge is interrelated with L2 proficiency level and L2 vocabulary size, therefore, learners with different L2 proficiency and vocabulary size may have differences in L2 vocabulary knowledge and the depth of acquisition (Liu, 2001).

2.3.3 The Role of Vocabulary in Language Acquisition

As Ellis (1997) stated that, essentially speaking, vocabulary is intricately linked to a learner's proficiency and ability to function in a language. So, when students claim that they are struggling to understand what they are learning in English, which most probably indicate that they have difficulties in coping with the vocabulary. Therefore, it is indispensable to include a focus of vocabulary when students need to successfully access their learning in the learning context where they struggle with proficiency in language. As the core of language teaching and learning, vocabulary deserves a more prominent features in language teaching and learning (Carter & McCarthy, 2013).

However, teaching and learning vocabulary seems to be incorporated (sometimes implied) in the studies which are focusing on reading, writing, and second language acquisition (Carter & McCarthy, 2013). As early as the 1980s, Meara (1980) has noticed the importance of vocabulary, but there is a dearth of research related to vocabulary. The reasons for this situation are that only grammar was concerned and

focused on at the time as well as lack of the effective vocabulary teaching model. For a long time, vocabulary was not paid enough attention in second language teaching and learning (Cahyono & Widiati, 2015).

Until recently, Folse (2010) noticed that the interest on vocabulary development has been increasing gradually, which propels the change of the prospects in vocabulary research in recent years. For instance, Newton (2001), in his study, left students the determination of the word meanings by exposing them to new vocabulary items without teacher's explanation or the dictionary in the reading tasks. In doing so, he discovered that the process of negotiating meaning from context could lead in an increase in examples of language used by the students. What's more, the vocabulary newly learnt by the students was retained for days after the completion of the learning task.

Another vocabulary study was conducted in a secondary school in China by Tang & Nesi. (2003) In this study, the participants learned the vocabulary in planned lessons with multiple treatments and various kinds of input. The results indicated that the positive perspective was that the learners had mastered the targeted vocabulary included in the vocabulary test, while the drawback lied in that even with the extra lessons given by the instructor, the learners barely had chances for the output.

In order to observe which type of vocabulary instruction could produce a better learning outcome of vocabulary, Akın & Seferoğlu (2004) compared two instructions of vocabulary based on delayed recall - one is using a course book of its own, the other is a combination of strategy awareness and recycling words. The result showed that the latter one contributed more positively to the vocabulary recalling in the selected items during the learning process.

In the research done by Erten and Tekin (2008), a controversy whether the vocabulary teaching should be carried out in semantically related sets or in semantically separated sets was triggered. This research aims to probe into the effects of vocabulary recall of the above two methods vocabulary teaching. Through the statistical analysis, the results indicated that by adopting the semantically unrelated sets, students produced better results than using the semantically related sets. The effect in vocabulary recalls even keeps further in the delayed posttests. The findings of this research are in congruence with previous findings of Finkbeiner & Nicol's (2003). They asserted that teaching vocabulary in semantic sets had a "deleterious effect on learning", which means learning in semantic sets was of uselessness and harmful to vocabulary learning.

In summary, from the aforementioned studies, it can be seen that there are various perspectives concerning what should be focused in vocabulary learning and teaching, from negotiated meaning and opportunities for output to vocabulary teaching in semantically related sets or unrelated sets. What's more, studies related to vocabulary implicit teaching focused on the individual learners who mastered words while reading or being engaged in other learning activities. Studies concerning explicit vocabulary teaching are inclined to concentrate on learners and words, ignoring the effects of interaction. Therefore, how vocabulary learning is enhanced by interaction should also be taken into consideration. As is well-known, vocabulary learning does not just happen in a vacuum but in use. So, it is essential to consider interaction when one is learning vocabulary.

2.3.4 Types of Vocabulary Learning

According to Webb & Nation (2017), there are two main kinds of vocabulary learning, namely, incidental learning and intentional learning.

Generally speaking, incidental vocabulary learning refers to the learning of words that occurs naturally in the context of daily life, to simply put, students learn knowledge or words "accidently". There are several different definitions of incidental vocabulary so far. Schmidt (1994) defined incidental vocabulary learning refers to acquiring new words from various contexts without explicit instruction. Wesche and Paribakht (1999, p.176) took it as what takes place when "learners are focused on comprehending meaning rather than on the explicit goal of learning new words." Huckin and Coady (1999) presented that the incidental learning is a "by-product, not the target, of the main cognitive activity, reading". Despite of the various different definitions, the most common one is the one proposed by Ellis (1999). He proposed that incidental vocabulary learning refers to "learning words as a by-product of a task". For instance, in daily life people will pay attention to understanding the message when they read or listen to some material, but during this period of time, people may pick up some words which are encountered in the message by hearing or seeing repeatedly in context, which indicates that people's intention lies in understanding the input, not in picking up the new words on purpose. Thus, vocabulary learning is considered as being incidental rather than intentional. Just as Webb & Chang (2015a) proposed, the amount of incidental vocabulary learning relies on the number of inputs. More inputs denote that there are more opportunities for repeated encounter of the words, and therefore there will be a greater probability for people to learn words. In addition, according to Schmidt (1994), incidental vocabulary learning has the cumulative feature, which means that the learners utilize accumulated occurrences and contexts to form

a more complete sense of word meanings. Plus, it is highly individualized since it heavily depends on the language exposure and engagement. In the world today, people have entered the digital era, which indicated that the learners' experiences have been transformed as they have increased online access to all kinds of resources in English (audio, video and multimedia products such as millions of free eBooks provided in e-libraries; private texts in the form of microblog, weibo or Facebook; free access to all kinds of movies; free access to the journals, newspapers etc.) The learners have enough freedom to pursue the knowledge based on their own willing, and to learn vocabulary incidentally from authentic materials. To sum up, incidental vocabulary learning refers to the learning with accumulative, ubiquitous, and individualized features, and it occurs without explicit instruction.

The other kind of vocabulary learning is called intentional learning or deliberate learning. Be contrary to incidental learning, it refers to learning that students consciously undertake and is defined as being designed or planned by teachers and students. It is generally believed that intentional learning focuses attention directly on the information to be learned, which offers the greatest opportunities for its acquisition. Just like Hulstijin (2001) stated that any activity aimed directly at acquiring new words by committing lexical information to memory is referred to as intentional vocabulary learning. For example, at school setting, instructors might intentionally extend students' vocabulary by giving them specific tasks to complete, such as matching exercises, filling in the blank, or looking up words in a dictionary. At other settings, students may try to learn how the word is used and pay attention to its grammatical functions and collocations, or compare the new words with the word parts they already know. In other words, intentional learning happens when the students focus on a single aspect of vocabulary knowledge, such as spelling, and analyzing the written form of the word so that they could remember how to spell it the next time they need to use it. Some scholars suggested that in the EFL learning context, intentional learning might be responsible for most vocabulary growth (Laufer, 2003, 2005; Cobb, 2007; Webb, 2008a). Other scholars such as Laufer (2005) reckons that intentional vocabulary learning is a must for a better chance of retention and mastery of specific vocabulary, with incidental learning being complementary.

In summary, intentional vocabulary learning happens when learners try to figure out the meaning by using any tools or the teacher gives them activities that aim at acquiring new words. Explicit instruction is necessary for this kind of vocabulary learning. Nation (2014) proposed strategies for learning vocabulary deliberately: studying (unknown) words preferably through the use of bilingual word cards; doing

intensive reading while consciously focusing on vocabulary with the help of a teacher or a dictionary, and getting feedback on spoken and written production. Among the vocabulary learning strategies that English learners use are the dictionary, notebooks, flashcards, reading activities, use of L1, and mobile devices.

Based on the above statements, the comparison between incidental learning and intentional learning could be made from two aspects: firstly, from the learning gains made by learners, as Webb (2002) and Laufer (2003) stated that when the gains made by students in incidental and intentional learning are measured, the intentional learning gains are always much larger. However, when the long-term gains are being considered, what might be gained is unclear. Webb & Nation (2017) argued that intentionally learning the form and meaning of words will definitely lead to greater knowledge of the form-meaning connection of words in the short term, yet it seemed to be undetermined whether intentional learning produces greater knowledge of the form-meaning connection of words than frequent encounters of words repeatedly over a long period of time. Webb & Chang (2015a) proposed that incidental learning of the form-meaning connection in words through reading and listening takes time and is achieved most effectively through reading and listening to large amounts of the language. Moreover, Webb & Nation (2017) mentioned that when certain aspects of vocabulary knowledge are discussed, such as grammatical functions, collocation, and association, they might be better developed through repeated encounters in spoken and written input. Secondly, from the value that each learning provides, students tend to make relatively large and rapid gains in vocabulary knowledge through intentional learning. However, they might not learn many things about the words through quick study. For example, some frequent collocates of ‘take’ include: ‘~ care’, ‘~ control (of)’, ‘~ place’, ‘~ over’, ‘~ down’, ‘~ steps’, ‘~ turns’, ‘~ back’, ‘~ away’, ‘~ up’, and ‘~ in’. Most intentional learning activities are improbable to contribute to the knowledge of more than one or two collocates. We can easily made similar arguments regarding the learning of various derivation, association and senses of words through intentional instruction. On the other hand, though it might be considerable amount of knowledge that can be gained through repeatedly word-encounters, it is a quite time-consuming process, and it relies largely on whether the students could receive sufficient input or not.

Having weighed the two methods of learning, it seems clear that both incidental and intentional learning provide benefits and should therefore be included together in a vocabulary learning process. (Webb & Nation, 2017).

2.3.5 Vocabulary Teaching

As early as 1970s, Politzer (1978) proposed that the word in use is crucial in interpersonal communication and based on his research, students held the belief that mistakes made in vocabulary belong to the most serious category among all the error types. Later, Krashen and Terrell (1983) also stated that without comprehension of vocabulary, language acquisition will not even take place, which indicates the magnitude of vocabulary in language learning. Besides, Zimmerman (1997) argued that vocabulary is vital to language and of critical importance to the typical language learner. Therefore, it is obvious that vocabulary can facilitate or obstruct the communication process just as it can advance or hinder academic achievement. As Nation and Waring (1997) pointed out that there are not only serious errors related to lack of vocabulary in academic performance, but there are also 2000 high-frequency English words which hinder students to use English in a "right way". In addition, there are another 800 academic words in English which can meet the students' need for reading newspapers with comprehension and for academic study in any field. Coxhead (2000) further renewed these academic words in the Academic Word List (AWL). In a word, it is apparent that if a language needs to function normally, and specifically for academic study, it needs to be supported by well-developed vocabulary.

Many scholars admitted that vocabulary is of essentiality in both language learning and communication (Gu & Johnson, 1996; Nation, 2001, 2006), but there has been an obvious exiguity of research with a clear focus on vocabulary. Gass (1988) expounded the concept of the difference between the importance of vocabulary and limited research and focused on vocabulary. He pointed out that although the lexicon has an obvious role, it still has a unique position in L2 research. This opinion was supported by Oxford and Scarcella (1994) and Zimmerman (1997). The assertion above does not imply that there does not exist research in vocabulary, but Carter and McCarthy (2013) state that although there has been an increasing growth interest in vocabulary research to some extent in the past 25 years, the evidence of that interest is scarce. Back to 1970s, Wilkins (1972) stated that one can convey his idea with little grammar, but never does he convey the idea without words. Thus, it is needful to research and report on studies that focus on explicit vocabulary teaching and learning.

The situation mentioned above does not indicate that research on vocabulary development does not exist, but to show that the vocabulary has been attributed to something that can be acquired incidentally due to the focus of teachers and learners transferring to other aspects of language teaching and learning, Owen (1993) provided some examples in which the discussion revolved around teaching

grammar in relation to vocabulary because they are closely related or these two are taught separately. So far, language teaching has mainly focused on syntax, learning style, learner's motivation, student needs, learner strategies and incidental learning (Folse, 2004). In other words, it seems to be a strange thing that when learners focus on input, vocabulary will be picked up in some way. The debate on how language is learned and by extension, how it should be taught, has continued for many decades, largely between implicit and explicit vocabulary teaching. The supporters of implicit vocabulary teaching and learning claim that learning vocabulary is incidental and takes place when one is involved in other pedagogical activities. Gass (1988) labeled incidental vocabulary learning as a by-product of other cognitive activities that needs to be understood. Therefore, incidental vocabulary learning is thus implicit. Implicit language learning can be dwelt on the mother tongue acquisition in which the main mode of vocabulary acquisition is incidental, that is, through listening and interacting with people around.

Although this study acknowledges the advantages of implicit vocabulary learning, it recognizes the merits of direct and purposeful teaching of vocabulary in the form of explicit vocabulary teaching. Furneaux (1999) proposed that vocabulary teaching deals with the selection and presentation of words for learners. Dempster (1996) emphasized that the importance of systematic and planned vocabulary teaching should be paid the attention to, besides what must be taught and how it should be taught should also be underscored. In this case, the intentional and conscious vocabulary learning leads to vocabulary growth in SLA.

Previous studies which compared implicit and explicit vocabulary teaching and learning have shown that intentional vocabulary learning is more effective than incidental acquisition. Explicit learning of new words can lead to an increase in vocabulary and better retention of learned words. Although there are some controversies about explicit and implicit vocabulary teaching, vocabulary teaching is still guided by well-supported principles (Nation, 2004), because vocabulary is an important part of language and language learning. It is arguable, though, that both implicit and explicit vocabulary teaching can be used together for effective vocabulary development, this particular study will focus on the explicit teaching of vocabulary, while acknowledging that students can and will be exposed to the environment in which they will learn vocabulary intentionally. In order to investigate the vocabulary learning behavior, this study will focus on the explicit teaching of the vocabulary. The question is: if students randomly pick up vocabulary as they focus on other cognitive tasks such as reading comprehension, then how they will understand what they are

reading if they have not been taught those words. (Folse, 2004; 2010). Ellis (1994) proposed that understand the entire paragraph, the memory of new words comes from the natural result of this process, without consciously studying hard. In other words, what all the learner seems to have to do is to focus on mastering the general concepts of the text, rather than learning specific words. If a reader needs to understand 95% to 98% of words in a text he or she is reading (Nation, 2006), then how will comprehension lead to vocabulary being acquired if those words are not taught? This study, thus, will focus on explicit vocabulary teaching and interaction in a seamless learning environment using mobile learning technologies.

2.3.6 Principles of Vocabulary Teaching and Learning

While there is a consensus that vocabulary is a crucial part of proficiency and the ability to function in a language, "the best means of achieving good vocabulary learning is still unclear, partly because it depends on a wide variety of factors" (Schmitt, 2008: 329). Researchers such as De Groot (2006) have drawn attention to the lack of agreement on the core principles of vocabulary learning. According to De Groot, the uncertainty is attributed mainly to the wide variety of factors that affect vocabulary learning. Some studies, for example, emphasize the importance of learner motivation in vocabulary learning. Gardner and MacIntyre (1991), in reporting a study on learning vocabulary, assert that both integrative and instrumental motivation influence the rate of second language learning. The seemingly dichotomous nature of instrumental and integrative motivation has been a subject of much debate in Second Language Acquisition (SLA). The consensus is that instrumentality and integrativeness complement each other when a learner pursues individual goals (Dörnyei, 2003; MacIntyre, Baker, Clément, & Conrod, 2001). While this particular study does not focus on motivation, the intervention was designed in a manner that would appeal to the participants. According to Dörnyei (2003), language learners could be in the pre-actional stage-where motivation is generated; the actional stage-where motivation is actively maintained and protected as well as the post-actional stage-where the learner evaluates his or her progress and experiences, noting the strategies that primarily worked in helping to protect his or her goal. In this study, there was no control over the first stage of motivation; however, the vocabulary intervention took cognizance of the need for activities to appeal to the participants, so their attention and interaction are maintained for successful vocabulary learning (Oxford & Scarcela, 1994).

Other studies, in search of the best way to teach vocabulary, have highlighted the importance of tailoring vocabulary learning programs to various learner attributes such as their learning styles. Curry (1983) stated that there are as many

definitions of the concept of learning styles as there are researchers who have written on the subject. This is what often causes confusion and difficulty when one tries to apply the learning style theory in some contexts. According to Curry (1983: 3), the concept of learning styles refers to a "general area of interest concerning individual differences in cognitive approach and process of learning". While Curry's definition related to a general area of interest, Felder and Henriques (1995) provided a more accurate view of learning styles as diverse ways in which different individuals receive, process and retrieve information. Again, this particular study does not focus on learning styles, but it acknowledges that the use of m-learning technologies provides numerous opportunities for the participants to interact and learn in ways as closely linked to their learning styles as possible, using podcasts, audio and video clips, graphics and designs, pictures and videos and even reading and writing.

With the varied options for areas of focus concerning teaching vocabulary, this study sought guidance in the literature for principles that guide vocabulary teaching and learning. This study, thus, relied on three principles including explicit vocabulary teaching; repeated exposure to vocabulary as well as assessment (Folse, 2010). Generally speaking, according to Folse, explicit vocabulary teaching and repeated exposure to the words involves actions from the teacher and the learner. The teacher draws attention to the word being taught "in some way, such as by writing it on the board, using it in an example sentence, repeating it, asking what it means, asking students if they know its meaning, or asking students to use it in an example" (2010: 144). The student, on the other hand, focuses on the word "by looking it up in a dictionary, asking the teacher or another student for its meaning, attempting to use it in an example, or even highlighting it in the book or on the worksheet". Assessment, Folse (2010: 149) stresses, should form part of a vocabulary program while vocabulary activities should emphasize word use and go "beyond definitions". More details and related research regarding the three principles will be given in the following section.

Explicit Vocabulary Teaching

The first fundamental principle of vocabulary learning is explicit teaching of the lexicon (Nation, 1990). That is to say, the direct instruction of vocabulary should be presented for a particular text. As explained above, vocabulary is a must for students to comprehend what they are reading (Anderson & Nagy, 1991). Oxford and Scarcela (1994) reckon that if the teachers just assign a list of vocabulary for the learners to memorize without any guidance, it is far from enough. According to Schmitt (2008), the majority of vocabulary materials and activities just function as the meaning providers. The same thing happened on the most of vocabulary learning apps across

platforms, languages and proficiency levels. The form and meaning of words seem to be the focus of many applications, but the use of vocabulary is ignored. It will not help if the learner spells the word correctly and uses it inappropriately in the context.

Just as Gee (2014) claimed that even if the definition of a word is informed, it only presents us a range of meanings a word has, it does not really tell us how to use the word appropriately in actual contexts of use. Being unable to recognize and apprehend the context in vocabulary teaching and use may lead to precarious consequences. For an instance, the word for obtaining something with one's hands, could include "take", "grab", "grasp", "seize", "grip", and so on. To use "take", or "grab" is depending on the context. Therefore, just as Stahl and Kapinus, (2001) stated that knowing how a word looks or how it is related to others is of exiguity, since people need words, so they are able to function appropriately in different contexts.

In a word, vocabulary teaching should be explicitly conducted for learners so that they could get familiar with the context of using the words.

Repeated Encounters with Words

The second principle relates to repeated exposure to vocabulary (Craik & Lockhart, 1972) which, according to Thornton and Houser (2001) leads to deeper mental processing. Ellis (1996) stated that memory functions through short-term and long-term processes. Words stored as short-term representations are quickly forgotten, whereas long-term representations of words are retained longer. Words learned through short-term representation can be maintained as long-term memory through rehearsal or practice, resulting in acquired vocabulary. In other words, the intervals for learning are not only intended to provide space between the learned words but also to give room for recycled vocabulary; as new words are added, older words are reused as the vocabulary increases. Ellis found that rehearsal "results in superior performance" in a range of linguistic activities (1996, p.243). The notion of multiple exposures to new words in various contexts is supported in the literature as a crucial aspect of vocabulary teaching and learning (Henriksen, 1999; Nation, 2001; Schmitt, 1998). The concept of creating opportunities for repeated interaction with vocabulary is evident in Wilkins' (1974) assertion that a language learner should receive considerable exposure to vocabulary. The exposure should not be mere repetitions, but students should have opportunities to encounter words repeatedly in a variety of contexts (Stahl, 2005). Schmitt has elaborated on the importance of contact with vocabulary by declaring, "The overriding principle for maximizing vocabulary learning is to increase the number of engagement learners has with lexical items" (2008, p.329). While many other strategies could be used to enhance vocabulary, Schmitt argues,

"Overall, it seems that virtually anything that leads to more exposure, attention, manipulation, or time spent on lexical items adds to their learning" (2008, p.339). Nation sums up the importance of repeated exposure by contending, "The more meetings, the more likely learning is to occur" (2015, p.136). It is against this background that vocabulary teaching in this study was designed into the mobile vocabulary app as well as WhatsApp so that the participants and, ultimately, students would have multiple encounters with learned vocabulary in a variety of contexts.

Assessment

The final principle for vocabulary development in this study relates to assessment (Folse, 2006). Assessment forms an important part of vocabulary learning because testing vocabulary facilities vocabulary retention (Mason & Krashen, 2004). According to Dougherty Stahl and Bravo (2010), assessment plays a crucial role in vocabulary teaching, for the benefit of both the teacher and the learner, in that it determines learners' vocabulary growth and helps to direct vocabulary instruction. The assessment of vocabulary provides more opportunities for repeated encounters with the learned word as well as opportunities for output in the form of rehearsals (Thornton & Houser, 2001). Rehearsals, which include using the new word in various contexts, are not haphazardly thrown to students, but are spaced to facilitate systematically and planned vocabulary teaching and learning (Dempster, 1996). Because vocabulary learning follows a developmental trajectory (Biemiller, 2004) which, according to Schmitt (2008), is sometimes referred to as incremental learning, recycled words in the assessment ensure that new words are used together with older words through practice. Acknowledging the importance of assessment as a crucial part of teaching and learning leads to the question of how the assessment should be carried out. Read (2000) pointed out that the first step to vocabulary assessment is the design. To this extent, Read (2000) put forward a model which can be used to inform assessment design as shown in Figure 2.5

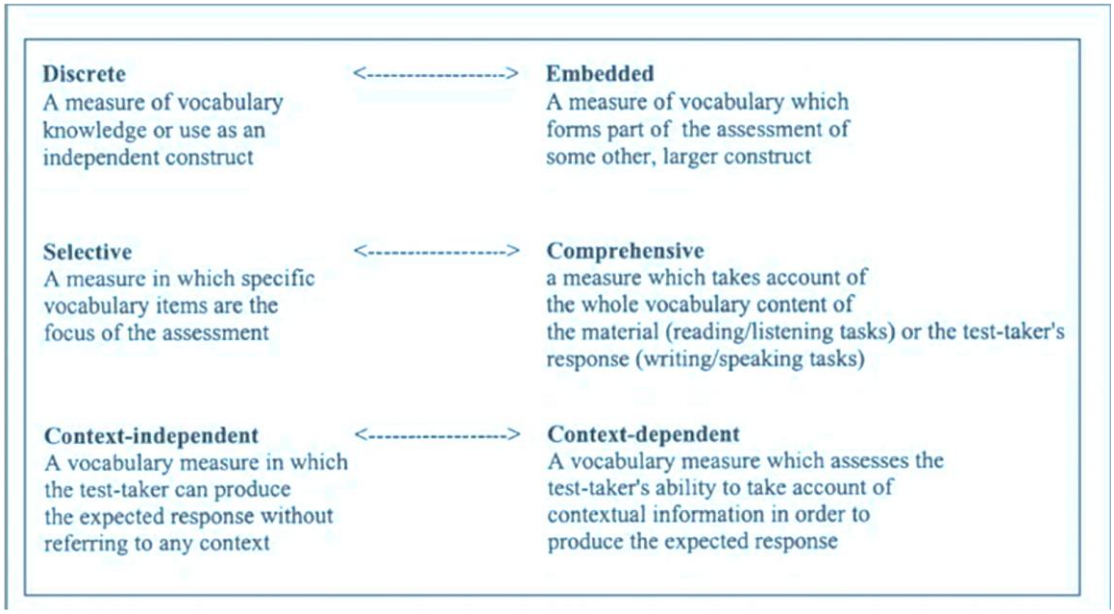


Figure 2.5 Model for assessment design (Read, 2000)

According to Read's dimensions, therefore, the Vocabulary Levels Test on which the vocabulary in this study is based is discrete, selective, and context-independent (Read & Chapelle, 2001). The vocabulary exercises that form part of the intervention, however, are embedded, particular and context-dependent in the form of multiple-choice questions and writing sentences and paragraphs.

Taken all together, based on the above fundamental principles, vocabulary should be explicitly taught in its multi-componential nature while providing opportunities for repeated exposure to the learned words and rehearsals. Assessment, in various forms, is a crucial part of vocabulary teaching and learning.

2.3.7 Challenges, Difficulties, and Gaps in Vocabulary Learning

It is common for learners to encounter a variety of challenges and difficulties as they attempt to acquire vocabulary in a second language (L2). These challenges arise from the interaction between the learners' native language and the target language. This section provides insight into the complexities of L2 vocabulary learning and the profound impact of L1 concepts on the mental lexicon of L2.

We begin by discussing the foundational theories proposed by renowned linguists. These theories include Levelt's model of the internal structure of the lexical entry, which provides insight into how words are represented within the mental lexicon. We thus gain a deeper understanding of the challenges faced by adult learners in assimilation of new words in L2, especially when their mental lexicon is still in its developmental stages. Furthermore, the section emphasizes the differences in

conceptual representation between the L1 and L2, emphasizing the role of cultural and social factors in shaping language comprehension. A number of empirical studies have also examined the relationship between the conceptual systems behind words and the acquisition of the first and second languages. As a final note, we explore the profound effect of L1 semantics on the mental lexicon of L2. A series of models and hypotheses illustrate the stages of L2 vocabulary learning, from lexical association to full integration, emphasizing the involvement of the mother tongue.

The Influence of the Concept of L1 on the Mental Lexicon of L2

Levelt (1989) proposed a model of the internal structure of the lexical entry, which is represented in the mental lexicon of adult native speakers (Figure 2.6). This model can be divided into two parts: lexeme and lemma. The lexeme contains the morphological, phonological, and orthographical information which represents the form of the word; the lemma includes the semantic and syntactic information, which indicates the content of the word. Besides, a word also contains its corresponding conceptual system characterized in L1. All of these constitute a complete status of a word in a mental lexicon.

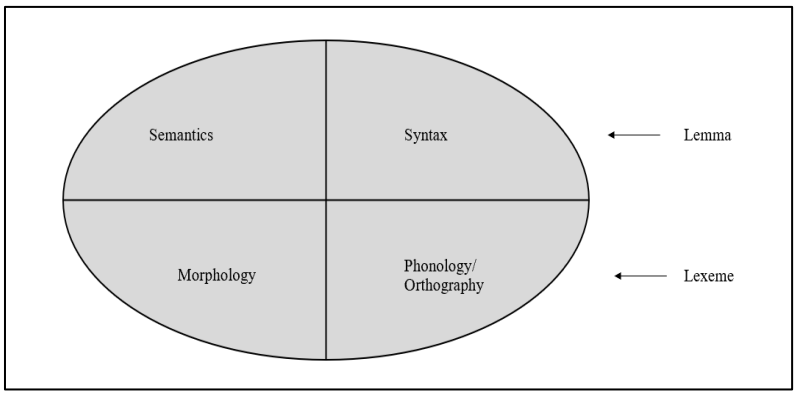


Figure 2.6 The Internal Structure of the Lexical Entry (adapted from Levelt, 1989)

When adult learners attempt to pick up a word in L2, a lexical entry will be created in their minds. Since orthographic information and phonological information belong to the basic visual and audio elements which can be easily distinguished between L2 and L1, so these elements will be built in the lexical entry immediately. As Figure 2.7 shows, the shape with solid line refers to the segment which has been built in the lexical entry. Meanwhile the L2 lexical system in learner's mind has not yet been established (the area with dotted line in Figure 2.7), therefore the semantic and syntactic information related to the new word needs to be expressed by L1. Thus, the corresponding semantic and syntactic information in the phrase is written into the

lexical entry in learner's mind (see Figure 2.8), which completes the most basic requirement for the learner to match the "form" with "meaning". When the word needs to be used, it must be "borrowed" from the corresponding L1 word (see Figure 2.9). However, the morphological information such as the inflected form and derived form of the word are relatively minor in the practice of communication, and there is no equivalent information in the L1 vocabulary, so it is difficult to be written into the lexical entry. In this beginning phase, the words used by L2 learners will show the characteristics of the interlanguage, that is, the phonological and orthographical features of L2 represent the whole lexical entry, and the semantic and syntactic features of L2 actually duplicate words of L1, and L2 learners also frequently make mistakes on the morphological levels. With the continuous learning and observation of the context and syntactic information of the word, the learners may optimize lexical entry and gradually replace the semantical and syntactical features which they used in the initial stage with the genuine ones in L2, and the morphological characteristics of the word are correctly matched with the semantic and syntactic features, which will make the learner get close to the word use of the native speakers.

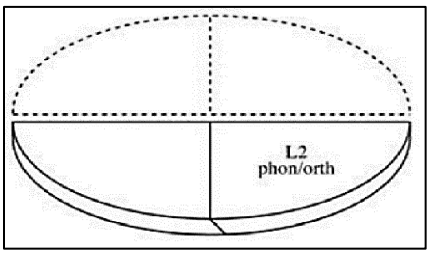


Figure 2.7 The orthographic and phonological representation of L2 words in mental lexicon (Levelt, 1989)

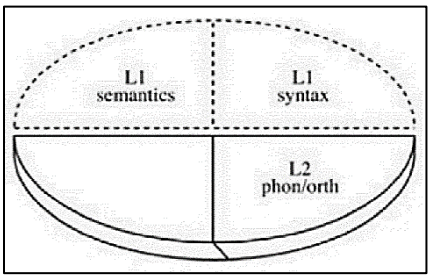


Figure 2.8 L1 representation of semantics and syntax in L2 mental lexicon (Levelt, 1989)

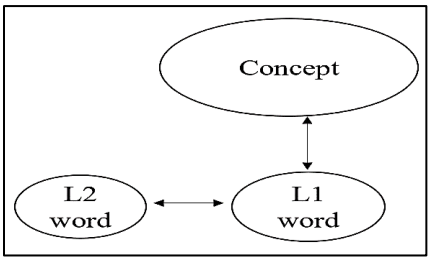


Figure 2.9 The retrieval process of L2 words through the translation of L1 equivalent words (Levelt, 1989)

The Disparities in Conceptual Representation between L1 and L2

However, this model does not take the disparities of the conceptual representation in L1 and L2 into consideration. The language acquisition process is also the process of concept acquisition, so language is a basic tool to express conceptual systems. On the one hand, people in different regions have numerous common perspectives on specific things, which may cause them to use similar concepts for describing things in different languages. On the other hand, due to the different social and cultural concepts, different races have their own unique perspectives which shape the unique concepts, and then these concepts are expressed in specific languages. Therefore, the acquisition of words should not only consider lexeme and lemma, but also the conceptual level of words. Take the common noun “dog” for an instance. If this word refers to “a common mammal with four legs especially kept by people as a pet or to hunt or guard things”, then in Chinese and English they are equivalence. However, in Chinese culture, the word “dog” contains the meaning of “being in low social status”, “adulating” and “fawning upon the rich and powerful people”. In Western culture, although the word “dog” also has the meaning of “despicable”, it can also be expressed as “tenacious”. The reference of words cannot be categorized completely in one-to-one relationship in different languages, and the corresponding conceptual systems may be overlapped or separated. For English learners whose native language is Chinese, the meaning of the word “dog” cannot be grasped solely from the semantic point of view but needs to be learned through the understanding of the cultural factors behind the context, which involves the sharing and separation of conceptual systems.

In order to examine the relationship between the conceptual system behind words and the acquisition of L1 and L2, de Groot et al. (de Groot, 1992; de Groot, et al., 1994) analyzed recognition task regarding the translation of specific/abstract words through a series of empirical studies. The distributed model is proposed based on the experimental results (see Figure 2.10). L1 and L2 represent specific words in the first

and second language respectively, and concept 1 to concept 2 represent all the notion. Among them, concept 2 to concept 4 are the parts shared by L1 and L2 words. Concept 1 and concept 2 are the unique elements in L1 and L2 respectively. The specific words which reflect the common experience of human beings (such as earth, sky, water) and the cognate words such as ("gratitude" in English and "*gratitud*" in Spanish) share commonalities in concepts, while the abstract words which connotate social and cultural traits. (such as happiness, life, religion) share the relatively fewer conceptual meanings than the former one.

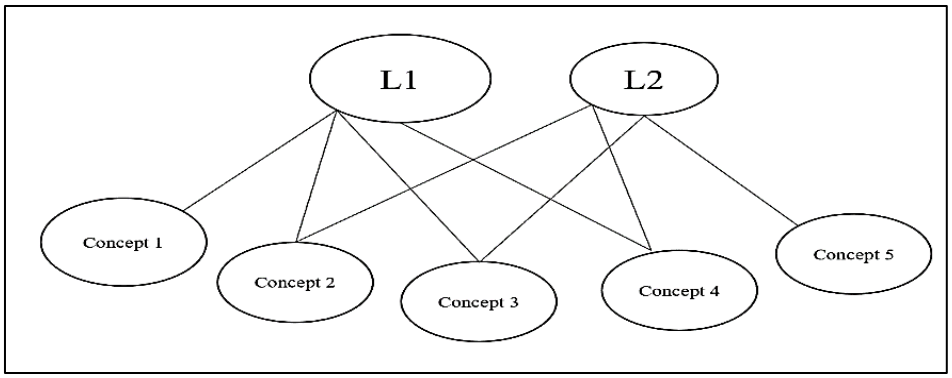


Figure 2.10 The distributed model (adapted from de Groot, 1995)

Dong et al. (2005) proposed the shared (distributed) asymmetrical model based on the previous research on the experiments of association between L1 and L2 (see Figure 2.11). It can be seen that the lines connecting L1-L1, L2-L2 elements are solid lines; the lines connecting L1-L2 elements, L2-L1 elements, and connecting L2-Common elements are dotted lines; the solid line connecting L1-Common elements and the dotted line connecting L2-Common elements are bold lines. The solid, the dotted, bold solid and bold dotted lines stand for the strength of the connection. The model shows that the strength of connection between L1 words and a shared core element is stronger than that between L2 words and a shared core element. In the early stage of L2 acquisition, the unique conceptual elements and shared conceptual elements of L1 are linked to L2 words.

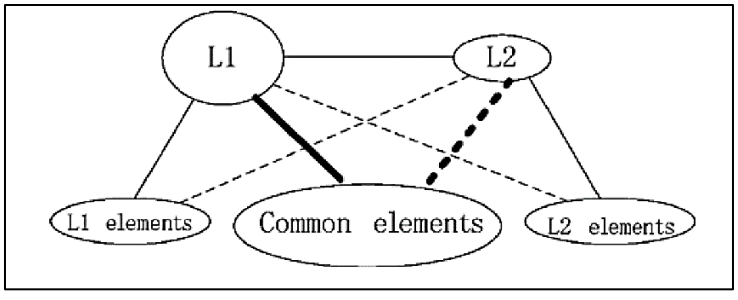


Figure 2.11 The shared (distributed) asymmetrical model (Dong et al., 2005)

With the improvement of second language proficiency, the specific conceptual connection between the L2 and L1 becomes weakened, while the connection between L2 words and their conceptual element is enhanced. It is also found in the study that the connection between L1 words and L2 conceptual elements is also enhanced, but its connection is not as solid as the connection between L2 words and their conceptual elements. Based on this model, the total conceptual elements corresponding to L1 can be taken part into the specific conceptual elements of L1 and a conceptual element shared with L2 words. L2 vocabulary acquisition requires a complete allocation of a conceptual element with L1 vocabulary. With the development of L2 proficiency, the learner's L2 concept system grows mature. The part of the L1 conceptual element which is inconsistent with the second language will gradually be stripped away. At the same time, the unique conceptual elements of L2 merge into vocabulary learning. However, the development of the conceptual system formed by L2 vocabulary acquisition does not reach the corresponding development of L1.

The Influence of L1 Semantics on L2 Mental Lexicon

Jiang (2002, 2004) conducted the research on the same-translation effect of second-language users. Through research on L2 learners' translation of two sets of L2 word pairs (one set of words pairs are often translated into the same meaning in the mother tongue; while the other set of words pairs are different in the native language), he noticed that the difference lies in the response time of L2 learners. The response time to the former set is shorter than the latter one. So, it is concluded that the semantics of L1 is involved in the processing of L2 vocabulary. Thus, he proposed and validated the semantic transfer hypothesis:

- The phase of lexical association: A word entry is established in the L2 lexicon, which contains the specific information form, and has a pointer to connect the word to L1 translation. The use of L2 words relies on and leverages the equivalent translation words in L1. Equivalent translation words have complete semantic, syntactic, morphological, and formal information as L1 words. The L1 lexical entry provides the key information such as syntax and semantic for the use of L2 words. When the use of L2 is activated, this kind of information is also activated synchronously. As the frequency of synchronization activation increases, the L1 lemma information is transferred to the L2 lexical entry.
- The phase of L1 lemma mediation: as the connection between L1 lemma information immigrated and the corresponding concept of L2 is enhanced,

the translation behavior of L1 declined. With the increase of the contextualized input, the unique meaning of L2 is added to the L2 lexical entry. so, the L2 lemma contains information related to L1 and L2.

- The phase of full integration: as the specific information of L2 takes up the L2 lexical entry, and L2 word and its conceptual connection are strengthened, the morphological knowledge is merged, and the connection between the L2 words and its corresponding translation words in L1 is diminished.

Jiang's model not only depicts the constituent elements and development process of second-language vocabulary but more importantly, it also elaborates on the inevitable participation of the mother tongue in L2 vocabulary acquisition. In the initial stage of L2 vocabulary learning, the spelling and pronunciation of the L2 words are mastered first. At this time, the semantics and related concepts of L1 must be assigned, and the corresponding syntax is adopted to activate the use of the L2 words. Therefore, it can be concluded that the phrase played an important role in intermedia. Under the context in which the syntactic and semantic knowledge closely related to L2 are in scarcity, the use of the L2 words can only rely on the semantics of the translated equivalent and its corresponding syntactic and semantic information. The more frequently such situation happens, the stronger the connection between L2 form and L1 semantics/syntax becomes, and thus it is more likely that fossilization in L2 vocabulary use will occur, and stay in the phase of L1 lemma mediation. "There is already considerable evidence indicating that semantic development can be very slow and often unsuccessful in L2 acquisition." (Jiang, 2004; p. 425). For example, Schmitt (1998) found through a longitudinal study in a graduate program at a British university that if the students did not know the meaning of an English word at beginning of the study, then in most cases (72%), they had no knowledge of that sense after a year of studying. Besides, Verhallen & Schoonen (1993) found that even for children who are at the same age, the semantic development of L2 vocabulary is slower than their peers who learn L1. Even if children learn second-language vocabulary, the level of semantic progress is lower than that of children of the same age (Verhallen & Schoonen, 1993). Jiang (2004) believes that in order to make the mental lexicon of L2 learners independent from their mental lexicon of L1 and build up the morphological, syntactic, semantic, and conceptual connections, explicit instruction should be adopted to explain the difference between the L2 words and its translated equivalents, meanwhile, a large number of contextual inputs for the target words

should also be supplemented so that the L2 learners can reach the stage of the communicative use of words.

The acquisition of vocabulary in a second language (L2) is a complex process, which is heavily influenced by one's native language (L1). There is an initial tendency for learners to rely on their L1, particularly in the area of semantics and syntactics, resulting in an "interlanguage" phase in which L2 words may sound correct but carry meanings that are proprietary to L1. As a result of this overlap, there may be misunderstandings, especially when each language has its own cultural nuances or conceptual aspects. The word "dog" has different connotations in Chinese and Western cultures, for instance. The integration of L2 vocabulary with its intended meaning can be challenging for many learners. A crucial aspect of Jiang's research is the recognition that L1 semantics play a significant role in L2 learning. He suggests that learners may remain tethered to their L1 interpretations without explicit instruction and ample contextual exposure, which may prevent them from becoming proficient in L2.

2.3.8 Gaps in Vocabulary Learning: The Limitations of Traditional Methods

2.3.8.1 Traditional Vocabulary Learning: An Overview

Learning new vocabulary has always been one of the most fundamental components of the process of acquiring a new language. To facilitate this process, there have been a wide range of approaches employed over the years, with traditional methods being largely predominant for a considerable amount of time. There are many ways to memorize words, including paper wordlists, vocabulary notebooks, and the use of bilingual dictionaries, as well as rote memorization techniques.

It is well known that the use of flashcards is one of the most effective ways of learning new material. Over the past few decades, these simple paper cards have been a staple in vocabulary learning, often with the target language on one side, and the translation or definition on the other side. It has the advantage of being portable and enabling repetition practice, which is one of the most important factors for memories to be retained. Ashcroft, Cvitković, and Praver (2018) examined whether digital flashcards had greater effectiveness than traditional paper flashcards among Japanese university students. Their findings highlighted the enduring value of traditional methods, especially for certain learner groups. However, the advent of technology has ushered in a new era of vocabulary learning tools. In recent years, electronic flashcards, language learning apps, and online platforms have become increasingly popular. These digital tools, often enhanced with multimedia features, promise an engaging and interactive learning experience. As well as being flexible, they

also offer the advantage of being able to adapt to the needs and progress of individual learners.

Despite their apparent simplicity, traditional methods, in spite of their apparent simplicity, have a number of unique advantages. It was emphasized by Nation (2001) that repetition and retrieval play an important role in vocabulary acquisition. Flashcards and wordlists, which are traditional methods of teaching, inherently promote these practices. To optimize vocabulary acquisition, educators and learners must find a balance, combining the best of both traditional and modern approaches.

Throughout the following sections, we will explore the specific challenges and difficulties associated with traditional vocabulary learning methods, based on a rich tapestry of research and expert commentary.

2.3.8.2 Limitations of Rote Memorization

Rote memorization, a traditional learning method, involves learners repeating information until they can recall it without thought. This method has been widely used in educational settings, especially when learners need to memorize vast amounts of information quickly. However, this method has been criticized for its lack of creativity and for not encouraging students to think critically about the material they are learning. Additionally, rote memorization can be ineffective for long-term retention, as learners can easily forget the information they have memorized over time. While it might be effective for immediate recall, such as for exams, the information is often quickly forgotten. Bahrick and Phelps (1987) emphasize that retention through rote memorization declines rapidly over time, especially when context or application is not added.

There may also be a limitation related to a lack of deep semantic understanding. It is possible to obtain superficial knowledge of a language by memorizing words without understanding their deeper meaning or nuances. In addition to simply knowing the definition of a word, Schmitt (2008) points out that vocabulary acquisition involves understanding its collocations, connotations, and appropriate usage.

In addition, the focus of traditional memorization tends to dwell more on individual words rather than phrases or chunks of language as a whole. There is a possibility that this can lead to a fragmented understanding of language. Several studies, including Nattinger and DeCarrico (1992), indicate that helping learners to use language more fluently and naturally requires teaching phrases or "lexical chunks".

A final point worth noting is that relying heavily on rote memorization can lead to the development of fossilized language forms, which become habitual in

a person's mind. The concept of "interlanguage fossilization" was introduced by Selinker (1972), who suggested that if a learner is not corrected early in the process, they could become deeply ingrained in their language usage.

Although rote memorization can be a useful method of learning new words, it has obvious limitations. Modern language teaching methodologies advocate a holistic approach to language learning, emphasizing an understanding of the world around us and meaningful engagement with it.

2.3.8.3 Lack of Contextual Understanding

Many of the traditional methods of learning vocabulary, such as rote memorization, vocabulary lists, and flashcards, present words in isolation without any context in which they may be used in the real world. In spite of the fact that these methods may help learners to become familiar with the definition of a word, they often fall short when it comes to conveying how the word is used in actual communication. To truly learn words, learners need to be able to use them in different contexts and be able to recognize them in context. This is why context-rich activities such as reading, writing, and talking are essential for vocabulary acquisition. The context of a statement is critical to understanding its meaning and applying it in the most appropriate manner. Taking a vocabulary class is not merely about learning the meaning of a word, but also about understanding its use and the company in which it is kept, as Nation (2001) emphasizes. Similarly, Hatch (1978) emphasized that language learning goes beyond vocabulary and grammar; it is essential to understand how language functions in a given situation.

Several challenges are associated with decontextualized vocabulary learning:1) A lack of context may cause learners to misuse words or misunderstand nuanced meanings. It is not necessarily sufficient to know the definition of "sarcasm" in order for a student to recognize or use it in conversation; 2) Words learned in isolation are often forgotten more quickly than those learned in context. This is supported by Webb (2007), who found that words learned through reading (a contextualized activity) were retained better than those learned through isolated word lists; 3) Words often appear in predictable combinations or collocations. Without exposure to these in authentic contexts, learners might struggle to use words naturally. Lewis (2000) emphasizes the importance of teaching collocations as they appear in real language use; 4) Ellis (1997) points out that learners who rely on decontextualized vocabulary learning often resort to direct translations from their native language, which can lead to errors in understanding and usage.

Modern language teaching methodologies advocate for the presentation of vocabulary within meaningful contexts. Activities such as task-based learning, storytelling, and content-based instruction all emphasize learning vocabulary through context, ensuring deeper understanding and more effective retention. For effective vocabulary acquisition, it's essential to move beyond traditional, decontextualized methods and embrace approaches that immerse learners in authentic language use.

2.3.8.4 Cultural and Conceptual Gaps in Vocabulary Learning

Language is deeply intertwined with culture, and words often carry cultural connotations and meanings that go beyond their dictionary definitions. Traditional vocabulary learning methods, which focus on direct translations and rote memorization, may not adequately address these cultural and conceptual nuances (Lado, 1957). Words are not just neutral carriers of meaning; they are embedded in cultural contexts that shape their connotations and uses (Sapir, 1929; Whorf, 1956). For instance, the word "dog" in English and its equivalent in Chinese carry different cultural connotations, a phenomenon explored in linguistic relativity studies (Lucy, 1992).

Challenges arising from these cultural gaps include misinterpretations, where learners might understand the direct meaning of a word but miss out on its cultural connotations (Kramsch, 1998). This can lead to misunderstandings, especially in idiomatic or figurative language use. Stereotyping and overgeneralization are other challenges. Without a deep cultural understanding, learners might overgeneralize, or stereotype based on limited exposure to vocabulary (Pavlenko, 2009). For instance, interpreting all cultural idioms or proverbs literally can lead to misconceptions. Additionally, words that have no direct equivalent in another language can be challenging to learn and use appropriately, resulting in the loss of nuance or richness in communication (Nida, 1964).

Beyond cultural gaps, there are also conceptual gaps in vocabulary learning. As explored with the models from Levelt (1989) and de Groot (1992, 1994), the mental lexicon of bilinguals or multilinguals is complex. Words in one language might not map directly onto concepts in another, leading to challenges in translation and comprehension (Aitchison, 2012). The language acquisition process is also the process of concept acquisition, so language is a basic tool to express conceptual systems (Vygotsky, 1962). Different cultures and languages might have unique perspectives that shape the unique concepts, which are then expressed in specific languages (Hall, 1959).

To bridge these gaps, several strategies can be employed. Engaging with authentic materials, such as literature, films, and music, can help learners understand the cultural contexts of words (Byram & Morgan, 1994). Learning vocabulary in context can provide clues about cultural and conceptual nuances (Nation, 2001). Engaging in discussions with native speakers or fellow learners can also help clarify cultural and conceptual ambiguities (Ellis, 1994). In conclusion, understanding the cultural and conceptual dimensions of vocabulary is crucial for effective communication in a second language. Modern vocabulary learning approaches need to address these gaps to ensure learners can use words appropriately in diverse contexts (Schmitt, 2008).

Traditional vocabulary learning methods, while foundational, often lack the dynamism and interactivity that can engage learners in the modern age. The process of rote memorization, for instance, can be tedious and may not cater to the diverse learning styles of students (Ebbinghaus, 1885). Without engagement, the retention and application of vocabulary can be compromised, leading to superficial learning where words are quickly forgotten after an exam or a test (Bahrick, 1984).

Drawing from my own experience as an English teacher in a Chinese college for over a decade, as mentioned in chapter One, I've frequently encountered students lamenting the challenges of vocabulary acquisition. Time and again, I've heard them express frustrations about the difficulty of memorizing words and the monotony of traditional learning methods. Their complaints often revolve around the same themes: vocabulary learning is "hard to remember," "boring," and "uninspiring." This firsthand insight underscores the pressing need for methods that not only teach but also inspire and engage.

One of the primary challenges of traditional methods is that they often isolate vocabulary from authentic contexts. Learning lists of words or using flashcards might help in the short term, but without understanding how these words function in real-life situations, learners might find it challenging to use them appropriately (Willis & Willis, 2007). This lack of contextual understanding can lead to a sense of detachment, where learners see vocabulary as mere lists to be memorized rather than as tools for communication (Laufer & Hulstijn, 2001).

Furthermore, motivation plays a crucial role in language acquisition. Traditional methods, which might not incorporate elements of fun, challenge, or real-world relevance, can lead to decreased motivation (Dörnyei, 2001). Without motivation, even the most diligent learners might find it challenging to sustain their vocabulary learning efforts over time. The lack of feedback mechanisms in traditional

methods can also deter learners, as they might not have a clear sense of their progress or areas that need improvement (Nunan, 1991).

In conclusion, while traditional vocabulary learning methods have their merits, they also come with inherent limitations. Modern pedagogical approaches need to address these challenges by integrating more engaging, context-rich, and motivation-enhancing methods. Incorporating technology, real-world contexts, and interactive elements can make vocabulary learning more engaging and effective for learners of all ages (Nation, 2001; Godwin-Jones, 2010).

2.3.8.5 The Need for Modern Approaches:

In the current pedagogical landscape, traditional paradigms of vocabulary learning, while foundational, are becoming increasingly perceived to be incompatible with the needs and proclivities of the modern learner, who is characterized by a multifaceted set of abilities. With rapid technological changes and a paradigmatic shift toward interactive and individualized learning trajectories, the era of digitization requires a thorough reexamination of the means through which vocabulary is imparted and assimilated.

A new era of vocabulary pedagogy is emerging with the advent of MALL. Through mobile devices such as smartphones and tablets, MALL establishes a mode for language acquisition that is malleable, omnipresent, and customized to the idiosyncrasies of each student (Pegrum, 2014). Unlike conventional methodologies that rely solely on rote memorization, MALL utilizes a wide variety of multimedia elements, such as audio, video, and gamified interactions, to create a cohesive and captivating learning environment (Gikas & Grant, 2013). As a result of the multimedia-rich approach, learners are able to retain vocabulary but also gain a nuanced understanding of vocabulary within authentic contexts, which enhances retention and comprehension of the material. In addition, many MALL platforms provide instant feedback to learners, enabling them to effectively recognize and correct their shortcomings (Huang, Yang, Chiang, & Su, 2016). By providing real-time evaluative mechanisms, which are conspicuously absent from traditional pedagogical architectures, learners can gain greater self-efficacy and intrinsic motivation, which enables them to carefully monitor their progress and set individualized goals for themselves.

It has been demonstrated that avant-garde methodologies, such as MALL, offer a significant advantage in terms of collaborative learning. A variety of digital platforms incorporate social features, ranging from chat ecosystems, discussion forums, and collaborative assignments, providing learners with opportunities to interact with peers, native linguists, and educators (Liu, Han, & Li, 2010). In addition to providing

genuine contexts for vocabulary acquisition, such interactive engagements also enrich the learner's sense of community, further motivating them to participate.

Though contemporary methodologies offer a variety of pedagogical benefits, they also present certain challenges. In order to effectively integrate technology into vocabulary pedagogy, pedagogical principles, learner preferences, and technological demands must all be carefully aligned (Chinnery, 2006). Furthermore, any pedagogical instrument, MALL included, is only effective when it is employed in a deliberate and purposeful manner.

As the inadequacies inherent in traditional vocabulary pedagogical frameworks have become increasingly evident, an imperative has emerged to adopt contemporary methodologies that exploit technology's latent potential. The academic pivot is anticipated to result in not only improved engagement and effectiveness, but also alignment with the exigencies and realities of the 21st century educational environment.

2.4 Bridging MALL and Vocabulary Learning: Theoretical Synthesis and Implications

It is safe to say that the advent of MALL has revolutionized the landscape of language learning. Due to its flexibility, interactivity, and immediate feedback, MALL is more engaging than traditional methods when it comes to acquisition of vocabulary, making it more effective. In many ways, mobile devices align well with the principles of vocabulary learning as a result of their inherent features, such as portability and multimedia capabilities. For instance, Stockwell (2010) found that the use of visual aids, audio clips, and interactive games as part of MALL applications can facilitate better lexical retention and recall (Stockwell, 2010). As a matter of fact, most MALL platforms are equipped with spaced repetition algorithms that ensure that learners review words at optimal intervals so that long-term retention can be enhanced (Nation, 2013).

2.4.1 The Synergy Between MALL and Vocabulary Learning

The integration of MALL into the pedagogical framework has resulted in a significant change in the dynamics of language education, especially in the domain of vocabulary acquisition, which is a key component of language education. In many instances, the interactive and dynamic capabilities of MALL have supplemented traditional vocabulary learning methods, which are often characterized by rote memorization.

There is no doubt that MALL has many advantages, one of which is its inherent flexibility. In the 21st century, students are no longer confined to classroom settings or controlled by physical textbooks as they used to be. A better alternative would be for students to access vocabulary exercises and resources at their convenience, regardless of where they are, whether they are traveling or in a waiting room, thus maximizing their chance of becoming proficient in the target language (Kukulska-Hulme, 2009). This 'anytime, anywhere' learning paradigm is not just about accessibility; it is about creating an environment where vocabulary acquisition is viewed as part of everyday life, so that the acquisition of vocabulary is a continuous process.

Another advantage of the mobile devices is the fact that they have multimedia capabilities that can be used to enhance vocabulary learning even further. It allows students to use visual aids, audio clips, and interactive simulations to provide them with a multisensory learning experience, which caters to a variety of learning styles. A study conducted by Thornton and Houser (2005) demonstrated that the use of multimedia in MALL facilitates better comprehension and retention of words, due to the fact that learners are able to associate words with pictures, sounds, and contexts, allowing for a holistic learning approach. Games and quizzes, which are often incorporated into MALL applications, are one of the most effective methods of making vocabulary learning more fun and engaging as well as offering immediate feedback. The instant feedback mechanism enables learners to identify their mistakes, rectify them, and reinforce correct usage within a matter of seconds, thereby promoting active learning (Lan, Sung, & Chang, 2007).

Additionally, many MALL platforms utilize spaced repetition algorithms. This is a cognitive psychology technique that has a long history in the education field. By utilizing these algorithms, learners can ensure that words are reviewed at intervals where there is a high probability of memory retention. There is no doubt that spaced repetition is a powerful method of enhancing long-term retention of vocabulary in MALL applications, as noted by Nation (2013) and Godwin-Jones (2010).

There is no doubt that the synergy between MALL and vocabulary learning provides a compelling example of how technology can be harnessed in order to improve educational outcomes, making the process more efficient, engaging, and conducive to a greater sense of identity.

2.4.2 Empirical Evidence: Studies Demonstrating the Impact of MALL on Vocabulary Learning

During recent years, a great deal of research has been conducted on the integration of MALL into vocabulary acquisition, and this has been a subject of extensive research.

MALL has proven to be an effective method for enhancing vocabulary learning, according to empirical evidence, making it an attractive alternative to traditional methods when it comes to learning vocabulary. The ubiquity of MALL is one of the most salient advantages it has over other competing solutions. As Pimmer, Mateescu, & Grohbiel (2016) point out, mobile devices have become one of the most convenient means for learners to access educational resources seamlessly, and this fosters a sense of autonomy as they participate in the educational process. It is through this constant access that learners are not only able to engage with vocabulary content in diverse contexts, but also reinforce their understanding of the vocabulary through spontaneous learning opportunities. According to Lai & Gu (2011), continuous exposure to new words is critical to the acquisition of vocabulary, as learners can engage with new words in a variety of settings, from structured classrooms to informal everyday settings in which they can gain a deeper understanding of the words. MALL platforms have also received considerable attention in recent years due to their interactive capabilities. An in-depth study conducted in 2017 by Lin & Huang revealed that interactive approaches in MALL have a profound impact on vocabulary retention in the long run, which is confirmed by the results of the study. As a result of their findings, it appears that learners who are engaged with vocabulary through interactive mobile apps tend to understand and retain words for longer periods of time than those who are engaged with vocabulary through traditional methods. Xie, Chu, Hwang, & Wang (2019) also echo this sentiment, contending that a multisensory approach is beneficial to a more holistic understanding of vocabulary because it enables a student to receive visual imagery, audio pronunciations, and tactile feedback throughout the learning process. Additionally, MALL is able to offer a range of adaptability and personalization features that make it truly stand out as a game changer. According to Heil, Wu, Lee, and Schmidt (2016), MALL platforms can be tailored to address the needs of individual learners, therefore ensuring an adaptive learning environment for all learners. Through this process of personalization, learners are assured that they are not subjected to a one-size-fits-all approach; instead, content is tailored to meet the unique learning styles and paces of they and their instructors. By providing learners with customized experiences, instructors can ensure that they remain engaged, motivated, and, most

importantly, successful in their efforts to acquire vocabulary. Moreover, MALL, when integrated with other technological advancements, such as artificial intelligence and machine learning, offers promising research avenues in the future. Through these technologies, MALL may be able to further enhance its personalization capabilities, providing learners with even more tailored vocabulary learning experiences.

To conclude, empirical evidence strongly supports the use of MALL in the acquisition of vocabulary. Its myriad advantages, ranging from enhanced engagement and interactivity to unparalleled personalization capabilities, make it an indispensable tool in the modern language learning landscape.

2.4.3 Addressing the Gaps: How MALL Can Enhance Vocabulary Learning

As MALL has evolved, a new era has dawned in the field of vocabulary acquisition, which has seen a transformation in the way vocabulary is acquired. Despite the many advantages of traditional learning methods, MALL provides innovative solutions to bridge the gaps and challenges associated with conventional vocabulary learning, which has its own inherent challenges.

A major benefit of MALL is that it provides its users with contextual understanding, which is one of its most significant advantages. The traditional method of teaching vocabulary is often presented in an isolated manner, thus hindering the learner's ability to grasp the nuanced meanings of words and the applications to which they can be applied. MALL applications, however, often immerse learners in real-world scenarios, dialogues, and interactive exercises. By immersing students in different contexts, the student not only gains a deeper understanding of what a word means, but he or she also ensures that those words will be applied correctly in different situations (Burston, 2015; Godwin-Jones, 2011). According to Huang et al. (2016), this immersive approach supports a deeper connection between the learner and the language, which in turn enhances the learner's retention and ability to apply what they have learned.

As well, MALL is capable of bridging the gap between cultural and conceptual learning of vocabulary which is often encountered in traditional vocabulary learning. In most MALL platforms, there is a significant amount of information that is culturally rich, which exposes learners to the nuances associated with specific words and phrases from a variety of cultures. In order to truly grasp the language holistically and to avoid potential misunderstandings, cultural immersion is critical for a holistic understanding of the language (Chinnery, 2006; Lai & Gu, 2011). As an example, understanding the cultural connotations of a word is one way to ensure effective communication in a conversation, in which its usage has a significant impact.

In many traditional methods, engagement and motivation are often identified as vexing challenges. By utilizing MALL, these challenges can be effectively addressed. It has become a common practice for MALL platforms to incorporate gamification, multimedia content, and interactive exercises into their platforms, which transform vocabulary learning into an engaging experience. As a result of this enhanced engagement, not only is interest maintained, but also deeper immersion is promoted, resulting in enhanced retention (Godwin-Jones, 2011; Kukulska-Hulme, 2019). A recent study by Wang et al. (2020) showed that the interactive nature of MALL platforms can significantly boost the motivation levels of learners, ultimately resulting in better outcomes for them.

Last but not least, MALL is a unique learning environment because of the adaptive learning experiences it provides. With the help of advanced algorithms which are included in many MALL platforms, learners can customize their learning journey based on their progress and needs. As a result of this adaptability, learners are receiving instruction that is tailored to their strengths and areas of improvement, resulting in improved vocabulary acquisition (Huang et al., 2016; Burston, 2015).

To conclude, MALL offers a comprehensive and adaptive approach to learning vocabulary, addressing many of the challenges that traditional vocabulary learning methods suffer from. MALL, with its contextual, culturally competent, engaging, and customized learning experiences, is poised to radically change the landscape of vocabulary acquisition in the second-language classroom by revolutionizing the way experience-based and problem-based learning is approached.

2.5 Seamless Learning: Foundations and Principles

It is widely acknowledged that seamless learning, as a concept, is one of the most talked-about concepts in the areas of educational technology and pedagogy. It is the objective of this section to take a deep dive into the fundamental principles and characteristics that have been defined as the foundations of seamless learning as well as its significance to the modern educational scene. There will be an exploration of the origins and evolutionary history of the seamless learning concept, as well as its potential for bridging formal and informal learning spaces in a transformative way. The ten dimensions of mobile seamless learning outlined by Wong & Looi (2011) will also be discussed, along with Nation's (2001) theoretical model of vocabulary acquisition, which will be discussed in greater depth, emphasising its relevance for forming vocabulary learning strategies within a seamless framework to support vocabulary acquisition. This section will provide readers with an understanding of the multifaceted

nature of seamless learning, and its implications for vocabulary acquisition in the digital age.

2.5.1 Introduction to Seamless Learning

The term “seamless learning” signifies the absence of interruptions, or what is referred to as “seams”, in the learning process. There are two types of learning, “seamed learning” and “seamless learning”, as defined by Wong & Looi (2019). Seamless learning consists of a continuous journey of learning instead of discrete episodes of learning.

In contrast, "seamed learning" represents an approach where learning is fragmented into distinct episodes, often resulting in disjointed and compartmentalized educational experiences. This traditional model of education is marked by clear boundaries between different learning environments and contexts, such as the classroom, home, and workplace. These boundaries create 'seams' that can disrupt the continuity of learning, posing challenges in synthesizing and applying knowledge across various contexts (Fischer et al., 2014).

Seamed learning often follows a linear and structured format, predominantly relying on teacher-led instruction and standardized curricula. This approach may limit opportunities for student-driven exploration and hinder the development of critical thinking and problem-solving skills, which are crucial in the modern educational landscape (Salomon & Perkins, 2005).

Additionally, seamed learning environments may struggle to integrate technology effectively, often using digital tools in isolation from the overall learning journey. This can lead to missed opportunities for enhancing learning experiences through technology, particularly in language education, where digital tools can play a pivotal role in facilitating immersive and interactive learning experiences (Godwin-Jones, 2018).

The limitations of seamed learning are particularly evident in the realm of language acquisition. The segmented approach can impede the natural flow of language learning, which ideally involves a continuous and contextualized process of exposure, practice, and application (Ellis, 2003). Language learners in seamed environments might find it challenging to connect classroom learning with real-world language use, leading to a gap between theoretical knowledge and practical language skills (Nunan, 2004).

In the realm of educational technology, Chan et al. (2006) developed the concept of uninterrupted learning as a result of their pioneering work in the field of technology-assisted learning.

A study conducted by Chan and his colleagues (2006) proposed that the trajectory and evolution of technology-enhanced learning can be found in three pivotal elements: 1) Ubiquitous access to mobile, interconnected personal handheld devices; 2) Swift advancements in one-to-one computing technology; 3) Novel applications of these handheld devices in the learning sphere.

These elements combine to form what Chan et al. identified as 'seamless learning spaces' in their article. It is ideal for learners to have access to spaces such as this, which allow them to immerse themselves in learning at their own pace while fluidly transitioning between varied contexts, from formal to informal learning as well as taking part in individual and collaborative learning projects.

Burston (2021) adds to this idea by emphasizing the role that digital devices can play in enhancing learner-centric, continuous, and omnipresent learning experiences in a way that further understands the role of digital devices. A similar perspective is presented by Schuck et al. (2023), who emphasize the capacity for seamless learning in nurturing lifelong learning competencies, especially in a technologically driven era.

Interestingly, the concept of "seamless learning" was originally introduced without a direct technological association. According to the American College Personnel Association (1994, cited in Wong & Looi, 2011), students are more likely to excel academically when their in-class and out-of-class experiences are woven together to enhance seamless learning and academic performance. Afterwards, Kuh (1996, cited in Wong & Looi, 2011, & Wong, 2015) has expanded this idea to include off-campus experiences as well, which further enables students to contextualize classroom content with experiences from the outside world, thus making that content more relevant for them in their everyday lives.

According to Chan et al. (2006), technological advancements have paved the way for seamless learning across diverse learning scenarios with the use of digital devices such as tablets, smartphones, and laptop computers. The same sentiment was voiced by Milrad et al. (2013), who elucidated the key role that digital devices play in ensuring seamless connectivity and sustaining the continuity of learning experiences regardless of the environment in which they are used.

Tabuenca et al. (2015) provided a vivid picture of seamless learning in action, illustrating the way students navigate through a wide variety of contexts, modes, and technologies throughout the course of their daily lives. This adaptability to transition between learning contexts, identified by Chan et al. (2006) as a hallmark of seamless learning, is further augmented by the guidance of educators, mentors, professionals,

and familial and community support (Barden & Bygroves, 2017). The concept of seamless learning emerges as one of the foundational pillars for grasping the essence of Seamless Mobile Assisted Language Learning (SMALL) in the field of education today.

Seamless learning can take both intentional and incidental forms, depending on how it is implemented. The learning activity might be initiated by a student in class, and then later continued online by a student at home if he or she is absent from class. There is also the possibility that a news segment or a television show incidentally can trigger a learning discussion inadvertently (Sharples et al., 2012). This concept is reminiscent of situated learning, which emphasizes the application of knowledge in specific contexts, and as such, bears a lot of similarities to this concept. Nevertheless, seamless learning enhances situated learning by allowing it to be applied to a wide variety of settings.

Although seamless learning does not necessarily rely on personal networks, such gadgets can enhance the fluidity of the learning process. The time spent commuting or waiting, which was previously considered dormant, can now be transformed into productive learning intervals (Sharples et al., 2012). As a result of this evolution, the boundaries between learning episodes of varied settings, as well as time and context, have blurred.

Wong, Milrad, & Specht (2015) propose ten dimensions that capture the essence of seamless learning. In addition to these dimensions, seamless learning is characterised by its adaptability, omnipresence, and learner-centered nature.

To conclude, seamless learning should be understood as a concept that moves from an abstract idea to a concrete one, which is exemplified by Mobile Assisted Language Learning (MALL), which is an example of seamless learning in action. Aside from its unique attributes, such as bridging formal and informal learning arenas, fostering continuous learning, and enabling purposeful learning within fragmented time slots, it is notable that it has a number of other unique attributes as well.

2.5.2 Previous Studies and their Implications

The realm of seamless learning has witnessed a plethora of studies, each contributing unique insights and perspectives. Föβl et al. (2016) embarked on a study involving a fifth-grade maths class, leveraging an open education approach complemented by worked example videos. While the study made commendable strides in the domain of seamless learning, its focus remained confined to mathematics, sidelining the potential of seamless language learning.

Foomani & Hedayati (2016) adopted a different approach, emphasizing Mobile Assisted Language Learning (MALL) and the significance of student-generated

content. Their study centered on the role of artifacts in the language learning trajectory of Iranian EFL learners. Despite showcasing the potential benefits of the MSL method, the study lacked a robust experimental design and quantitative data analysis. Moreover, the absence of a theoretical learning framework left a gap in its design.

Wei (2012) explored the potential of the popular online communication tool, QQ, in fostering seamless learning among Chinese learners. This line of research was furthered by Wong (2012), who introduced the Facilitated Seamless Learning (FSL) process framework, aiming to assist researchers and educators in crafting seamless learning environments. Malandrino et al. (2014) provided guidelines for developing a flexible, platform-independent mobile learning system. Wong et al. (2017) took a different route, presenting an alternative techno-pedagogical framework for seamless learning, drawing inspiration from the Singapore-based "WE learn" project initiated in 2009.

Lamberti & Sanna (2023) added a fresh perspective by scrutinizing the theoretical foundations of engaging learners through mobile seamless learning. Their research accentuated the need to consider pedagogical implications meticulously when designing learning experiences.

A recurring theme across these studies is the apparent lack of robust theoretical underpinning, possibly hinting at the embryonic stage of seamless learning research. Xiao et al. (2021) posited that the concept of seamless learning is in flux, with its characteristics spanning various learning methodologies, spatial contexts, and technological applications.

However, a paradigm shift is evident in the recent discourse on seamless learning. Earlier, it was perceived as a subset of mobile learning (Wong, 2015; Wong & Looi, 2019). Now, the focus has shifted towards recognizing seamless learning as an independent learning paradigm, prioritizing "learner-centeredness" over sheer technological reliance.

In light of the literature reviews, it's evident that Mobile Seamless Learning (MSL) and seamless learning are intertwined concepts. The term SMALL (Seamless Mobile-Assisted Vocabulary Learning) was coined to emphasize the bridging of formal and informal learning, with mobile technology serving as an enhancer rather than just a tool.

Seamless learning, as a concept, has evolved significantly over the years. From its initial stages as an abstract idea to its current form, characterized by MALL, it has come a long way. The various studies and research in the field have contributed to shaping our understanding of seamless learning, highlighting its potential and

challenges. As technology continues to advance and integrate further into our daily lives, the role of seamless learning in education will undoubtedly become even more crucial.

2.5.3 Ten Dimensions of Mobile Seamless Learning

There is no doubt that seamless learning is a vast and intricate field. To be able to navigate this terrain, Wong & Looi (2011) provided a framework to provide a thorough understanding of Mobile Seamless Learning, which offered a comprehensive framework to describe its multifaceted nature. Besides underlying the features of seamless learning, these dimensions also underscore the benefit of mobile technology, which is its ubiquity, flexibility, and learner-centricity, as well as its ability to foster seamless learning.

Encompassing Formal and Informal Learning (MSL1)

With seamless learning, traditional classroom settings can be transcended to become more flexible and relevant. In other words, it is a means of linking a formal setting of education to informal learning places, such as the home, the workplace, or public areas. Learning experiences with this dimension emphasize the fluidity between structured and unstructured learning environments, allowing learners to switch effortlessly between structured and unstructured learning environments.

Encompassing Personalized and Social Learning (MSL2)

Although seamless learning is inherently personalized, catering to individual learning styles and paces, it also fosters collaboration. Social interactions, such as group activities, discussions, and collaborative projects, provide learners with an opportunity to enhance their understanding through social interaction.

Spanning Across Time (MSL3)

Learning is no longer restricted to specific times or periods. As a result of seamless learning, students can participate in educational activities at any time, whether they are on a commute, in bed, or taking a break. By engaging them continuously, learning is made a part of their daily routine.

Spanning Across Locations (MSL4)

A seamless learning environment eliminates geographical constraints. No matter where a learner is - at home, in a park, traveling, or at a café - the learning continues unhindered. In this sense, ubiquity guarantees that learning is not restricted to a particular class room or location, for example.

Ubiquitous Access to Learning Resources (MSL5)

There has been a revolution in the way information can be accessed since the digital age. A seamless learning environment provides learners with continuous

access to a wide variety of resources, including e-books, online courses, discussion forums, and virtual classrooms.

Encompassing Physical and Digital Worlds (MSL6)

With seamless learning, tangible and intangible elements are harmoniously integrated. In addition to engaging with the physical world, learners engage with digital resources simultaneously, thereby creating a holistic learning environment.

The Combined Use of Multiple Device Types (MSL7)

Several different devices are available to support a seamless learning experience, including smartphones, tablets, laptops and smartwatches. There are a variety of devices on the market, each offering unique functionalities that enhance the learning process.

Seamless Switching Between Multiple Learning Tasks (MSL8)

Learning can be accomplished by juggling multiple tasks, transitioning smoothly between them. As an example, a student might begin a lesson on a laptop, continue on a tablet during the commute, and finish it on a smartphone during a break in order to complete their lesson.

Knowledge Synthesis (MSL9)

By integrating knowledge from different types of sources, seamless learning can be used to facilitate the development of a broader understanding of different subjects. A student is able to connect information from different resources in order to synthesize it into a comprehensive knowledge base.

Encompassing Multiple Pedagogical and Learning Activity Models (MSL10)

Within the seamless learning ecosystem, pedagogical models as diverse as problem-based learning, experiential learning, flipped classrooms, and blended learning have all found their place. In addition to ensuring that learning is fun and engaging, this diversity ensures that learning remains dynamic.

In essence, these ten dimensions are able to paint a vivid picture of how seamless learning can provide opportunities to engage in a variety of learning contexts. A major theme that has emerged in these papers is that technology hamay have the power to transform the educational landscape, making learning a continuous, ubiquitous, and personalized process.

2.5.4 Noticing, Retrieving, and Generating Model of Vocabulary Acquisition

One of the leading experts in the field of second language acquisition, Paul Nation developed a comprehensive tripartite model of vocabulary acquisition, emphasizing the processes of noticing, retrieving, and generating. Nation (2001) states

that these three well-established psychological processes play a major role in the efficient acquisition of vocabulary, especially when integrated within a specific framework. In the first process, noticing, the learner observes a word, whether written or spoken, and is significantly influenced by motivation and interest. As for retrieving, it refers to a learned individual's ability to recall words from memory during a task. By engaging in repeated activities, the act of retrieval can manifest both as a receptive behavior when listening and reading or as a productive one when speaking and writing. Such repeated retrievals can further aid learners in utilizing derivatives and inflected forms of words. Lastly, the generating or creative use phase signifies the learner's capacity to employ vocabulary in novel contexts, potentially conveying varied meanings. A generative use may be both receptive, in which learners are able to acquire new usages, or productive, in which learners are able to actively employ them in their communication. A novel way of enhancing vocabulary acquisition in modern educational contexts could be to integrate these principles with the paradigms of seamless learning and MALL (Mobile Assisted Language Learning). These concepts offer a structured and holistic approach to examining how vocabulary acquisition occurs across the lifelong learning continuum.

Noticing

The initial step in vocabulary acquisition is noticing. As learners engage in this phase, they encounter and become familiar with new words, whether through reading, listening, or interacting. The act of noticing plays a vital role in stimulating curiosity and interest, leading to further investigation of the word's meaning and application. Due to the immediate nature of mobile devices and their multimedia capabilities, learners have an abundance of opportunities to become aware of new vocabulary within the context of seamless learning. As an example, learners might encounter new words while watching videos, listening to podcasts, or using language learning applications. Through this continuous learning environment, learners will be able to notice new vocabulary in a variety of contexts, bridging the gap between formal and informal learning.

Retrieving

When a new word is noticed, the next step is to actively retrieve it from memory as soon as possible. It makes sense that this act of recall would strengthen the memory trace of the word that is being recalled as well as help in associating it with previously known information. For the consolidation of memory, it is imperative that it is retrieved and reviewed on a regular basis.

It is through MALL that learners will be able to select from a wide variety of tools and applications that will assist them in retrieval of vocabulary. A few examples of educational technologies include flashcard apps, electronic dictionaries, interactive quizzes, and spaced repetition programs. Due to the portability of mobile devices, retrieval can take place anytime and anywhere, which aligns perfectly with the principles of mobile-assisted learning, which enables students to learn anywhere and anytime.

Generating

The final stage of vocabulary acquisition, generating, represents the pinnacle of the process. The learners are not only able to recall the word, but also use it in the appropriate context. By constructing sentences or applying the word in real-world situations, students are able to gain a deeper level of understanding and mastery of the word.

In a mobile-assisted learning environment, learners can engage in generative exercises in several different ways. Among the tasks they may be assigned are writing assignments, taking part in online discussions, or even participating in virtual simulations. In a variety of contexts, mobile devices provide learners with an interactive platform through which they can practice and apply their vocabulary knowledge.

Integration with Seamless Learning and MALL

It is important to realize that Nation's model is intrinsically aligned with the MALL principles. There is nothing more ubiquitous and accessible than mobile devices, which make them ideal tools for facilitating the processes of noticing, retrieving, and generating information, due to their ubiquity and accessibility. Providing learners with continuous access to learning materials and interactive platforms ensures that they are consistently exposed to new vocabulary, are able to retrieve these words at the point of need and can practice generating sentences with their new vocabulary. The seamless learning environment, which is characterized by a fluid transition between formal and informal learning environments, ensures that vocabulary acquisition isn't limited to the classroom and takes place across all learning environments. Learning a new vocabulary becomes a part of a learner's daily life when their mobile devices serve as a constant companion throughout the day to help them improve their vocabulary. This continuous, ubiquitous learning experience, facilitated by mobile technology, resonates deeply with Nation's model, emphasizing the importance of real-world context in vocabulary acquisition.

Therefore, Nation's Noticing, Retrieving, and Generating Model, which integrates the principles of seamless learning and MALL, provides a holistic framework

for understanding vocabulary learning in modern digital age when combined with Nation's Noticing, Retrieving, and Generating Model. The convergence of these concepts highlights the transformative potential of technology in language acquisition, making the learning process both seamless and centered around the learner.

2.6 Conceptualizing the Seamless Mobile-Assisted Vocabulary Learning Environment (SMAVLE)

Earlier in this article, we took a closer look at the intricacies of MALL, vocabulary learning, and seamless learning in depth. The unique characteristics and theoretical underpinnings of each of these domains have paved the way for the conceptualization of SMAVLE, as each has its own characteristics and theoretical underpinnings. In the case of MALL, it is this emphasis on leveraging mobile technologies to enhance language acquisition that provides the technological foundation. A pedagogical framework that underpins vocabulary learning is provided by the principles of Noticing, Retrieving, and Generating. The concept of seamless learning, on the other hand, is based on continuity and fluidity across contexts of learning, thus infusing the essence of adaptability and flexibility into the learning process.

There is no doubt that SMAVLE has drawn upon all of the theoretical approaches described above, and it represents an environment that combines the technological power of MALL, the pedagogical depth of vocabulary learning, and the adaptability of seamless learning, resulting in an environment that is a culmination of these theories. There is more to it than just integrating mobile devices or teaching vocabulary; it is about creating a holistic, adaptive, or contextually rich environment for vocabulary acquisition, in which learning is continuous, adaptive, and limitless, where it is possible to learn from anything and everything.

When we begin to explore the deeper aspects of the SMAVLE framework, it is vital that we begin by understanding the core essence that makes these theories so interconnected: what is meant by "seamless" within the context of the MALL.

2.6.1 Defining "Seamlessness" in the Context of MALL

The notion of "seamlessness" has emerged as one of the most transformative forces in educational technology, especially when it is coupled with a MALL system. Despite MALL being recognized for its ability to harness mobile technology to facilitate language learning, it is with "seamlessness" that this approach is refined and elevated to the level that it should be.

The concept of seamlessness should be distinguished from MALL. MALL, also known as Mobile-Assisted Language Learning, has been extensively studied by

scholars such as Kukulska-Hulme (2013) and Thang Nguyen Van & Ha Thi Mai Thanh (2020) and mainly focuses on leveraging mobile devices for language learning, emphasizing accessibility, flexibility, and on-the-go efficiency. Traditional MALL programs, on the other hand, can sometimes present learners with fragmented learning experiences, where they attempt to engage with individual apps or platforms by themselves.

It is possible that seamlessness can bridge some of the gaps that exist in MALL. As conceptualized by Wong & Looi (2019) and Chan et al. (2006), seamless learning refers to a continuous, cohesive pedagogical journey, which is aligned with intellectual and social development. In the context of MALL, seamlessness makes sure that learners do not simply use mobile devices to learn; instead, they experience fluid transitions between modules, platforms, and contexts within real world environments. The importance of this continuity cannot be overstated. A true potential for MALL can only be realized when digital learning experiences are seamlessly integrated with real-world applications, as argued by Burston and Kristianus Erwin Gael & Dewi Satria Elmiana (2020).

The seamlessness in MALL may be a decisive factor in amplifying its strengths. Seamlessness in MALL harnesses the full potential of mobile technologies. Given the omnipresent nature of mobile devices and their inherent connectivity, as emphasized by Schuck et al. (2023) and L. Van & Le Hoang Duong (2019), learners can transition between digital resources, integrate learning with real-world experiences, and collaborate seamlessly. As Milrad et al. (2013), and Wael A Holbah (2019) note, this integrated approach ensures deeper engagement, a better retention rate, and a more meaningful application of language skills in the workplace.

Taking the Nation's process of noticing, retrieving, and generating as a model, seamlessness ensures that these three processes are interconnected steps that make up a continuous cycle that can never stop. For example, through the use of interconnected MALL platforms, a learner can "notice" a new word in a mobile app, "retrieve" its meaning through online resources, and "generate" sentences using the word in and out of a virtual world, all facilitated through seamless learning between the MALL platforms (Nation, 2001).

In a nutshell, the groundwork of MALL has been laid, however, by integrating a concept called "seamlessness", we have refined this model even further. In addition to addressing its limitations and amplifying its strengths, seamlessness in MALL is designed to ensure a holistic learning experience, offering learners a richer, more engaging, and more effective language-learning path.

2.6.2 Key Components and Characteristics of the SMAVLE

There is no doubt that SMAVLE is more than just a theory or concept. It is a dynamic ecosystem that integrates many different elements to facilitate vocabulary acquisition. The key components and characteristics of this environment can be summarized as follows:

Based on what has been reviewed previously, SMAVLE may have the following components:

1) Adaptive Learning Modules: These modules adjust in real-time based on the learner's performance and preferences, so that the learning is optimized. If, for example, a learner struggles with business-related vocabulary, but excels at everyday language, the module might present more business-related vocabulary exercises to help bridge this gap.

2) Contextualized Vocabulary Tasks: Vocabulary exercises that are designed to incorporate real-world scenarios, multimedia content, and augmented reality into their vocabulary exercises. There can be a task in which learners identify and use vocabulary related to shopping and bargaining in a video clip, for example, following along with a short video clip of a market scene.

3) Collaborative Learning Spaces: These are platforms that help students to engage in group discussions, collaborative vocabulary projects, and peer assessment opportunities. An example of this would be for learners to be grouped together in order to create a story in which each member contributes a sentence using a set of vocabulary words that have been provided.

4) Gamified Learning Experiences: Vocabulary exercises that are developed to incorporate game mechanics into the learning process. For example, learners can play a game where they need to match words with their definitions and they earn points for matching words correctly.

5) Real-time Feedback and Analytics: Mechanisms that provide immediate feedback. For example, when students complete a vocabulary quiz, they will see immediately which answers they answered incorrectly, along with explanations and links to resources that will help them succeed.

6) Integration with External Resources: Seamlessly integrates with external platforms and resources. An example of this might be when a learner encounters an unfamiliar word in the course of reading a passage, and SMAVLE provides them with instant access to either a dictionary online or an educational video.

Characteristics of SMAVLE:

The characteristics of SMAVLE could be depicted in the following:

1) A holistic approach to learning: SMAVLE offers a comprehensive approach to learning, integrating several components for a cohesive learning environment. It is possible to start a lesson with a video, followed by vocabulary exercises, a group discussion, and then a gamified quiz in order to ensure that every word in a vocabulary list has multiple touchpoints throughout the lesson.

2) Interactivity and Engagement: High levels of learner engagement and interactivity are ensured through multimedia content and interactive exercises. Students could interact with a 3D model or simulation of a word in place of just reading the word's definition in order to gain a deeper understanding of the concept.

3) Flexibility and Accessibility: SMAVLE offers flexibility, allowing anytime, anywhere learning. On a train ride, a commuter might practice vocabulary on their phone and continue the practice on a tablet at home after they get off the train.

4) Continuous Learning: the learners may promote an uninterrupted vocabulary learning journey. A learner may receive notifications over the next few days with micro-lessons or quizzes related to the module he or she has just completed, which will ensure retention of the knowledge they gained.

5) Integration of Theory and Practice: The learners may balance conceptual understanding and application. A learner may practice identifying and using words in different sentences that have common roots after learning the theory behind the roots and affixes behind words.

The SMAVLE framework, with its detailed components and characteristics, offers a comprehensive environment for vocabulary acquisition, making it a significant advancement from traditional MALL frameworks.

2.6.3 Theoretical Bases Underpinning the SMAVLE

There is no doubt that SMAVLE is more than a product of technological advances but is firmly integrated into pedagogical theories and models as well. It is essential to understand how SMAVLE works in order to gain a clearer perception of its potential benefits for learners as well as its operational characteristics. Additionally, if we want to draw out a blueprint of the SMAVLE and use it to teach vocabulary, we should also examine how it interacts with existing pedagogical theories and models, its operational characteristics, and what it can offer learners as a result.

2.6.3.1 Formal, Non-formal, and Informal Learning Environments

The SMAVLE framework, while rooted in technological advancements, is also deeply intertwined with the diverse learning environments it seeks to support. These environments, primarily categorized as formal, non-formal, and informal settings, play a pivotal role in shaping the SMAVLE experience.

Formal Learning: This represents a highly structured and intentional learning trajectory, often managed by educational institutions. In all levels of education, from primary to higher academic levels, formal learning usually adheres to a specific curriculum that specifies learning objectives and expected outcomes according to a specific curriculum. In this environment, learners are primarily concerned with acquiring new competencies, skills, or knowledge. In the words of Coombs & Ahmed (1974), it is characterized by its institutionalization, the use of chronological grading, and the hierarchy it maintains. Using mobile technologies within formal teaching environments can enhance the traditional classroom experience by seamlessly integrating the technology into the classroom. An example of this would be to use mobile devices in fixed classroom settings, allowing educators to provide curriculum-led activities and manage those activities on a daily basis.

Non-formal Learning: While it may still be organized or even intentional, non-formal learning lacks the rigid structure of its formal counterpart (Werquin, 2007). The Cedefop European Commission (2016) explains that it is integrated within planned activities that, while not explicitly designed as learning experiences, contain significant learning elements. The emphasis here is less on certification, but rather on the acquisition of skills and knowledge, which may take place during work or leisure activities. In support of non-formal learning, SMAVLE provides flexible mobile platforms that learners can access during work breaks or leisure activities outside of a traditional classroom.

Informal Learning: This is the most unstructured of the three, primarily driven by experiential learning. As defined by Coombs and Ahmed (1974), it is the process of acquiring knowledge, skills, and insights over time by individuals based on their daily experiences and their environment. There are many ways in which this can be achieved, such as through interactions with peers, consumption of media, or even travel. A true strength of SMAVLE is the fact that it supports informal learning in a more effective and efficient way. As mobile devices have become more prevalent, learners have been able to integrate SMAVLE platforms into their everyday routines, thus enabling them to leverage everyday experiences as learning opportunities.

In spite of the fact that each learning environment offers its own set of unique experiences, the integration of SMAVLE ensures a cohesive, interconnected learning journey. Through bridging the gap between formal, non-formal, and informal learning, SMAVLE offers a holistic educational experience, ensuring learners benefit from the advantages associated with each environment. Within the SMAVLE framework,

this study acknowledges the potential of all three learning environments, but places particular emphasis on the synergies between formal and informal learning.

2.6.3.2 Constructivist Learning Theory

Since its inception in the 1960s, constructivism has spurred a revolution across diverse research fields, particularly in education. As a psychological learning theory, constructivism derives its principles from the cognitive theories of eminent scholars such as Piaget, Vygotsky, and Bruner, who laid the psychological groundwork for constructivism.

Constructivism is not monolithic; rather, it comprises a myriad of perspectives from various scholars. Generally, constructivists assert that "knowledge is constructed by learners as they attempt to make sense of their experiences" (Driscoll, 1994, p. 360). In other words, knowledge represents an individual's internal interpretation of a subject. This perspective contrasts with objectivism, which views knowledge as external reality, suggesting that as learners accrue more experiences, they get closer to true reality.

Constructivism posits that learners play an active role in interpreting their environment and ascribing meanings to information. It holds that knowledge acquisition is an outcome of the learner's interaction with the external environment. Learning, in essence, is a proactive construction process; students don't passively receive external information but actively and selectively perceive the world based on pre-existing cognitive structures. The extent of knowledge a learner gains depends on their ability to construct meaningful interpretations of relevant knowledge based on their personal experiences (Kirschner et al., 2006).

The elements of "situation," "collaboration," "dialogue," and "construction of meaning" are integral to the learning environment. Learners don't merely passively accept external guidance but build cognition through "assimilation" or "adaptation" in collaborative learning, a process that is uniquely personal and can't be replicated. In the learning community, learners re-interpret and encode updated information based on their existing knowledge and experiences, constructing internal knowledge representations that constitute personal interpretations and continually imbuing them with experience.

In the context of SMAVLE, the learning environment is analogous to a learning community where students cannot passively accept knowledge but must assimilate and adapt to new patterns to construct meaning. Similar to the experiential learning theory, constructivism emphasizes the learning environment and the internalization of knowledge.

Constructivist learning theory's emphasis on active learning, collaboration, and dialogue aligns well with SMAVLE principles, fostering an environment conducive to vocabulary learning. Mobile devices in SMAVLE mirror constructivist principles as learners actively engage with the material, construct knowledge, and interact with peers in a collaborative environment (Hsu et al., 2019). For example, mobile-assisted vocabulary learning activities could involve students collaborating to create digital flashcards, actively constructing their vocabulary knowledge, and engaging in peer discussions or quizzes to enhance understanding and retention.

2.6.3.3 Dual Coding Theory

First hypothesized by Paivio (1971), the concept of Dual Coding Theory (DCT) belongs to the school of cognitive psychology which proposed that the physical body of humans is equipped with appropriate tools. And these tools can be readily adapted to either system in brain or the physical system. Unlike the concept of the single coding theory which indicates that single channel either in verbal input or non-verbal input is enough for the learning process, dual coding theory maintained that two channels of inputting is better than one. (Paivio, 1971)

Later, Paivio (1986) updated and extended the concept, claiming that there are two subsystems in human cognitive system: a verbal system dedicated to dealing with language and a nonverbal system specialized for representing and processing knowledge about objects and events in the world. The image in the mind is the most common nonverbal expression. It is believed that these two subsystems are partially interconnected and able to function independently or in an integrated way.

The Definition of DCT

Paivio (1986, p53) states that “human cognition is unique in that it has become specialized for dealing simultaneously with language and with nonverbal objects and events. Any representational theory must accommodate this dual functionality”. The basic definition based on the views of Paivio can be interpreted that there are two detached but interconnected mental subsystems: verbal one and nonverbal one. Both two systems are capable of presenting and processing the environmental stimuli received by sensory organs. Since the essential role played in the generation, analysis and transformation of mental image, the nonverbal system is often regarded as an intangible system.

The Core Principle of DCT

In the view of experimental psychology, dual coding theory belongs to theory of modality. Modality or mode is a term which refers to any sense of various

kinds such as the audio modality or visual modality. especially in the fields of memory and learning. In other words, the modality in specific sense signified the fact that the learner's performance depends on mode of presentation provided for the learners. Therefore, DCT stressed that the cognition is based on sensory experience. Some may argue that the adoption of two channels in both verbal and nonverbal mode in processing two kinds of data synchronously may confuse the learners. However, Paivio (1986) insisted that it is appropriate to apply both verbal and nonverbal instruction to learning, claiming that these two systems do not interfere with each other and are able to work independently. Besides, they are integrative and interconnected. Despite the distinction in nature and structure, these two systems support each other in the brain memory function of encoding, storing and retrieving.

Generally speaking, the verbal system is dedicated to processing sequential information while the nonverbal one is specialized for processing the spatial and synchronous information. Take the word "bird" for an instance, the verbal form can be uttered as b-i-r-d. In contrast, the nonverbal system in people's mind would be exemplified by the thought of "a creature which is flying in the sky". When people begin to imagine a bird in their minds, a complete image with all properties, such as feathers, beak, and wings of a bird could be "seen". Therefore, the two systems are actually supporting each other without disturbing.

General Model of DCT

Before the general model of DCT is discussed, two terms adopted by Paivio need to be explained first. The first one is "logogens" which refer to humans' natural linguistic pieces, chunks or even inner speech, while the second term he used is "imagens" which stand for non-verbal objects, events, or kinesthetic.

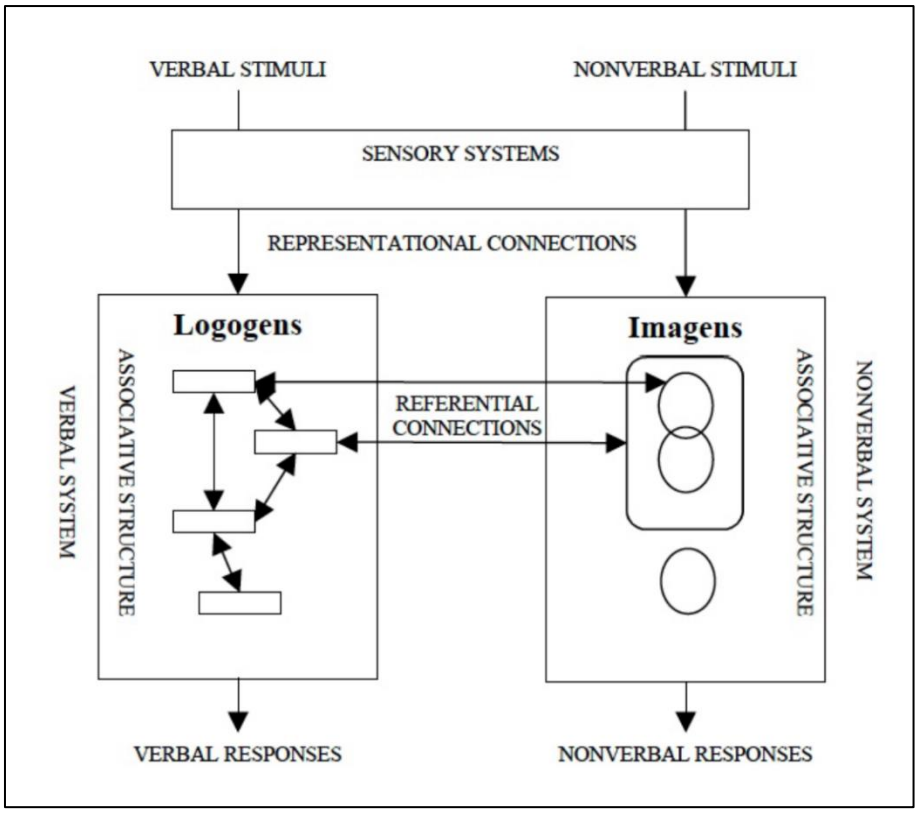


Figure 2.12 General model of DCT

The model in Figure 2.12 outlined the cognitive process in human mind. Besides, it elucidated the process of human' cognitive system, which includes the internal organizations and connections of the two systems as well as the three levels of information processing implied.

To view Figure 2.12 from the top part downwards, the verbal and non-verbal stimuli from the external world are the initial objects which are detected and received by sensory systems. Then the representational processing activates the logogens in verbal system and imagens in non-verbal system during the cognitive process. The logogens activation process runs as the verbal stimuli is perceived through certain sensory modality while the imagens activation begins to work at the moment when nonverbal objects and events are perceived. Thus, finishes the first level of cognitive information processing. The second level of cognitive information processing runs via the associative connections within system, which is also called spreading activation. It can be seen clearly that the associative structure of logogens in the verbal system is organized in a sequential order while that of imagens in the nonverbal system seem to be somehow overlapping. The third level of cognitive processing refers to the referential connections between verbal system and nonverbal system which means

that the information stored in one system can activate the corresponding one in the other system. This activation process across systems makes it possible for human mind to evoke a mental image of the related word, which could make contribution for remembering the word. Assume that Tony was walking along the street one day, and a tall tree came into his view. Immediately some related words such as “tree”, “forest”, “fallen leaves” or “trunk” popped out into his mind, and vice versa. This phenomenon could be explained by the referential connection between verbal and non-verbal systems.

The Adoption of DCT to SMAVLE

Since the SMAVLE, as discussed, is featured by its adoption of mediated handheld tools, such as mobile phones, tablets, laptops, and these tools will definitely “interact” with their owners, which means that the learners, when conducting learning activities, would use both the verbal system and non-verbal system in processing the information.

For instance, a student is assigned a task of watching the video which contains a new word- “scratch” which he does not know. As Figure 2.13 shows when he clicks the “play” button and begins to watch the video, as a verbal stimulus, the sound of the word enters into his verbal channel, synchronously, the visual image of “cat” appears on the screen of the device, which gets into his non-verbal system as non-verbal stimulus. Then he launches his process of inferential connection between the logogens and imagens. With the video being proceeding to play, he gets more verbal and non-vernal information, and finally finishes the guessing. (Building the inferential connection)

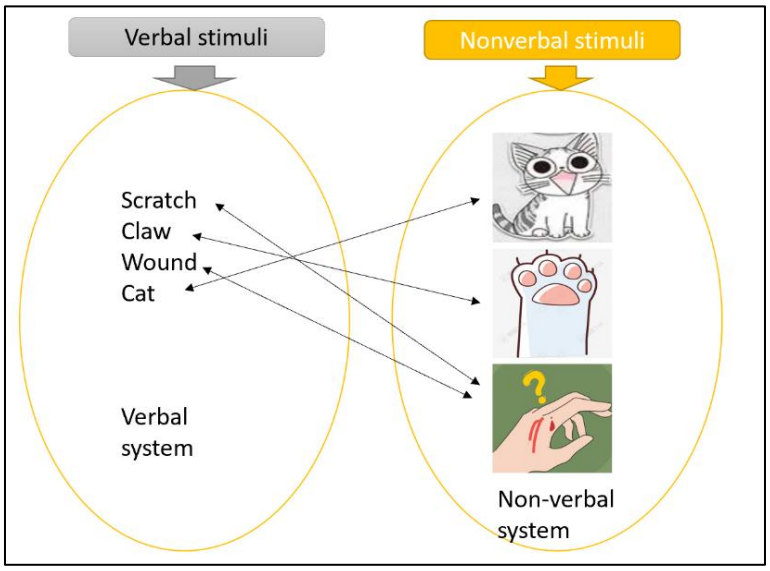


Figure 2.13 A simple example of DCT in SMAVLE

2.6.3.4 Autonomous Learning Theory

Autonomous learning refers to a modern learning concept which emerged in the 1960s. Educators in western countries believe that students should learn to be responsible for their own learning climate, and the ultimate goal of education is to cultivate learners' sense of responsibility. Autonomous learning in language education is often interpreted in various ways by using different terms (Ivanovska, 2015) like "self-directed learning", "independent learning", "self-planned learning", "self-managed learning", "self-monitored learning", and all these terms have been used to refer to similar concepts.

The Definition of Autonomous Learning

Since Holec (1981) introduced the concept of autonomous learning into the field of foreign language education and gave the definition to it as "the ability to take charge of one's own learning" and "to be responsible for one's own learning is to make decisions on all aspects of learning." His views have had a tremendous impact on the research of autonomous learning, and his original definition has been regarded as a prerequisite for research work in related fields. From then on, the increasing number of the extensive and in-depth research related autonomous foreign language learning has been flourishing and thriving.

Following Holec's lead, a number of scholars have gained a more deeply comprehensive and detailed understanding of the concept of autonomous learning based on the needs of the research field. Little (1995) believes that autonomous learning is the ability to analyze the learning process, to critically reflect the learning process, make decisions and act independently in one's learning process. Candy (1991) reckons that autonomous learning is a learner's awareness of learning rights within the education system. Dickinson and Stevens (1987) assume that it is "a situation where learners are fully responsible for the implementation of their own learning and decision-making." Allwright (1990) defines autonomous learning as "a constant change, but always the maximization of self-development and the independence of people are in an optimal balance." Legutke & Thomas (2014) deems that autonomous learning is "the ability to be responsible for one's own affairs" and "to be fully responsible for all decisions of one's own learning" Cottera (1995) believes that autonomous learning is the extent to which learners can use a set of strategies to control their learning. Littlewood (1996) points out that autonomous learning mainly includes learners' willingness and ability to make decisions for their own learning. In Littlewood's definition, willingness refers to learners' motivation and self-confidence

to be responsible for their own learning, and ability refers to learners' skills in choosing what to learn and how to learn.

The Features of Autonomous Learning

Hedge (2001) categorized the main characteristics of autonomous learning into four aspects: the ability to define one's own objectives, awareness of using language materials effectively; careful organization of time for learning; active development of learning strategies. Knowles (1975); Boud (2012); Kohonen (1992) believes that autonomous learners do not only rely on various kinds of stimuli from teachers in the learning process, but rather actively play their own role. Dickinson (1993)'s interpretation to the autonomous learning could be put into five aspects: First, learners should comprehend what the teacher has taught, and get to know what goal it is, then figure out how to turn the content instructed into their own knowledge base, and probe into the content afterwards; Second, learners should outline their own learning goals, which is often considered as a conscious behavior; Third, the learners should consciously select and implement learning strategies which meet their own needs; Fourth, the learners should monitor the application of these strategies in their learning process and identify which are effective ones and which are inapplicable and need to be altered; Fifth, the learners should be capable of monitoring their own learning process. Chan's belief (2001) is that autonomous learners should be able to set learning goals, identify and develop learning strategies to achieve these goals, then formulate learning plans, reflect on learning, including spotting the problematic aspects in the learning process and find solution to deal with the problems encountered, identifying and selecting relevant resources and supports to evaluate their learning progress.

In China, some scholars have also done the research about autonomous learning. For an instance, Hua (2001) classified autonomous learning into four categories, namely, the ability related theory, the environment related theory, the responsibility related theory, and the comprehensive theory. Under the scope of the "the ability related theory", autonomous learning is regarded as a learner's ability of self-management; from the perspective of "the environmental theory", it is believed that the core of autonomous learning is to require learners to be responsible for their own learning process in any environment. meanwhile, the physical environment plays a decisive role in promoting learners' autonomy. "The responsibility related theory" emphasizes that learners must take the responsibility for the results of their own behaviors. It is believed that to promote learner's autonomy, the consciousness of

responsibility must be cultivated. (Scharle & Szabo, 2007) “The comprehensive theory” defines learner autonomy from multiple levels.

To sum up, there are two crucial factors which autonomous learning should contain: First, learners must have the willingness and ability to take charge of their own learning so that the completion of autonomous learning could be ensured, which is considered as the internal factor; the second factor refers to the learning environment which is taken the external factor: learners can conduct their own learning practice in the controllable environment. What is worth being noted is the relationship between the two factors. Without the external support, such as teachers’ assistance, it is impossible for the internal factor to function in a proper way. Besides, generally speaking, autonomous learning can be accomplished through the teaching.

The Teacher’s Role in Autonomous Learning

As discussed above, when the autonomous learning is being conducted, the teacher’s role could not be neglected, thus it is essential to review the roles of the teacher.

The first role the teacher plays in the autonomous learning process is to support the establishment of learner’s autonomy in curriculum design. Cotterall (2000) put forward the principles of curriculum design to advance the development of independent learning. McClure (2001) and Hart (2002) implemented the empirical teaching practices of autonomous learning in the classroom setting to develop the students’ abilities of autonomous learning. Victori & Lockhart (1995) fostered the ability of autonomous learning through the training in adopting learning strategies. Gardner & Miller (1999) discussed about the establishment of autonomous learning ability by setting up a self-assessment center. Warschauer and Tiarbee (1996) explored the application of multimedia for enhancing the learner’s autonomy. He (2012) studied the roles of teachers’ supervision in the autonomous learning process in the college English course.

To sum up, having originated in the Western countries in 1960s, the autonomous learning has been investigated and scrutinized deeply in the domain of language education, and the importance and effectiveness in autonomous learning have been demonstrated in the language teaching and learning. Although the learners’ agency is of great importance, the role of the teacher also matters in the learning process. Two kinds of roles can be concluded here: the initial role is to help students develop their sense of learning autonomy, which includes setting goals and selecting learning materials; the second role refers to the resource provider - teacher should provide students with a variety of resources which contain the guidance on learning

strategies and information related to the language learning. From the angles of language education in college, the conclusions are as follows: 1) It is of great necessity to cultivate and foster the autonomous learning among the college students, since this is required by the goals of education and language teaching in modern times; 2) It is feasible to implement autonomous learning in English teaching for the undergraduate in college, because most undergraduates have already attained the ability to learn autonomously to some extent and they are equipped with the sense of self-development. While the teachers in college have also realized the significance and urgency of cultivating and enhancing the autonomous learning.

The Application of Autonomous Learning to SMAVLE

Seamless mobile-assisted vocabulary learning environment, as it is proposed in this thesis, concludes two kinds of learning environments: informal one and formal one which were discussed in previous section. Since informal learning is described as a type of learning which has never been organized or guided by a rigorous curriculum, but experiential learning, so with this type of learning conducted in SMAVLE, the learners need to set their learning objectives, to organize their time for learning, consciously adopt the learning strategies based on their own need. From the researcher's own perspective, the critical point of autonomous learning in SMAVLE lies in the identifying and selecting the learning resources. Since there is a sea of information available on the internet, it is somewhat difficult for the learners to decide on which material could be adopted or be disposed of. Last but not least, students also need evaluate the learning outcome in the process of autonomous learning, which is considered as the ultimate goal.

Apart from what students need to do in adopting the concept of autonomous learning in SMAVLE, teacher's role should also be taken into careful consideration. As discussed above, there two kinds of roles teacher play in autonomous learning: assisting students develop their sense of learning autonomy and being the resource provide. In SMAVLE environment, helping students establish their sense of learning can be quite problematic due to the limited class time. One possible proposal, based on the researcher's empirical way, for tackling this issue is that teacher needs to switch the "sermonizing character" into the role of a "pal online" for building a close rapport during the whole process of SMAVLE. The close relationship between the teacher and students may better the process in building up the learning autonomy. For the resource provider, the teacher should take the responsibility for preliminary screening the resource, which means that the teacher should examine the resource

for students first, and then get rid of some of the useless or worthless for students, finally leave the students select the resources they need on their own.

In a word, the concept of autonomous learning meets the needs of this research, but both the students and teachers should be involved and take responsibilities in establishing the learning autonomy in SMAVLE.

2.6.3.5 Production-oriented Approach

As a theory proposed by a Chinese leading scholar-qiufang Wen, Production-oriented Approach (POA) attempts to break the outdated assumptions about the hierarchy of language learning. Compared with other theory, POA focuses on the EFL context in China, which meet the very need of this research.

The Origin and Definition of POA

Based on the output hypothesis proposed by Swain (1985), input hypothesis by Krashen (1985), and interaction hypothesis by Allwright (1984) and Long (1983), Wen (2015) put forward the Production-Oriented Approach. As its name indicates, POA is a teaching method, driven by output, specially designed for teaching English to young adult learners (university students) in China. The underlying assumption is that outputs can drive students to learn which are in align with students' future career needs. At the same time, inputs serve as preparation for students' fulfillment of the output tasks.

The Theoretical System of POA

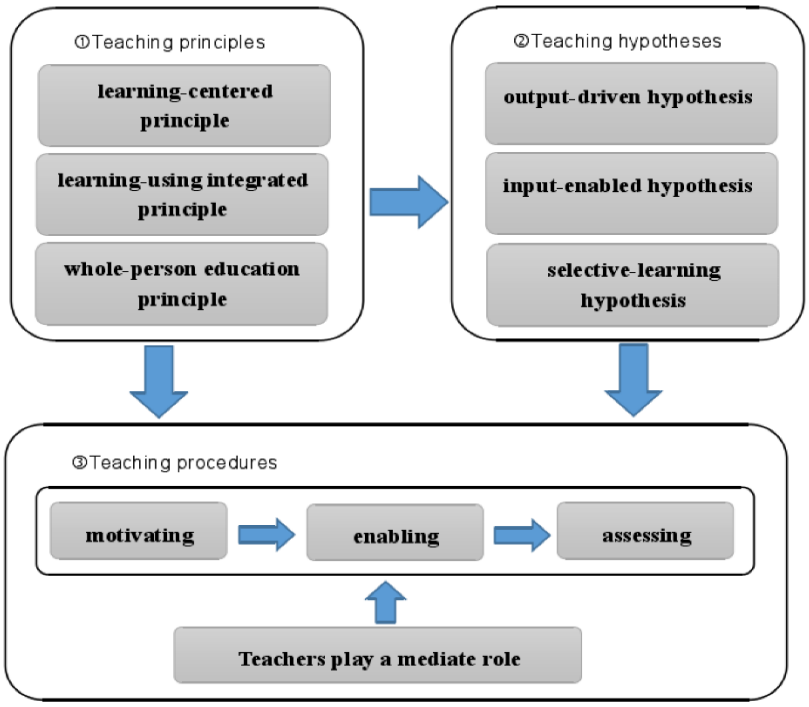


Figure 2.14 The system of the POA (Wen, 2015)

POA can be divided into three main parts (Figure 2.14): teaching principles, teaching hypotheses and teaching procedures. As the guiding pillars of the POA theoretical system, the hypotheses of the POA are composed of output-driven hypothesis, input-enabled hypothesis and selective-learning hypothesis. Guided by teachers, co-constructed by teachers and students, the teaching procedures can be considered as the realization of teaching principles and teaching hypotheses of the POA. There are three steps in the teaching procedures, namely, motivating, enabling and assessing, which are the continuous circulation of these three steps within the limited teaching time. It should be noted that all the three stages must be mediated by teachers, and the teachers play the guiding, designing and scaffolding roles during the teaching process (Wen, 2015).

As the initial phase of the POA, teachers are expected design productive tasks with potential communicative value. The teacher sets the communicative scenario which might happen in students' lives. According to the POA, students are expected to know what they lack for the productive tasks in the motivating phase and whether they have acquired the sufficient language input or not to accomplish the task. Once the students realize the difficulties when finishing the production task, their learning interest and enthusiasm would be aroused. Then they would set clearer focus for their further learning (Wen, 2016).

Enabling procedure is the second phase of the POA. It is claimed that the teacher should select suitable materials as enablers from the website or somewhere else in addition to the reading materials in the textbook. The motivating process mainly focuses on three aspects: language motivating, viewpoint motivating and structure motivating. Accordingly, the teacher should divide the enabling procedure into language enabling, viewpoint enabling and structure enabling. Adequate input materials in this phase would supplement students with theme-related ideas, language expressions and discourse structures for accomplishing the productive tasks. As it is required in POA, teachers would fully play the role of mediating, and guide students to have effective selective learning following a series of designed steps for the productive task. Students are encouraged to apply what they have learned from the given materials to complete the writing task.

Assessing is the last phase of the POA, which aims to evaluate students' language output products. The assessment phase could be divided into two categories, the ongoing diagnostic and formative classroom assessment and the achievement assessment. The ongoing diagnostic and formative classroom assessment take place in the enabling phase when students do the mini tasks. All the students

participate in the assessment collaboratively in class, and all the assessing criteria are set up by teacher and students together, which is to make comments in aspects of structure, content and language in the writings by the students. In this process, the students make their comments first, then the teacher gives advice and provides the revised versions of the students' production. The collaborative assessment would lead to better learning effects than a teacher's individual feedback. For one thing, the method of collaborative assessing would arise the students' attention to the teacher's feedback. For another; the common mistakes could be discussed by students and the teacher together (Wen, 2016b).

The Application of POA in this Research

Vocabulary learning requires certain amount of output behaviors, such as making sentence, or writing something in the target language. Therefore, POA can be adopted as an approach for motivating the students for more output. Besides, when mediated with mobile technology, POA could function better in terms of giving instant assessment or selecting material for learning.

2.6.4 Integration of Theoretical Frameworks in the SMAVLE

To comprehend the full scope of the SMAVLE, one must understand its foundational pillars - five key educational theories that intricately shape this interactive learning model. Now here are some possible adoptions of these "pillars" in the design of the SMAVLE.

Firstly, Formal and informal learning environments could set the stage for the SMAVLE system, providing a multifaceted platform for dynamic learning experiences. During the formal learning phase, structured instruction could be given to learners through digital tools, such as certain teaching mobile app. This part embodies the structured, curriculum-driven aspect of formal learning. For the informal learning environments, they could be then introduced, enabling students to explore targeted words and self-create learning materials through mobile devices. These processes add flexibility to the learning environment and are driven by self-direction, encapsulating the essence of the formal and informal learning structures.

Secondly, constructivist learning theory may form the backbone of the personalized learning processes in SMAVLE. This theory posits that knowledge is constructed through personal experiences and interactions, mirroring the learner-driven activities within SMAVLE. Learners actively engage with the material, constructing knowledge and interacting with peers in a collaborative environment.

Thirdly, dual coding theory could be integrated throughout the learning process in SMAVLE. The theory suggests that information is better remembered when

it is presented both visually and verbally. Accordingly, the SMAVLE could encourage learners to engage with visual content (like pictures and video clips) and verbal content (such as words and feedback), which enhances information processing and learning outcomes.

Fourthly, autonomous learning theory underpins the self-regulated aspects of learning within the SMAVLE. It could encourage learners to reflect on their own learning, to identify and correct mistakes based on feedback, and to take charge of their learning trajectory. This emphasis on self-regulation and personal responsibility promotes the principles of autonomous learning within SMAVL.

Finally, the production-oriented approach could also be echoed in the SMAVL's design. Aligning with the approach's central idea of learning as an active production process, students in the SMAVLE actively participate in creating learning materials, peer interaction, and self-correction, transitioning from passive recipients to active contributors and constructors of knowledge.

In summary, SMAVLE is not a singular, static learning model but rather a dynamic integration of diverse educational theories. It combines elements of formal and informal learning environments with key principles from constructivist learning, dual coding, autonomous learning, and the production-oriented approach. By weaving these theoretical threads together, SMAVLE provides a rich, engaging, and interactive vocabulary learning experience that acknowledges and leverages the multifaceted nature of learning.

2.6.5 Conceptual Framework of the SMAVLE

A testament to the synergistic potential of pedagogical theory and technological innovation, the Seamless Mobile-Assisted Vocabulary Learning Environment (SMAVLE) represents a new paradigm for vocabulary acquisition in the field of Mobile-Assisted Language Learning (MALL). By synthesizing contemporary learning theories, this conceptual framework seeks to operationalize an integrative model of vocabulary learning that seamlessly transitions across learning contexts and reflects the digital nativity of modern learners.

The objective of this framework is to serve not only as a theoretical framework to be used as a guide to develop and implement mobile-assisted language interventions, but also as a functional scheme to guide their design, implementation, and evaluation. By embracing and harnessing the dynamic interplay between learner, tool, and context, SMAVLE may emerge as an innovative and transformative way to teach vocabulary in a way that aligns with the cognitive and cultural fabric of the 21st century educational landscape.

2.6.5.1 Overview of the Framework

In essence, the Seamless Mobile-Assisted Vocabulary Learning Environment (SMAVLE) embodies a paradigmatic shift in educational pedagogy through the convergence of mobile technology and language pedagogy. Specifically, it provides an operationalization of a nexus between the affordances of mobile computing and the epistemological basis for language acquisition. This framework represents a double challenge: harnessing the potential that mobile technologies offer to enable ubiquitous learning and integrating this within the theoretical rigor that characterizes effective learning.

A key function of the SMAVLE conceptual framework is to serve as a crucible within which vocabulary learning processes are not merely supported, but also enhanced significantly. Its central purpose is to encompass and address the multiple dimensions of learning - cognitive, affective, and contextual. There is more to this framework than a simple pedagogical scaffold; rather, it is a blueprint for an immersive learning ecosystem that liberates the act of learning from the traditional constraints of the classroom. As envisioned in this schema, vocabulary acquisition is not an isolated cognitive pursuit, but an integrated endeavor mediated by mobile technologies that have become part of our everyday lives. By allowing seamless integration of learning experiences across multiple contexts and modes, SMAVLE emerges as a responsive and adaptive framework.

A judicious blending of pedagogical theories mentioned in the previous part forms the bedrock of the SMAVLE, each providing a crucial perspective on how seamless learning can be achieved, which are discussed in the following aspects:

First and foremost, the framework emphasizes the concept of learning as a continuum, transcending traditional dichotomies of informal and formal settings**.** The concept proposes a fluid educational experience in which learners navigate both structured academic environments, unstructured social environments, and introspective and reflective personal environments.

Secondly, based on constructivist beliefs, the SMAVLE framework situates learners as active agents who construct meaning through interaction rather than simply assimilating information. Learning is characterized by the interaction between the learner and the material, with their peers, and with the larger social context, rather than as a static commodity to be transmitted.

Thirdly, the dual coding theory is a theory that incorporates the strategic use of multimedia resources to facilitate both channels of cognitive

processing, reflecting the tenets of the dual coding theory. Visual and verbal synergies are considered a powerful means of enhancing the retention and application of new vocabulary, and this approach recognizes the potency of these synergies.

Fourthly, SMAVLE emphasizes the vital role that autonomy plays in the learning process, in order to encourage learners to exercise self-discipline and self-management. Through mobile technologies, learners are able to customize their educational experiences in a way that reflects their unique learning styles, learning needs, and educational goals through the use of personalization capabilities inherent in mobile technologies.

Lastly, in accordance with the production-oriented approach, SMAVLE places significant emphasis on the learners' role as creators as well as producers of content. According to this aspect of the framework, language learning should be viewed as actively engaging, creative, and generative, with the act of creating language artifacts at the same time serving as a catalyst for deeper learning and as a bridge towards authentic communication.

SMAVLE represents a paradigm which illustrates a symbiotic relationship between the theory of language learning and the use of mobile technology on a daily basis. The model is designed to facilitate the acquisition of vocabulary in a manner that is seamless and extremely integrated into the cognitive and cultural dimensions of learning, in order to facilitate a seamless process of learning vocabulary.

2.6.5.2 Components and Variables

In order to conceptualize the SMAVLE framework, it is important to distill the essence of mobile-assisted learning into discernible components and variables that can be measured and quantified. A theoretical paradigm serves as a medium through which theoretical principles can be converted into observable constructs within a research paradigm which can be construed and observed as actual, practical phenomena. The following are three general aspects which will be discussed in detail:

An important aspect of the SMAVLE is its technical aspects, which are comprised of the digital infrastructure and the learning interfaces that students interact with. Among the components of this are mobile platforms for delivering content, applications to facilitate interaction, and the ubiquitous connectivity that drives seamless learning through the delivery of content. It should be noted that these technical elements are not simply functional; rather, they also have a pedagogical purpose, and are designed to facilitate a variety of cognitive and linguistic activities,

such as the access to lexical databases and the interaction with multimedia-rich learning modules. Through the use of verbal and visual imagery in the learning process, they implement the principles of the Dual Coding Theory to make learning more effective for learners by giving them the opportunity to learn vocabulary in a multimodal manner.

The cultural aspects of the SMAVLE are an integral part of the alignment of the content of the learning with the linguistic and cultural contexts of the learners. As a matter of fact, this alignment is one of the fundamental principles of the Constructivist Learning Theory, which posits that learning occurs most efficiently when the learning is relevant to learners' own experiences and cultural backgrounds. In addition to incorporating cultural aspects, it is also imperative that the learning environment is adaptive in nature, ensuring that it is responsive to the diversity of needs of the students, thus facilitating a more inclusive and resonant learning environment.

There is a composite of theoretical aspects that underpin the SMAVLE that guide its implementation and provide the framework for its design. As an example of this, scaffolding of learning experiences across formal and informal settings can allow learners to engage in language learning within and beyond the classroom setting as they transition from formal to informal settings. The Production-oriented Approach is exemplified in the way that it encourages learners to create and share digital artifacts, thereby allowing them to not only become consumers of content, but also to contribute to the landscape of linguistics through their creations and sharing.

In order to determine what impact each component within the SMAVLE has on the language learning process, each component is meticulously calibrated to serve as a variable that can be measured and manipulated in order to get a clear image of its effects. It can be argued that the efficacy of these components is driven by their ability to facilitate the acquisition, retention, and application of vocabulary in a manner which is consistent with the realities of the digital era in terms of their ability to facilitate learning.

To summarize, the SMAVLE framework's components and variables embody its theoretical foundations, operationalized through the interaction between technology and pedagogy. In other words, they are tangible manifestations of an educational philosophy that advocates a learner-centered, technology-enabled approach to language learning. The following sections will explore the operationalization of these variables, explaining their selection and explaining how their influence on learning outcomes can be assessed.

2.6.5.3 Operationalization of Variables

The operationalization of variables within the SMAVLE framework allows the theoretical underpinnings to be translated into measurable and manipulatable entities, essential for the scientific scrutiny and pedagogical application of the framework. The objective of this transformation is to establish the validity and reliability of the framework as a tool for improving vocabulary learning through the use of mobile technologies, in order to establish its validity and reliability.

It is important to note that each component within the SMAVLE framework is associated with variables that lend themselves to measurement and manipulation. As a result, these measurements are crucial when it comes to assessing the effectiveness of the SMAVLE in assisting the acquisition and retention of vocabulary. When it comes to Technical Aspects, variables such as the frequency and duration of Rain mini-program use in the classroom, the number and quality of interactions with Rain, as well as the amount of engagement with video editing tools for the creation of artifacts are quantifiable indicators of the effectiveness of the technical component. Aspects related to cultural aspects are measured using qualitative assessments of whether the learning materials are relevant to the learners' cultural backgrounds and to the extent to which the learners are able to relate the target vocabulary to their personal experiences. Analyzing students' artifacts may be one of the ways to evaluate cultural integration and personalization of the program. Based on the Theoretical Aspects, an evaluation of the constructivist, autonomous, and production-oriented activities within the learning environment must be carried out. There are several variables that serve as measurable outcomes for these variables, such as the amount of active engagement in learning activities, the level of self-directed learning, and the quality and creativity of learner-generated content.

In order to manipulate these variables, the design of the SMAVLE provides a deliberate process, orchestrated by the SMAVLE. Basically, this involves the implementation of learning activities that are structured to make use of the Rain-classroom and other mobile technologies to provide opportunities for noticing, retrieving, and generating vocabulary in a meaningful way. Furthermore, by allowing learners to use mobile devices for learning at their convenience, this manipulation of the learning process is further enhanced, thereby fostering a sense of autonomy and self-regulation among the learners.

SMAVLE variables are selections based on their ability to catalyze a vocabulary learning process, which is a very important consideration when choosing variables for the SMAVLE. In the selection of the theories, we have taken into

consideration their alignment with the theoretical frameworks that are the basis of the SMAVLE, their relevance to the practicalities of mobile-assisted language learning, and their capacity to provide insightful insights into what might be going on during the learning process. In addition to the fact that technology is increasingly prevalent in learners' lives and there is evidence supporting the effectiveness of multimedia learning, the technical variables are justified. It is important to include cultural variables in order to ensure that the learning is contextually based and reflects the lived experiences of the learners. As a result, a broad range of variables is selected in order to ensure that they can capture the active, engaged, and autonomous nature of learning that is advocated by contemporary educational theories.

In essence, operationalizing these variables is a meticulous process in which every aspect of the SMAVLE can be measured, observed, and modified. It is through this process that the SMAVLE is not only rooted empirically but is also able to be adapted to the diverse contexts in which modern language learning takes place.

2.6.5.4 Visual Model

The visual model of the SMAVLE framework is designed to elucidate the components and the dynamic processes that characterize the mobile-assisted learning environment. It serves as a schematic representation that captures the essence of the operationalized variables and their interrelationships, facilitating an intuitive understanding of the framework's functional architecture. The conceptual framework for SMAVLE is visually represented in Figure 2.15 , illustrating the intricate interplay between various components that contribute to the seamless mobile-assisted vocabulary learning environment.

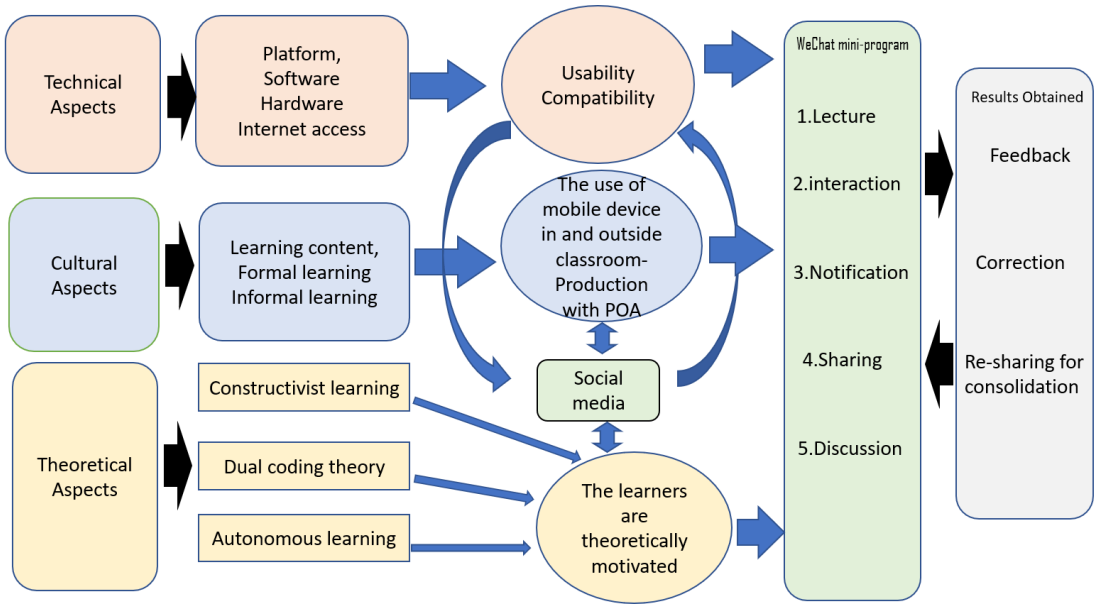


Figure 2.15 The conceptual framework of the SMAVLE

Technical Aspects: The SMAVLE framework begins with the technical aspects, which includes the platform, the software, the hardware, and the availability of the Internet. The platform's usability and compatibility guarantee that learners will be able to interact seamlessly with the content and tools provided, which will make the learning process more fluid and integrated, and therefore, more engaging.

Cultural Aspects: The cultural components of the SMAVLE framework ensure that the learning materials are relevant, engaging, and culturally appropriate for learners. Mobile devices are used both inside the classroom as well as outside of the classroom to bridge the gap between formal and informal learning environments, creating a more holistic learning environment.

Theoretical Aspects: SMAVLE is based on five key learning theories which have been discussed previously. The first one is constructivist learning, which posits that learners construct knowledge based on their experiences. In the context of SMAVLE, learners actively engage with the content, constructing their vocabulary understanding through various phases of the experiment. The second one, dual coding theory, suggests that information processed in both verbal and visual forms is better remembered. For example, video making and sharing align with this theory, as students engage with vocabulary in both verbal (spoken words) and visual (video scenes) formats. The third one is called autonomous learning which highlights the importance of learner autonomy in the learning process. SMAVLE may promote autonomous learning by allowing students to retrieve information related to the target words. They

can create word entries and reflect on their learning at their own pace and based on their interests. The last theory related is production-oriented approach. (POA) which functions as a way for pushing students to produce more materials of learning outcomes.

Integration with the Learning Platform-WeChat Mini Program: Crucial to the SMAVLE framework is the integration of the learning platform, which serves as the primary medium for delivering content and facilitating interactions. This platform could 1) support the structured introduction of vocabulary and concepts, ensuring that learners have a solid foundation. For example, the teacher could introduce target words using the WeChat-embedded mini-program, facilitating effective noticing of the words; 2) allow for self-directed learning, where students can explore and retrieve information at their own pace and based on their interests; 3) facilitate feedback mechanisms, allowing for iterative learning and continuous improvement. By receiving feedback and making necessary corrections, learners can reinforce their understanding and solidify their knowledge.

In conclusion, the SMAVLE conceptual framework provides a holistic approach to mobile-assisted vocabulary learning. By integrating technical, cultural, and theoretical components, it offers a seamless and effective learning environment that caters to the modern learner's needs. This framework lays the foundation for the subsequent experimental design, ensuring that the research is grounded in sound theoretical and practical considerations.

2.6.5.5 Conclusion

This framework represents an innovative confluence of pedagogical strategies and mobile technology, which is devoted to meeting the evolving demands of vocabulary learning in second language acquisition, as depicted in the visual model above. It is the purpose of this conclusion to synthesize the framework's components and their operationalization in order to showcase the many empirical and theoretical contributions that the SMAVLE has made to the field of mobile-assisted language learning. It is easy to understand the comprehensiveness of the SMAVLE through its incorporation of diverse learning environments, its facilitation of constructive and autonomous learning experiences, and its promotion of active learning through active learner participation in the production of language. By combining these elements, mobile technologies offer opportunities for seamless integration of cultural and linguistic content relevant to the learner's own experiences, as well as bridging formal and informal learning contexts. The strength of this framework may be in its adaptability and responsiveness to the individual needs of learners, who are

increasingly seeking educational experiences that are flexible, accessible, and integrated into their daily lives. The robust theoretical basis of the SMAVLE ensures that mobile technology in language learning is not simply an enhancement to traditional methods, but a transformative approach that enhances and extends learning. The operationalization of SMAVLE's components-technical, cultural, and theoretical-provides clear, measurable variables that can be manipulated and evaluated to determine their effectiveness in promoting vocabulary acquisition. Through this thoughtful operationalization, each component of the framework is made visible and contributes to the learning process as a whole.

Finally, the SMAVLE framework provides a comprehensive, theory-driven approach to vocabulary learning in a mobile environment. Essentially, it is a demonstration of the potential of integrating educational technology with pedagogical theory to transform learning into an engaging, seamless, and effective process. Due to the growing penetration of mobile technologies into all aspects of life, the SMAVLE framework provides a model compatible with contemporary learning paradigms as well as capable of driving future innovations in the field of language education.

2.7 Summary

The literature review set out to explore the facets of Mobile-Assisted Language Learning (MALL) and how it intersects with vocabulary learning in the context of second language acquisition. It begins by emphasizing the importance of understanding the historical and theoretical foundations of MALL, highlighting its evolution and key features, as well as the pressing need for seamless integration in order to overcome traditional limitations.

A careful examination of vocabulary, as a cornerstone of language acquisition, was conducted. As a result of the review, the importance of vocabulary learning and its role in language comprehension and expression is shed light on the intricate nuances of vocabulary learning. Several challenges and opportunities associated with vocabulary learning were highlighted, which revealed the limitations of traditional methods and the need for innovative approaches.

By bridging the domains of MALL and vocabulary learning, the synergy between the two was demonstrated. Literature provided compelling empirical evidence that MALL enhances vocabulary acquisition in digitally enhanced environments, offering strategies and insights to facilitate vocabulary acquisition.

Seamless learning has emerged as a pivotal concept in modern education, its significance being emphasized on a daily basis. Seamless Mobile-Assisted

Vocabulary Learning Environment (SMAVLE) was conceptualized based on the ten dimensions of mobile seamless learning and Nation's model of vocabulary acquisition.

A wide array of theoretical bases is deeply rooted in the SMAVLE as a groundbreaking approach to vocabulary learning, ranging from constructivist learning to the production-oriented approach. In the final section of the chapter, a comprehensive conceptual framework for the SMAVLE was presented, integrating the diverse theoretical frameworks discussed and setting the stage for the practical application of the framework.

A detailed examination of the potential and implications of the SMAVLE was conducted. Literature on the SMAVLE has shown that it offers several transformative benefits in addressing both the gaps in MALL and vocabulary learning that have been identified. It was acknowledged that there would be challenges associated with its implementation, as well as wider implications for the future of language education and the integration of new technologies.

To summarize, the literature review has systematically laid the groundwork for the SMAVLE to be an effective tool for redefining vocabulary learning in the digital era, illuminating its potential in this regard. We believe the insights gained from this comprehensive exploration will serve as a guiding beacon for future research and applications in the field of language education.

CHAPTER 3
METHODOLOGY

This chapter starts with the descriptions of the research site and participants and the research design of the study. The data collection instruments for the quantitative and qualitative phases are explained, research procedure, and data collection are specified. The analysis processes are provided together with the reasons for using these methods for both the quantitative and qualitative phases. The ethical considerations are discussed. After that, the pilot study is described. At the end of the chapter, a summary is presented.

3.1 Research Context

The research site chosen for this study is Xi'an Shiyou University (XSYU) which is a unique multidisciplinary university in northwest China characterized by petroleum and Petro-chemical engineering. It was founded in 1951 as Northwest Petroleum Technical School and upgraded to Xi'an Petroleum Institute in 1958. Being changed into a factory in 1969, it was then rebuilt in 1980. In 2003, permission to rename Xi'an Shiyou University was granted by the Chinese Ministry of Education. The developmental history of XSYU indicates that it constantly improves and raises its educational quality in order to become one of the outstanding universities in domestic and global contexts. Nowadays, students have more chances to further their studies in Western countries. In terms of English proficiency requirements, all the students who are non-English majors must pass College English Test Band 4 (CET 4) in order to graduate. As for English teachers, there are 71 female teachers and 16 male teachers in a school of foreign languages. At present, XSYU has three campuses, this research was conducted on the Huyi campus, the largest one in which all the undergraduate students study and live.

3.2 Research Design

The research paradigm on which this research is built belongs to the pragmatic worldview. When the research occurs in social and other contexts, "what works" and "solutions to problems" are the key points that pragmatists are concerned about. Pragmatism is often used as a philosophical underpinning for mixed methods studies (Creswell, 2009). This is because researchers could adopt both quantitative and

qualitative approaches to derive knowledge about the problem. The advantage of utilizing a pragmatic approach in this study is that the researcher could apply mixed methods that drew on both quantitative and qualitative assumptions. Moreover, the researcher could also select the methods and procedures that best meet the needs and purposes of the study (Creswell, 2009). Then the researcher made use of both quantitative and qualitative data to provide the best understanding of the research problem.

The reasons for conducting mixed method research given by Ary, Jacobs, and Sorensen (2010) included seeking corroboration of findings, developing interpretations, and expanding the depth of a study, etc. This study adopted mixed-method approaches in order to derive theory from data collected in a social setting (Babbie, 2013; Khan, 2014), and triangulate evidence for a better understanding of the effectiveness of students' vocabulary learning under this new seamless mobile-assisted vocabulary learning environment constructed by the researcher. According to Creswell (2009), quantitative research aimed to test objective theories by examining the relationship between variables, while qualitative research was adopted when the researcher needed to explore and understand the meaning individuals or groups attributed to social or human issues. Specifically, test scores were used as quantitative data for measuring the effectiveness of vocabulary learning under the SMAVLE while students' learning logs and semi-structured interviews were used as a qualitative method to explore students' opinions towards as well as experience under the SMAVLE. A sequential explanatory strategy was adopted in this study, which meant the quantitative data was first collected, and then the qualitative data was collected afterward to build on the quantitative results and explain and interpret relationships. The multiple data sources in the current study were drawn on to minimize the weaknesses in using only one approach (Creswell, 2009; Creswell & Clark, 2011).

Despite descriptive and explanatory aims, this study also had an essential purpose which was exploratory. According to Babbie (2013), exploratory research is intended to satisfy the desire for a better understanding of a topic and develop methods to be employed in subsequent studies. Although there was abundant research about exploring the affordances and potential of new instructional design mediated with technologies in SLA, there was a dearth of research that considered how students learned in a seamless language learning environment and how this environment influenced their learning and supported their needs. So, this research could also be considered as an exploratory one.

Under such context, this study adopted an embedded mixed-methods approach to answer the research questions. More specifically, an embedded experimental mixed-method design was utilized. In this design, the researcher collected and analyzed quantitative and qualitative data within the larger experimental research design. Qualitative data were collected after the experiment to provide deeper insight and further understanding of the quantitative findings. This approach allowed for a richer, more comprehensive understanding of the students' vocabulary learning under the new seamless mobile-assisted vocabulary learning environment.

To conduct this study, 128 first-year, non-English major students between the ages of 18 and 21 were carefully selected. Various disciplines were represented among the participants to ensure a diversity of academic backgrounds. An essential component of the study's methodology was the selection process, which was one of the most integral components. With the support of the Office of Teaching Affairs, the researcher was able to identify four intact classes from the pool of first-year students to ensure an unbiased and representative sample. The College English Department of the School of Foreign Languages randomly assigned these classes to the study, in a manner that ensured the integrity of the study. In order to guarantee that the findings of the study were robust and generalizable, a methodical approach to participant selection played an essential role in the study's success. Following the research design, the participants, who were native Chinese speakers with an average of 8 to 9 years of experience with English learning, were divided into control and experimental groups, further confirming the validity of the study. Since all the participants were from four intact classes, it indicated that the randomization of sampling could not be completed. Thus, the present research was a quasi-experimental one. For the control groups, the students learned vocabulary in the seamed mobile-assisted vocabulary learning environment (explained in the latter part), while the students in the experimental groups learned vocabulary under the SMAVLE constructed by the researcher. The focus of the research design aimed to inspect whether the intervention, the SMAVLE, could improve the students' vocabulary learning outcome. At the beginning of the experiment, both groups took the same tests, including the language proficiency test, vocabulary size test, and vocabulary knowledge test. In the end, both groups took the previous tests again for later comparison in data analysis. Both groups learned the same amount of target words but under different learning environments. The independent variable was the seamless mobile-assisted vocabulary learning environment applied to the

experimental group during the research, while the scores of tests in vocabulary size and vocabulary knowledge were the dependent variables in this research.

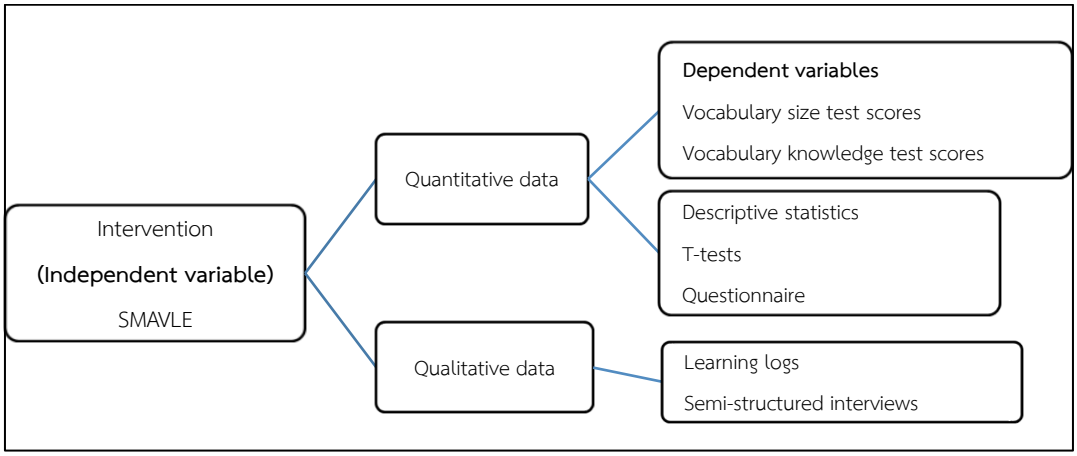


Figure 3.1 Design of the research

According to **Figure 3.1**, the researcher collected various types of data for different purposes.

3.2.1 The Implementation of SMAVLE

According to Chapter 2, SMAVLE exhibits characteristics that make it distinct from traditional classrooms or computer-based learning environments. By addressing the dynamic and mobile nature of modern learning, SMAVLE provides education across a variety of contexts and life transitions. This design was in response to the challenges in mobile learning (m-learning) identified by Sharples (2009), which included the non-static nature of m-learning scenarios spanning formal and informal environments, as well as a variety of locations and timings for learning activities and ethical considerations associated with monitoring learning outside of conventional classroom settings. The purpose of this section was to provide an overview of the implementation of SMAVLE, emphasizing its ability to bridge these gaps and facilitate seamless learning across multiple environments.

SMAVLE, as part of Mobile-Assisted Language Learning (MALL), inherently addresses these challenges, notably flexibility in social and personal learning activities across varying times and places. In order to meet these challenges within the study, SMAVLE's implementation extends beyond traditional classroom environments. It emphasized the impact of individual learners and their environments, both geographically and temporally. In this manner, the impact of MALLs in diverse learning settings can be analyzed comprehensively.

It was the primary objective of the research project to enhance vocabulary learning outcomes for Chinese EFL learners by utilizing the SMAVLE. Through the development of SMAVLE, Nation's vocabulary learning process was integrated with seamless mobile learning dimensions. Designed to take advantage of the ubiquitous nature of mobile devices, and the flexibility of modern learning paradigms, this integration leverages both. A design such as this facilitates an approachable and engaging learning experience, aligned with the changing needs of language learners today.

The researcher, serving as both teacher and supervisor, participated deeply in the study, bringing an emic perspective to it. Through this involvement, students were provided with real-time feedback and their progress was evaluated in real time. A dynamic and responsive educational environment at SMAVLE has been achieved as a result of this engagement, which ensured active participation in the students' learning process.

When examining the relation between SMAVLE's implementation and the theoretical underpinnings explored in Chapter 2, a critical aspect examined was the influence of the first language on the acquisition of second language vocabulary. According to the analysis in Chapter 2, L1 elements are highly beneficial to the learning of L2 vocabulary for Chinese learners. Consequently, integrating L1 components was deemed essential in SMAVLE's configuration, aligning with these theoretical insights.

As part of SMAVLE's implementation, mobile devices and Internet connectivity were required, which are essential elements in enabling flexible learning. It is through this technological foundation that students can engage in learning activities at any time and any location, epitomizing the concept of seamless learning. As part of this seamless approach, short videos were identified as a critical component for ensuring effective content delivery. By presenting these videos, smooth transitions between different learning scenarios can be achieved, thus enhancing the learning environment's adaptability and accessibility.

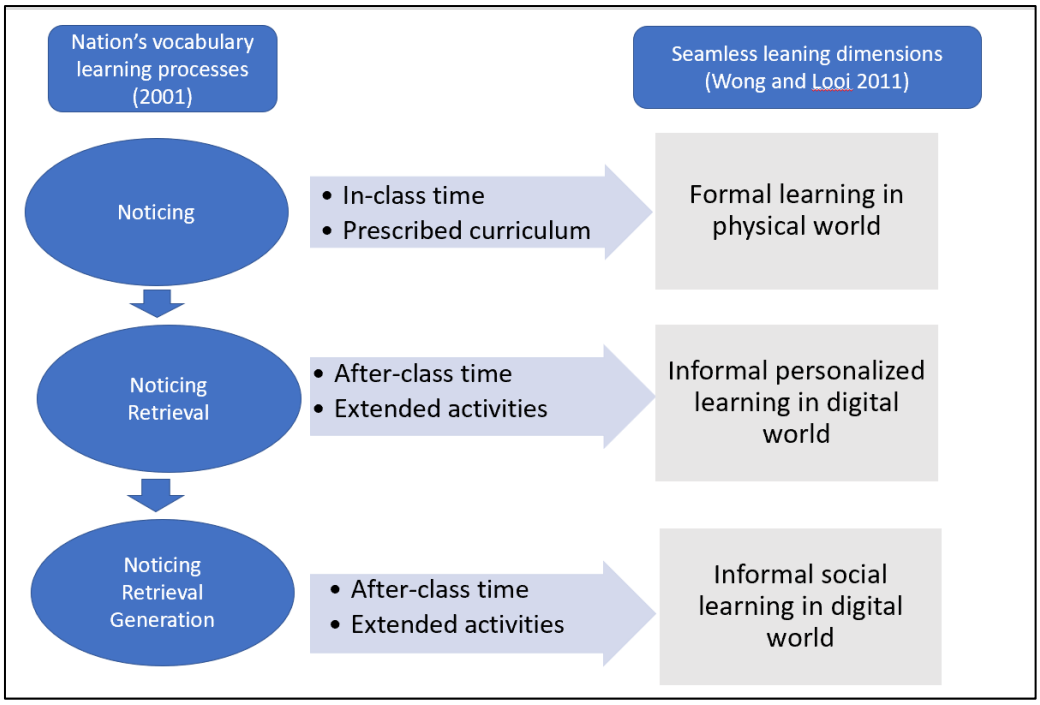


Figure 3.2 Conceptual blueprint of SMAVLE

As demonstrated in **Figure 3.2**, the SMAVLE integrated six learning dimensions of seamless learning into the three general processes of vocabulary learning, as proposed by Nation (2001). The model encompassed formal learning and physical learning environments during the initial phase, representing a traditional classroom scenario with a teacher and a prescribed curriculum. Both dimensions were combined due to the overlap in their characteristics, adhering to Werquin's (2007) emphasis on intentional, organized, and structured learning settings.

As guided by Dual Coding Theory (DCT), the learning materials within the SMAVLE incorporated audio-visual components with bilingual subtitles, tapping into both verbal and visual channels of information processing.

Figure 3.2 presents the conceptual blueprint of SMAVLE, illustrating the integration of six seamless learning dimensions into Nation's (2001) three general processes of vocabulary learning. In its initial phase, SMAVLE encompasses both formal and physical learning environments, simulating a traditional classroom setting with teacher-led instruction and a structured curriculum. This combination reflects Werquin's (2007) focus on intentional, organized, and structured learning, thereby aligning with established educational paradigms while incorporating the flexibility of mobile learning.

The second phase, mapped to the noticing and retrieval process, took place in an informal digital learning environment. In this phase, students engaged in self-

directed learning outside the classroom, following Autonomous Learning Theory. They utilized mobile devices to retrieve words and conduct information queries, then recorded relevant sentences in a Word document, indicating their sources.

In the third phase, students were expected to create personal learning artifacts in an informal social learning environment. This part was rooted in the Production-Oriented Approach, where students generated artifacts reflecting their real-life experiences and the use of target vocabulary.

The final phase, which was a part of the informal, digital, social learning environment, involved sharing these artifacts with all students after the instructor checked and evaluated the content. The students had the freedom to view these posts at any time, further enhancing the informal learning activity. This last phase also asked the students to create their own learning log. The log consisted of the pictures and descriptions related to the artifacts they viewed. This phase was deemed the most critical phase in the entire seamless learning cycle, as it encompassed personalized, social informal learning in a digital setting, all guided by Constructivist Learning Theory.

In summary, by effectively combining five prominent learning theories-Constructivism, Autonomous Learning, the Production-Oriented Approach, Dual Coding Theory, and Social Constructivism-the SMAVLE served as an effective and comprehensive medium for vocabulary learning for Chinese EFL learners.

3.2.2 Training on Adopting the SMAVLE

In this study, students in the experimental group took part in the training sessions which is offered by the instructor. There were two reasons for training. First, students must get familiar with the modules and functions of the Rain Classroom: a WeChat-embedded mini-program that will be adopted in this study, even though it was simple to use. Another application was the editing apps with which students used to create artifacts. The second reason was that the learning activities in this study also needed to be described in detail so that students would know the procedure.

The training session took 2 hours in class and 4 hours after class. For the two hours of in-class training, the researcher explained how the mini-program in WeChat would be used for SMAVL and how to make artifacts by the apps. For the four-hour training out of class time, students created examples of artifacts and their own learning log and sent them to the researcher for evaluation.

The in-class training session consisted of the following steps:

First, the instructor used a demo-video to present the artifacts which students created for vocabulary learning. This video was downloaded from *words in*

a sentence.com by the researcher. The screenshot of the video is shown in **Figure 3.3**. This short demo-video was shown to students for two purposes. The first purpose is to let the students acquaint themselves with the layout of the video which they were going to create. The second purpose was to provide the students with a reference for the content or the inspiration for their own creation. However, the researcher would not limit the content of the video strictly in order to encourage the diversity of the artifacts.

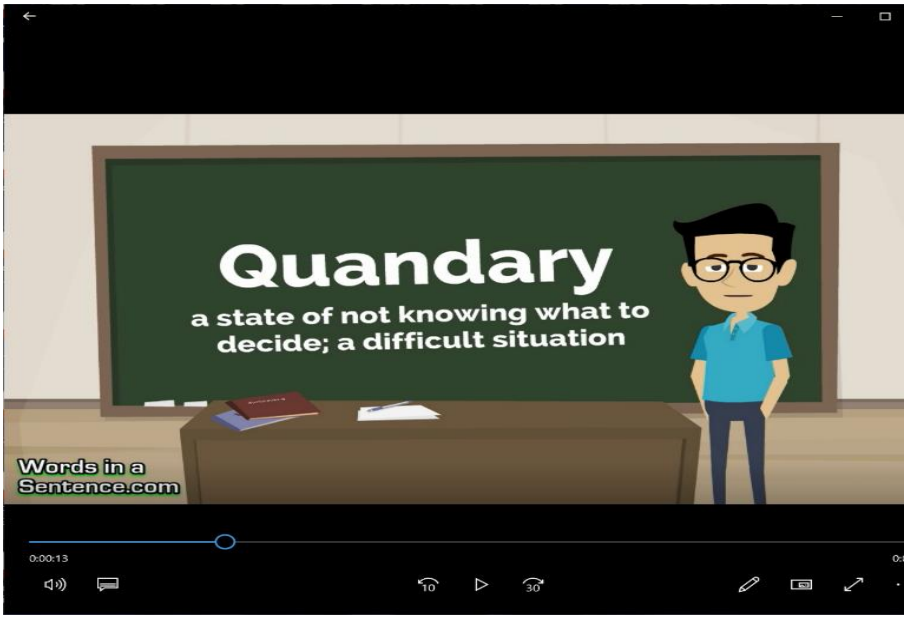


Figure 3.3 Screenshot of the example video

Second, the application for making the video was introduced to students. The researcher chose Jianying, a free short-video editing application on a mobile phone, for its user-friendly interface and easy-to-use wizards. Besides, this app did not take up much memory capacity of the student's mobile devices. As the interface is shown in **Figure 3.4**, the procedure of editing your video is simple. Once the video was taken, students could click the "Begin your creation", and then uploaded it to this app which allowed them to add other components they needed such as the subtitles, the background music, etc.

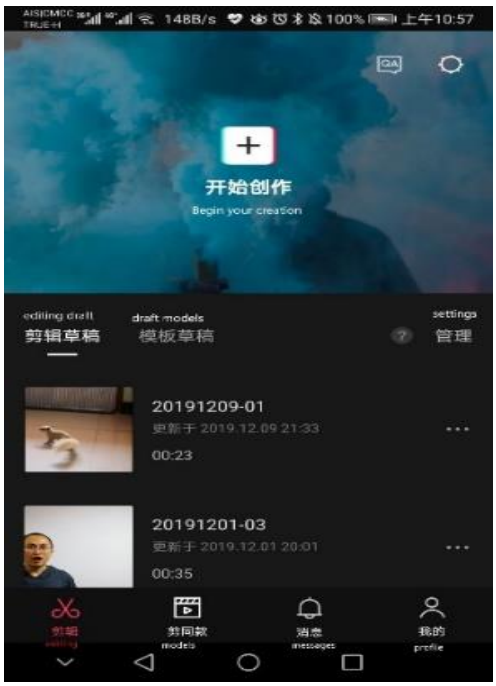


Figure 3.4 The interface of the Jianying app

Third, the instructor offered the training using a mini-program named “Rain Classroom” which was embedded in the app of WeChat for students. WeChat is a free Chinese application developed by Tencent company in 2011 to provide instant messaging services for terminals of smart devices. WeChat supports the rapid transmission of free voice messages over the network across communication operators and across operating system platforms, videos, pictures, and text. Based on the user data provided by Curiosity China (2015), by the end of the year 2015, WeChat covered more than 90% of smartphones, and the monthly active users of WeChat has reached 549 million, covering more than 200 countries in more than 20 languages. Among the contemporary college students known as “digital natives”, WeChat is undoubtedly the most popular social application at present. Just as Tencent has advertised, WeChat is already a lifestyle of contemporary college students. Therefore, adopting it into this research would not make students feel nervous or uncomfortable. The mini-program in WeChat is a functional module that is free of installation and user-friendly. The following **Figure 3.5** shows the interface of the mini-program.

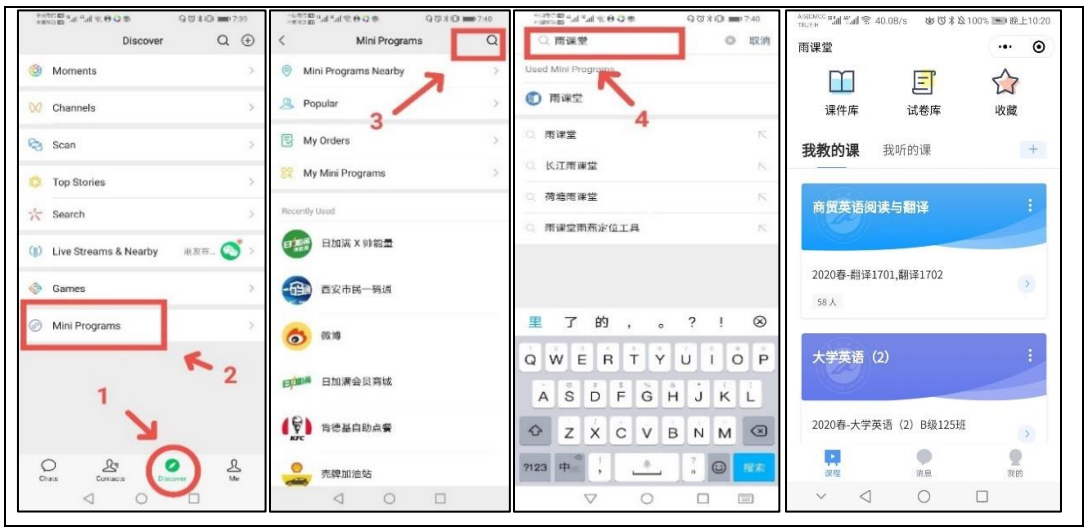


Figure 3.5 The interface of Rain classroom

Fourth, the instructor trained students to create their learning logs with pictures and descriptions of their lives. **Figure 3.6** shows an example of the learning log. The core of creating the learning logs is that students are required to speculate about the situation of using the target words in their daily lives since seamless learning focuses on bringing the life experience into the learning process. Students were required to take pictures of their daily lives and then make sentences by describing the picture with the target words or using the target words to compose a short story in a real-life situation. The learning log contained four parts: the target word, the part of speech, its definition, and its pictures with a description. Students needed to provide Chinese equivalence for references. The example sentences or descriptions were put into pictures by editing apps of pictures so that students could link the real situation with the target words in their minds. Besides, the last part of the learning logs is the reflection of daily learning in which students could express problems encountered in creating artifacts or learning new words, and they also need to record their time spent on each task and location for completing these tasks, and then briefly describe the learning process and their feeling for today. Eventually, these entries in learning logs will be recorded in students' smartphones in the format of electronic document files for their learning purposes.

Target words	Part of speech	Definition	The pictures in my life with description
depressed	Past participle of "depress" used as adjective 过去分词作形容词	Unhappy or hopeless 抑郁的；沮丧的	
scratch	Transitive verb; 及物动词	To make a slight mark on the surface of something with something sharp or tough 划伤，抓伤。	
Reflection: (problems encountered in creating artifacts or learning the new words) (time spent on each task and location for completing these tasks) (briefly describe the learning process for today)			

Figure 3.6 Example of students' learning logs

3.3 Research Participants

128 non-English major students aged 18-21 were the participants in the current study. They were first-year students from a variety of disciplines who constituted the four intact classes as a result of the arrangement from the Office of Teaching Affairs. Two classes were assigned randomly to the researcher and the other two to the researcher's colleague by the College English Department of School Foreign Languages. The colleague worked as a research assistant during this study. For these participants, Chinese was their mother tongue, and English was their foreign language. Their average time spent learning English was estimated from 8 to 9 years. Two classes were randomly assigned as the control groups (66 students) and the other two as the experimental groups (62 students) by the researcher.

3.4 Instruments

Following the completion of the demographic profile and the selection process of our participants, attention should be directed to a critical aspect of this study - the instruments. During this segment, which was divided into sub-sections, an in-depth discussion of the instructional instrument, which contained two parts, used in the research was first presented. The description was then systematically analyzed to identify the various instruments used. In turn, this provided a comprehensive view of the tangible and intangible elements that comprise our research methodology.

3.4.1 Instructional Instruments

There were two kinds of instructional instruments adopted in this study. The first kind of instructional instruments was the learning materials. In this study, the learning materials (target words) for teaching and learning were taken from the core words (Appendix A) in the vocabulary list of the syllabus of the College English Test band 4. (CET 4 for short). The researcher decided to choose this vocabulary list for the following reasons. First, based on the Guideline for College English, Chinese undergraduates needed to reach the required English levels specified in the National College English Teaching Syllabuses (NCETS) (Syllabus for College English Test, 2006, p. 1). These target words met the needs of students' desire for learning. Second, the mastery of these target words was appropriate for the graduation requirements for the students in the learning program in the study. Third, the difficulty level of these target words was also suitable for students based on their proficiency in English. Fourth, these target words in the CET4 vocabulary list were carefully considered and evaluated by the committee in the Chinese Higher Education Administration so that they were essential for the needs of college students. Altogether, these characteristics mentioned previously made these target words a reasonable choice to serve the purposes of the present study.

The second type of instructional instruments referred to the teaching curricula. Based on Nation's vocabulary learning process (2001) and the purpose of this research, the instructional instrument adopted in this research is mainly the instructor's explicit vocabulary explanation. The teaching content (target words for learning) of the control and experiment group was identical, the difference lied in the ways to present.

Experiment Group Lesson Plan (example):

Phase 1 - Formal learning in a physical world:

Introduction of target words: Using the word "Accelerate" as an example. The teacher introduced the word on Rain Classroom, a WeChat-embedded mini-program, explaining its meaning, pronunciation, usage, and examples. This helped students effectively notice the word.

Phase 2 - Informal personalized learning in the digital world:

Retrieval practice: Students used their mobile devices to retrieve the word "Accelerate" anytime and anywhere during the day. They could use online dictionaries, encyclopedias, or educational platforms to refresh their understanding of the word.

Phase 3 - Informal personalized learning:

Artifact creation: Each student must create a video clip related to his own assignment by using a free video-editing app on their personal devices. This could involve acting out a scene where “Accelerate” was used or narrating a story that included the word. This creative task aids in memorizing and understanding the word’s application.

Phase 4 - Error correction and consolidating presentation in the informal digital world:

Feedback: The teacher posted 4-5 student-made video artifacts made by students in the WeChat group each day. Students watched these videos and then made an online learning log, including a word entry with pictures related to their daily lives. The teacher checked the video clips and online learning logs and provided feedback for correction online.

Control Group Lesson Plan (example):

Phase 1 - Formal learning in the physical world:

Introduction of target words: Using the same word “Accelerate” for example, the teacher wrote the word on the blackboard, explained its meaning, pronunciation, and examples. Students took notes in their paper notebooks.

Phase 2 - Informal, personalized learning in the physical world:

Retrieval practice: Students used any dictionary app they prefer during a fixed classroom and self-studying time (19:00-20:40) to review the word “Accelerate”. They reviewed its meaning, pronunciation, and examples, practicing their understanding and memory of the word.

Phase 3 - Informal, personalized learning:

Note-taking: The teacher also showed a video clip containing the word “Accelerate”. However, this video clip was not created by students in control group but prepared by the teacher. Students watched the video and took notes on the usage of the word in their paper notebooks.

Phase 4 - Error correction and consolidating presentation in the physical world:

Feedback: The teacher gave 4-5 target words to students and asked them to make sentences and write them in their paper-based notebooks. Students submit their learning logs (notebook), and the teacher provided feedback by writing comments in the logs. If a student had misused “Accelerate”, the teacher corrected the mistake, helping the student learn the correct usage.

As it could be seen that, in the SMAVLE (experimental group), the learning process was more fluid, flexible, and integrated into the students' daily lives. Students could access information, created and receive feedback anytime and anywhere. The use of technology (e.g., cell phones and social media) allowed the learning process to cross the limits of physical space and time, resulting in a natural, continuous, and unhindered learning experience. In contrast, in seamed learning (control group), learning took place at a specific time and place in a more traditional and structured format. Students learned at a specific time (e.g., self-study time) and place (e.g., classroom), and learning and life are clearly separated. Feedback and error correction also take place at a fixed time and in a fixed format, and there is a clear "gap" between the various stages of learning. Thus, the main difference between seamless and seamed learning is the continuity and flexibility of learning and the degree to which it is integrated into the student's daily life. Seamless learning was more personalized, autonomous, and real-time, while seamed learning was more structured and rule-based.

3.4.2 English Language Proficiency Test

Although students in this study were placed at the same level based on their scores gained in the National College Entrance Examination (NCEE), which meant that the difference between their scores was not significant, the researcher would like to test their proficiency for the reassurance of their English language proficiency. The test system used in this study for measuring English Language Proficiency was called DIALANG, an online diagnostic language testing platform for foreign language abilities. It contained 5 parts of language knowledge: reading, listening, writing, grammar, and vocabulary. This test system is in 14 languages, and the test results conform to the six levels of the Common European Framework of Reference (CEFR) and will be reported on each of these tests separately. When the students finished the tests, they would be offered two kinds of extensive feedback as well as detailed test results. The first feedback provided the difference between students' self-assessment and test performance, from which learners could find out the reasons for these discrepancies. The adoption of this system for measurement might help to raise learners' awareness about the core of language learning meanwhile it could help to diagnose their strengths and weaknesses. The second feedback offered advice for improving student's language proficiency, which is useful for moving on to the next level.

The rationales for adopting DIALANG as a proficiency test for identifying the students' English proficiency were threefold. First, this system follows CEFR, which was a set of standards for language development, therefore, student's self-evaluation

of English language proficiency was meaningful for learners as well as the purpose of the current study. Second, the validity and reliability of the test could be guaranteed. Besides, it enabled the learners to relate their performance to an accepted standard of ability. Third, from the researcher's own perspective, this system was economical and served the purpose of this study as well. From the participants' angle, it is informative to know their own English proficiency with necessary feedback for improvement. What's more, this system is free to use without a time limit. To some extent, the subjects may feel at ease without extra pressure.

The following part described the DIALANG test and the steps of taking the test. In order to use it, the learners could log on to the system with a computer or pad which had internet access, then they could select which skill they wish to test first, and they also could quit a test at any point. When learners log on to the website at https://dialangweb.lancaster.ac.uk/, they could see the interface of this system in Figure 3.7 below. The instruction for this system was in 14 different languages, in this case, the students in this study would select Chinese instruction. To begin with, the students could initiate the test by clicking the play button in the middle of the interface. In this stage, the learners would see a brief description that can be skipped. The first part of the test presented for the subjects was the Vocabulary Size Placement Test (VSPT). It is a list of YES-NO vocabulary test which served to assist as to which one of three levels of difficulty to administer tests. This VSPT consisted of 75 words which contain 50 real words, 25 nonwords in a randomized order. The learners would just need to click 'YES' for a real word and 'NO' for a nonword. Immediate feedback would be offered to learners on their performance. The next section was the 'I CAN' self-assessment for other skills in CEFR. Learners could click 'Yes' if they reckoned that they could do what was described in the statements and 'No' if they thought they could not. When students finished the two parts of the test, the system would offer a test that is suitable for students. There were three levels for the test difficulty: easy, medium and difficulty. If students skipped the two assessments mentioned earlier, the medium test would be administered among three levels in the system. At this phase, students could choose any type of test of their own willingness. Each test contains 30 questions which are in 4 forms-multiple choices, dropdown menus, text entry, and short-answer questions. A variety of feedbacks will be shown below upon the completion of the test:

- *Your level*: test results in terms of the six levels of the CEFR
- *Check your answer*: a summary of right and wrong answers with feedback
- *Placement test*: score on the VSPT

- *Self-assessment feedback*: a comparison of their test scores based on CEFR levels with their self-assessment CEFR level
- *About self-assessment*: reasons why there is a mismatch between their score and self-assessment

Figure 3.7 The interface of DIALANG

When learners get the test results. They will keep a record of their score for each skill and submit it to the researcher at the end of the overall test, more details in Appendix B.

3.4.3 Vocabulary Size Test

Vocabulary Size Test (VST for short) is intended as a test of overall vocabulary size. It is now available in an interactive web format on Tom Cobb's *Lextutor* website at https://www.lextutor.ca/test/. Using a traditional four-option multiple-choice meaning-recognition format along with the target word and a non-defining example sentence as the stem, this VST test is broken into 1,000-word frequency bands and ranges from the first 1,000 words to the fourteenth 1,000. Beglar (2009) has made proper validation work for this test. In other words, each item in the test means 100-word families. The scores of this test need to be multiplied by 100 to get his/her vocabulary size. For instance, at the first 1,000 level, if the test-taker has

correctly answered 6-word questions out of the 10 words questions, then it means that the learner has 600/1000-word families at this level. The screenshot of the online VST is shown in Figure 3.8:

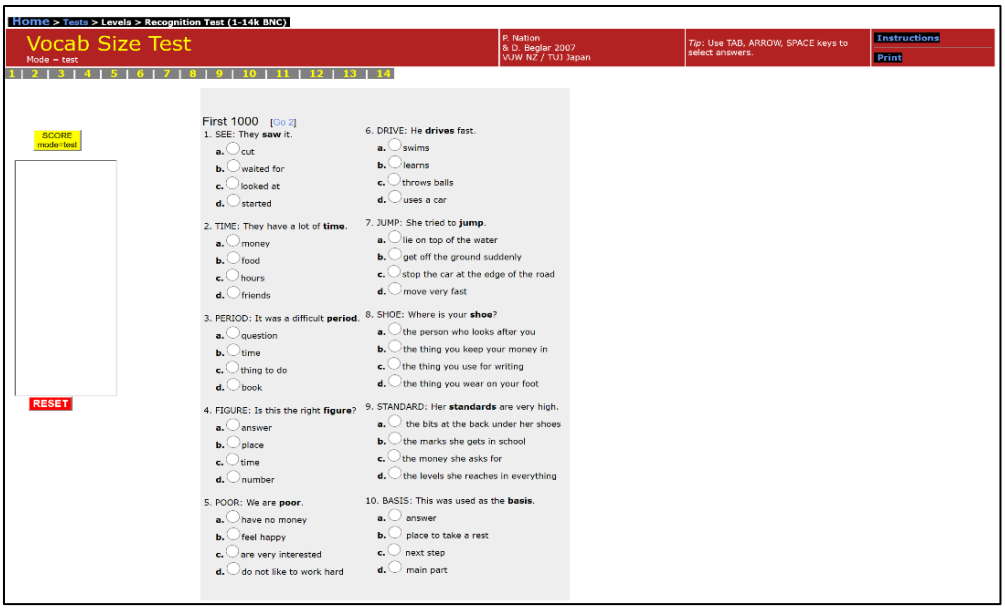


Figure 3.8 Screenshot of the Online Vocabulary Size Test (Nation & Beglar, 2007)

According to Schmitt (2010), "vocabulary size test is developed to provide a reliable, accurate and comprehensive measure of a learner's receptive vocabulary size." There are three reasons why VST is adopted in the research. First, according to Schmitt (2010), VST has value in measuring learners' progress in vocabulary learning, which meets the core task of this study. Second, Nation (2012) suggested that VST may encourage the study of isolated words since the test format has a discrete, context-independent nature. In this research, the words for learning are isolated, so VST is fit for this study. Third, Nation (2012) believed that VST could be used as a measure of total receptive written vocabulary size, which could help the researcher ensure that the students in both experimental and control groups are at the same level in this study. Fourth, for a convenient reason, VST is collocated with multiple choices so that the participant can finish it quickly without arduous efforts.

3.4.4 Vocabulary Knowledge Scale

Besides VST, this study will also adopt the Vocabulary Knowledge Scale (VKS) designed by Paribakht and Wesche (1996), which stated that the vocabulary knowledge scale is a practical tool that can be used with any set of words and is useful for research related to word recognition and usage. The content of the test is in Figure 3.9.

I. I don't remember having seen this word before. (1 point)
II. I have seen this word before, but I don't think I know what it means. (2 points)
III. I have seen this word before, and I think it means _____. (synonyms or translation) (3 points)
IV. I know this word. It means _____. (synonyms or translation) (4 points)
V. I can use this word in a sentence: _____. (if you do this section, please complete section IV) (5 points)

Figure 3.9 Sample of Vocabulary Knowledge Scale (Paribakht & Wesche,1996)

There are three justifications for adopting this test. First, Paribakht and Wesche (1997) described the VKS as a practical and useful tool for studies referring to the recognition and use of words, which meets the demand in this research. Second, according to Tan, et al (2016), VKS can prompt students to demonstrate their receptive knowledge of a particular word as well as their productive knowledge (using the words). So, in this study, the VKS test can be used to measure the difference of students' learning outcome towards the target words between the pre-experiment and the post-experiment so that it can be sure that the difference after the experiment is caused by the design of this research. Third, Bruton (2009) mentioned that the VKS test could track the gradual development of learners' knowledge of specific words at a given time in an instructional or experimental situation, which fits the end of this study to a large content.

Considering the English edition may cause inconvenience and anxiety for students, the researcher decided to adopt the Chinese version of VKS. The accuracy and quality of the translated version have been evaluated by two professors from the Translation department at another university. Both the English version and the Chinese version are provided in Appendix C. The VKS test used in this research contains 50 words which are selected randomly from the core vocabulary list in Appendix A.

3.4.5 Students' Learning Logs

A learning log is a kind of tool that is used by students in learning vocabulary. For this research, the researcher requires the students to use a note-taking format for a word in context, a definition in one's own words, a picture with description, and reflection. There are three reasons why students are required to keep a learning log. First, such a log can be taken as a personal reference system which could help students bridge the gaps between vocabulary learning in the formal environment and in the informal learning environment; Second, as O'Callaghan (2012)

stated that the learning log is considered beneficial in exploring the meaning of words because it is one of the strategies in facilitating vocabulary learning, so the purposes of keeping a log in this research could help students explore the meanings of targeted words more deeply; Third, according to Centenario (2015), creating a learning log allows students to learn independently. In this study, students have to gain knowledge about the targeted words by themselves in the informal learning scenarios, so it is requisite for them to keep learning logs.

Five elements are required to be covered in the learning log created by students as illustrated in the template (Appendix D). The elements are explained as follows:

1. **The Target Words:** These were the words presented by teachers in the formal learning context. They were often perceived by students as difficult, unknown, or unfamiliar.
2. **Part of Speech:** In the learning log, students had to label all the target words. This practice helped students to notice the grammatical properties of those target words, thus when they tried to use the target words, they could avoid misusing them. For instance, some students usually took the word “mention” as a noun since it contains the “-tion”. Marking out the parts of speech of target words provided guidance in using them correctly.
3. **Definition:** The definitions of the target words were based on students’ retrieval in the informal learning process. After consulting the words in a dictionary or online resources, students were required to note down the meanings of the target words in English and Chinese (preferably in their own language).
4. **The Example of a Sentence Related to Daily Life Experience:** For creating sentences with the target words, it was suggested that students should create a picture representing situations that could occur in their daily lives to enhance comprehension of the target words. The sentences had to be in both English and their native language. This approach allowed, once students made mistakes in writing English sentences, teachers and peers to notice the errors and help them correct them. For example: when students made sentences with the word “customer”, one student wrote: As an old customer of this supermarket, I didn’t make a complaint.（我是超市的老顾客，所以也没有抱怨什么。）The Chinese

sentence provided made it easy to notice that he used the wrong adjective to express the meaning of “regular”.

5. **Reflection:** Students were encouraged to take notes regarding the creation of the learning log or problems encountered during the learning and creation process. By identifying the problem, researchers were able to improve the quality of students’ learning logs. Furthermore, students were required to record the amount of time they spent on each phase of the project, as well as their feelings about the daily learning experience.

3.4.6 Questionnaire

In this research, there were two parts to the questionnaire. Part I was used for both groups for collecting personal information, which focused on collecting demographic information related to age category, gender, discipline, length of study, etc. The reason for the collection of personal information was to identify learners’ characteristics. For an exploratory purpose, the questionnaire was also used to gather some general information concerning the students’ opinions about the SMAVLE in which they learned target vocabulary. Therefore, Part II was adopted only for the experimental group to collect the opinions toward the SMAVLE with a Likert scale format (Strongly Disagree- Disagree-Undecided-Agree-Strongly Agree) (Appendix E). This questionnaire was designed based on the factors in the Nation’s vocabulary learning process. Items 9-10 were general questions for the preference to the SMAVL, item 11 was related to the form of the vocabulary, item 12 was related to the meaning of vocabulary, item 13 was related to the use of the word. Item 14 focused on learning autonomy. This questionnaire was distributed online using Wenjuanxing, a website specifically designed to support an online survey. An advantage of using this tool was that questions could be branched and items could be displayed or hidden, depending on the selections made in previous questions. In order to make students understand the questionnaire better, the questionnaire was provided in both English and Chinese language versions. The translation of the questionnaire was checked by experts for accuracy. To check the validity of the questionnaire, the researcher sent it to two experts for suggestions. Besides, the researcher also adopted the Index of Item-Objective Congruence (IOC) to find out the content validity. To do this, the questionnaire was evaluated by six experts who are associate professors in the field of second language acquisition. (see Appendix F) The scores from the experts were higher than 0.8, which meant that it was suitable to conduct this questionnaire.

3.4.7 Semi-structure Interview

As Merriam (2009) stated, the purpose of an interview in doing research was that the researcher tried to enter someone's mind and get specific information. In this research, since informal learning had hidden, vague, and private features, students' feelings and thoughts were not observable, so the researcher decided to adopt a semi-structured interview. Based on Cohen et al. (2013), interviews served three purposes: the first one as a means of collecting information having a direct influence on the research objectives; the second as an explanatory device to help identify variables and relationships; and the last one as a supplement to other methods in a research undertaking. With the aforementioned aims, the researcher planned to take interviews as means to explore his research questions from a different aspect and corroborate with the other methods as well. What was more, it was in line with the interview function of methodological triangulation in doing research mentioned by Mason's description (2002). The definition proposed by Merriam (2009) pointed out that the semi-structured interview was taken as a more open-minded, more flexible, and less structured form of the interview. In the current study, the researcher attempted not only to obtain specific information from all the students but also to explore students' experience of the effect of the intervention. Therefore, the interview should have been conducted in the student's native language and guided by a list of issues that allowed the researcher to respond to a special situation or new ideas emerging. Specifically, the researcher in this study sought additional information about the use of mobile devices in the SMAVLE, learning, and types of study behaviors, and gathered student interpretations and insights about their learning experiences. The interview protocol consisted of questions related to the following issues: (see Appendix G for more details)

1. **Effectiveness and Impact of SMAVLE**: Questions focus on evaluating SMAVLE's overall impact on English vocabulary learning, comparing it with traditional methods, and understanding changes in students' learning habits (Questions 1, 6, 8, 9).
2. **User Experience and Perceptions**: These questions aim to gather students' feelings and opinions about SMAVLE, including the benefits and challenges of using mobile devices for vocabulary learning in and out of the classroom (Questions 4, 5, 10).
3. **Learning Context and Environment**: This theme explores the various locations and contexts where students use mobile devices for learning and investigates external factors affecting vocabulary learning (Questions 3, 7).

4. **Technology and Tools in Learning**: One question is dedicated to identifying the most important tools or technologies students perceive as necessary for effective learning (Question 11).
5. **Feedback for SMAVLE Improvement**: Students are asked to provide suggestions based on their experiences, aimed at improving the implementation and functionality of SMAVLE (Question 12).
6. **Challenges and Problem Solving**: This includes inquiries about specific problems or challenges students faced while using SMAVLE, essential for identifying areas of improvement (Question 2).

The same procedure for IOC was conducted again to check the validity of the semi-structured questions: the questionnaire was scored by six experts who were associate professors. (See Appendix H) The results showed that the scores from the experts were higher than 0.88, which meant the items were suitable for adoption.

3.5 Research Procedure

Table 3.1 The procedure of the research

Phases	Experiment group (seamless)	Control group (seamed)
Phase 1	Formal learning in a physical world: teacher instructed students with 30 target words in the classroom with the aid of Rain-classroom (WeChat-embedded mini-program) every week (Noticing happens)	Formal learning in the physical world: teacher instructed students with 30 target words in the classroom through a demonstration on the blackboard every week. (Noticing happens)
Phase 2	Informal personalized learning in the digital world: Students were asked to use mobile devices to retrieve the target words anytime, anywhere they like during the day (Retrieval happens)	Informal personalized learning in the physical world: students were required to retrieve the target words by adopting any dictionary app they like in the fixed classroom and at fixed time (their compulsory self-studying time 19:00-20:40) (Retrieval happens)
Phase 3	Informal personalized learning: Every student was assigned the task of creating one artifact (video clips) every week from the 30 targeted words with a free video-editing app on their personal devices after class. (generation happens)	Informal personalized learning: Every student was shown the video clips on the target words provided by the researcher and wrote them down in a paper notebook after class. (generation happens)

Table 3.1 The procedure of the research (Cont.)

Phases	Experiment group (seamless)	Control group (seamed)
Phase 4	The instructor posted 4-5 artifacts in the WeChat group every day, the students were asked to watch these videos anytime, anywhere they wanted, and then make an online learning log (word entry with pics related to daily life).	The instructor also gave the same 4-5 targeted words to students and asked them to make sentences and wrote them down in their paper-based notebooks.
Phase 5	Error-correction and consolidating presentation in the informal digital world- the instructor checked all the learning logs students made in the online learning space and pointed out the errors made by students for correction, besides the feedback was given to students online.	Error-correction and consolidating presentation in the physical world: students submitted their learning logs, and the instructor gave feedback by writing comments in their logs and then returned to them for correction.

As shown in Table 3.1, for the first phase, the vocabulary instruction was placed at the beginning of each College English class. The time spent on vocabulary instruction was approximately 20 minutes. Both groups had the same 30 target words for learning per week. For the experiment group, the instructor used “Rain Classroom”, the embedded mini-program in WeChat for instruction.

Figure 3.10 Students’ adopting mobile devices in class

As it is shown in Figure. 3.10, the students were allowed to use mobile phones in the classroom, which to some extent, is an innovative point in college English classes in China. As the teacher projected a demonstration of the target words on the screen in front of the classroom, it also was shown on students’ mobile phones. what’s more, students in the experiment group were able to do the exercises provided by the instructor, meanwhile, the instructor also got feedback on student’s exercises. Such in-class interaction between teachers and students could help

highlight the process of vocabulary noticing. For the control group, students also used their mobile devices in classroom settings for consulting the targeted words, while the instructor only used chalk and blackboard for demonstration of the targeted words. When the instructor was instructing targeted words, he wrote them on the blackboard, students noticed the content and the exercise were written on a piece of paper. The interaction between teachers and students was a traditional face-to-face inquiry. To put it simply, the difference between the experiment group and control groups in this phase lies in whether it has a mobile-assisted way or not.

For the second phase, the informal learning and virtual learning dimensions will be intertwined together. As aforementioned in Chapter 2, informal learning is a type of learning that is never organized or guided by a rigid curriculum (Werquin, 2007). While the virtual learning environment, which refers to the internet-based learning context is where informal learning happens. Students used the internet to search for information and material they needed. In this study, informal learning in the digital learning environment helped the students with “retrieval” which was the second major step that promotes vocabulary learning. Based on Nation (2001), students needed to retrieve the word after they noticed the teacher’s explanation. The control group was required to use any app they like for retrieving the words in a fixed classroom during the fixed time (Students in our university have compulsory self-studying time from 19:00 to 20:40 from Monday to Sunday except Friday and Saturday, then the researcher made use of this period time). For the second phase, the difference between the control and experiment groups lied in making use of versatile resources and restriction of learning time and location.

For the third phase, with target words noticed in class, both groups had to complete the assignments related to the target words. For the experiment group, the 60 students created 720 artifacts in total, one student was responsible for 1 word per week, 12 words for 12 weeks. The presentation of these artifacts was a short video clip of about 1 minute to explain the vocabulary knowledge which included the form, meaning, and use of this word. Before they started creating the artifacts, the instructor offered training to teach students how to make short videos by utilizing a free video editing app. Then these video clips were sent to the researcher to evaluate for the use of the next phase. In this video-creating period, students experienced both noticing and retrieval in the processes of vocabulary learning. The control group was also shown the extant video clips of the same 720 words provided by the researcher. These videos are taken from the formal published material, every student viewed the

video at a fixed time of the day in the next phase. The disparity of this phase lies in the different kinds of video clips.

For the fourth phase, both groups learned the target 30 words per week under social learning and personalized learning environments. For the experiment group, the researcher uploaded the videos created by participants to the mini-program designed in WeChat for sharing and learning every day. For each day, there were 5 videos for sharing, 60 clips in total every week. When the videos were uploaded, every student in the experiment group watched them whenever and wherever they were on that day. After watching the videos, they needed to create their own daily learning logs related to these 5 words. The training for writing logs was offered to students beforehand. There were two requirements for writing the learning logs: 1) students should take pictures that show the context of the target words in daily life scenarios; 2) students made sentences concerning the words they learned from videos or describe the picture in English. If they could not take pictures, they could search online or turn to the instructor for help or discussed them with peers in the WeChat group. For the control group, they also created a learning log but they just needed to make the sentences and write them down in the notebook without the above 2 requirements.

The last phase is called error-correction and consolidating presentation which belonged to the integration of informal learning activity and formal learning activity. In the out-of-class environment, the researcher checked all the learning logs students made in the online learning space and pointed out the errors made by students for correction. In an informal learning environment, students were provided feedback online via mobile devices without worrying about the face problem. The teacher provided feedback for the students learning logs for correction afterward. This step closed the loop of the seamless learning cycle, aiming to correct the errors and giving feedback to the students' situated learning. The control group also handed in their learning logs written in notebooks to the instructor for error correction. The written feedback was given, and the logs were returned to students for checking. The students also did presentations associated with their learning logs in class.

In summary, the interventions between the experimental groups and control groups are 1). The instructor used the mobile-assisted presentation of targeted words to elicit the notice of experimental groups, while the control groups used the blackboard-presented ways; 2) The instructor assigned the experimental groups the tasks of retrieving the targeted words in mobile-assisted ways, while the control groups used any app they like for retrieving the targeted words; 3) The different

formats of learning productions: for experimental groups, they created video artifacts for peer learning while control groups with the sentences written on the notebook. 4) the learning logs of experimental and control groups were different in forms: for experimental groups, the participants attempted to integrate their daily life experiences into the learning logs which were presented in the form of pictures, while control groups use only words; 5) the feedbacks of the instructor for their learning log differed in forms of online or written ways.

3.6 Data Collection

As mentioned above, scores from the language proficiency test (DIALANG Test), the vocabulary size test, and the vocabulary knowledge test at the beginning of the study from both groups were collected to measure participants' abilities before the SMAVLE is conducted. During the study, learning logs from students in the experimental group were handed to the researcher each week. At the end of the study, scores from all the posttests measuring VKS and vocabulary size were gathered from both groups to check whether there is any enhancement or not. For the experimental group, the researcher gained the data from a questionnaire and semi-interviews. The data collection aimed to answer the research questions as demonstrated in Table 3.2.

Table 3.2 Data collection for answering the research questions

	Research instruments	Tool analysis
Research question 1	▪ DIALANG Test ▪ Vocabulary Size Test ▪ Vocabulary Knowledge Scale Test;	▪ Descriptive statistics ▪ Paired sample T-tests
Research question 2	▪ Vocabulary Size Test ▪ Vocabulary Knowledge Scale Test;	▪ Descriptive statistics ▪ paired T-tests
Research question 3	▪ Learning logs ▪ Semi-structured interviews	▪ Descriptive Statistics ▪ Content analysis
Research question 4	▪ Questionnaire ▪ Learning logs ▪ Semi-structured interviews	▪ Descriptive Statistics ▪ Content analysis

3.7 Data Analysis

SPSS 26 was employed to explore the data collected from pre-and post-test scores and the questionnaire. The following is a brief description of the procedures involved and the purposes of the analysis. Alpha Reliability Coefficients were

calculated to see the internal consistency of items of the questionnaire. Descriptive statistics were employed to calculate the means, standard deviation, and other statistical measures of the pre-test and post-test scores and the variables in the questionnaire.

Paired Samples T-test was used to see if there was any significant difference in the development of English vocabulary with each of the two classes of students after 12 weeks of learning.

T-test was carried out to see if there were any significant differences in the development of English vocabulary between the control group and experiment group concerning the pre-test and post-test. Independent Samples T-test was employed to see whether there was any significant difference between the class in the SMALL environment and the contrast group, to determine whether using SMAVL intervention will produce any difference.

For the data from learning logs, the researcher adopted a complicated way to analyze them:

Text Preprocessing: the researcher first cleaned and standardized the text data. This involved removing punctuation, transforming text into lowercase, and removing stop words. We also translated any non-English logs into English to ensure consistency in analysis.

Content-Encoding: Next, the researcher manually tagged each log entry based on its relevance to our identified SMAVL features: mobility and accessibility, contextual learning, multimedia inputs, immediate feedback, individualized learning, and peer collaboration. For instance, a log mentioning learning while waiting for the bus was tagged under ‘mobility and accessibility’.

Quantitative Analysis: Once the logs were encoded, the researcher would calculate the frequency of each feature across all logs. This provided a numerical representation of the prominence of each feature in the students’ learning experiences.

Qualitative Analysis: In parallel, the researcher would perform a qualitative analysis to gain deeper insights into the learning logs. This involved closely reading selected logs and noting down detailed information. And he noted down representative comments and experiences shared by students related to each feature.

Synthesis and Interpretation: Lastly, we integrated our quantitative and qualitative findings to draw comprehensive conclusions about the SMAVLE.

For the qualitative data from the interview, content analysis were adopted to make replicable and valid inferences by interpreting and coding textual material.

For sentence rating in VKS tests, teachers need to be uniformly trained to ensure they understand and can correctly apply the following scoring guide. Additionally, regular scoring calibrations are required to maintain scoring consistency.

Correctness of Word Usage: Evaluate whether students have correctly used the target word. Assess if they understand the meaning of the word and have appropriately used it in a sentence. For example, if the target word is "amiable", a student's sentence could be "My grandmother is an amiable woman who always welcomes us with warm cookies." If the student uses the word correctly, full marks can be awarded.

Accuracy of Grammar and Sentence Structure: Even if a student uses the word correctly, if the sentence's grammatical structure is flawed, points should be deducted. For example, if a student writes, "My amiable is grandmother", points should be deducted because the grammatical structure of the sentence is incorrect, which also shows that the part of speech is misused.

Appropriateness of Context: Evaluate whether the student has used the target word in an appropriate context. For instance, "amiable" is typically used to describe a friendly, pleasant person. If a student writes, "The amiable hamburger was delicious", points should be deducted because the word's usage is inappropriate in this context. Here's a specific scoring guide example:

If a student uses the word correctly, with accurate grammar and appropriate context, they can receive 5 points. If a student uses the word correctly, with accurate grammar, but the context is inappropriate, they can receive 3 points. If a student uses the word correctly, but with incorrect grammar or inappropriate context, they can receive 2 points. If a student does not use the word correctly, they receive 0 points.

3.8 Ethical Considerations

The process of carrying out the present study did not require any laboratory experiment or physical or psychological test, nor would it directly or indirectly involve any child given its aims, objectives, and hypotheses, its design and methodology, as well as the kind of geographical location, population, and sample groups. Though the students' confidentiality was respected all the time, this research did not need, bring about or utilize any personal, social, or classified information of any kind. However, academic research ethics must be considered by securing the relevant research affiliation, permit, and ethical clearance from the responsible institutions before

starting the data collection activities, and by signing the informed consent between the researcher and the participants. Besides, considering the fairness for both groups, the researcher will provide the same experiment for the control group in case they lagged behind in the progress of learning.

Starting with ethical clearance, the current study was approved by Xi'an Shiyou University (XSYU) as the institution hosting the research and XSYU as the institution where the data was collected. The first step is to submit the approved research proposal and the data collection instruments to the Academic Affairs Office (AAO) at Xi'an Shiyou University, in order to obtain ethical clearance. After receiving the AAO's approval, the application for research affiliation was addressed to the Officer in Charge. Then the office Clerk reviewed the application and forward the application review report to the Ministry of Education in Xi'an. After the review at the ministerial level, the researcher's affiliation, he will get the permit to collect research data. Both the research affiliation and permit will be granted by the Ministry of Education before the new semester. Then the researcher asked all volunteers to sign an informed consent form.

3.9 Pilot Study

As Arain, Campbell, Cooper, & Lancaster (2010) stated that pilot study belongs to a small-scale feasibility study that was designed to test various aspects of the methods planned for a larger, more rigorous, or confirmatory investigation. The essential aim of a pilot study is not to answer any specific research questions but to help researchers avoid insufficient knowledge of the proposed methods in launching a large-scale study; What's more, according to Polit & Beck (2017), the occurrence of a fatal flaw in a study leads to waste of time and money, so the main purpose of a pilot study intends to prevent such loss. In a word, a pilot study will offer the following "treats" for the researcher: firstly, it serves as a reference to the researcher for judging whether the study could be conducted appropriately as planned; secondly, the pilot study could offer an opportunity for spotting flaws which may happen during the process of the experiment. For this research, the SMAVLE is designed by the researcher himself, so the pilot is a necessity for the evaluation of the feasibility; thirdly, the pilot study offers the opportunity to assess the appropriateness of the data-collection methods as well as other procedures so that the researcher could make changes if necessary. In addition, the pilot study may also indicate whether the researcher needs to refine the experiment or not since its adoption could make tentative testing of the hypothesis. Eventually, some unexpected problems which may cause the infeasibility

of the trial can be spotted and solved by the researcher at this stage so that the effort and time could be saved later. To sum up, a pilot study is needed in this research.

Participants and Setting

The researcher was assigned as an instructor of two intact classes No.125 and NO.126. He then randomly selected class No.125 as the experimental group, and the other as the control group. For the experimental group, the participants were 28 first-year students in XSYU with ages ranging from 18 to 21 years; while for the control group, the subjects were 29 students with the same age range as the experimental group. The students in both groups were asked to submit their scores on English subjects in NCEE. As aforementioned, the aim of collecting their scores in NCEE was to make sure that they have similar English proficiency since the NCEE has high reliability and validity. To ensure their English proficiency, they were required to take the DIALANG test online and submit the results to the researcher. In addition, the students in both groups also took the VST and VKS tests as pre-tests for the comparison reference of their learning outcomes after the experiments. For the Vocabulary Size Test, the researcher required students to finish it online and submit the screenshot of the results, while VKS test was conducted in the classroom under the researcher's supervision. The time for the two tests was 30 minutes and 40 minutes respectively. The experimental group took a 5-hour training session online on how the apps of short-video editing, QQ, WeChat would be used in the experiment. What's more, the researcher also explained how the whole procedure went and asked students to follow the schedule.

Procedures and Initial Findings

The Participant's English Scores in NCEE

All the students took NCEE before they entered university, so the scores obtained from NCEE could demonstrate whether there is a distinguished difference or not in the English proficiency between students in the experimental group and control group.

Table 3.3 The comparison of students' NCEE scores in English

Group	Number	Mean	SD	T	P-value
Experiment	28	103.5	2.00	0.04	0.22
Control	29	104	1.63		

By conducting the t-test, the researcher got the results of the analysis based the Table 3.3. As aforementioned, the t-test can be used to determine if the means of two sets of data are significantly different from each other. From the data, it can be

seen that since the p-value= 0.22 > 0.05, so the scores of NCEE in the experimental and control group are not significantly different, which means that the student's English proficiency in both groups stays at the same level.

The collection of their scores is quite easy for students, they just need to submit their scores of NCEE. If they happened to forget the scores, the researcher could turn to the Academic Affairs Office in the university for help.

The English Language Proficiency Test Online (DIALANG)

Students did this test online after receiving the researcher's instructions. They could do it at their dormitories or libraries where the network ran smoothly. After finishing the test, a screenshot of pictures that contained the results was required to submit to the researcher.

Students' Opinions

Students reported that the listening material in DIALANG was quite fast for them, and they could not do well in the listening part. For other parts of the test, since the instructions could be set in Chinese, they could complete them without too much effort.

Some Problems in the Results

Generally speaking, the student's English proficiency levels based on the test were at A2~B1, and a few were reported as B2. However, after talking with students, the researchers knew that some students were using the Baidu dictionary or other online search engines to find out the keys to the test since they assumed that the results of the test might affect their grades in the final exam.

How to Improve the Accuracy of the Test

Clearer instruction was offered to students with highlighting notice that the results of DIALANG test were counted into their grades in the final exam. Meanwhile, the researcher needed to encourage students to show their genuine performance so that the instructor can help them in their language study. In other words, the researcher needs to break the traditional Chinese teacher-student relationship and build a more harmonious rapport with the participants. Besides, the monitoring of the test-taking process is necessary in case the participants may meet some operational problems. To realize the monitoring of the test, the researcher held the test in the multimedia language lab with himself as the invigilator, and the time for the test will be limited to 2 periods of class (100 mins).

The Vocabulary Size Test (VST)

The VST was also completed by students online within the given time (30 minutes). Similar to the DIALANG test, students were allowed to finish the test at any quiet place where access to the internet is possible without the monitoring of the process by the instructor. Then students were required to submit their results to the researcher. The sample result of the VST which students submitted to the researcher is shown in the Table 3.4.

Table 3.4 The sample result of the student's VST

VST-SCORE TIME(EST):2020.6.12/20 LOCATION:IP_ 124.89.103.79 NAME:LUYAO	**LEVEL**	**1K:**	**2K:**	**3K:**	**4K:**	**5K:**	**6K:**	**7K:**	**SIZE**
	PERCENT	100	100	90	70	20	0	0	3800

Students' Opinions

When probing into students' problems with VST, they reported that there was no difficulty in finishing the test. The only problem with the completion of the test, as the participants responded, was that they rarely knew the words from the 6000-word family level afterward, which seemed frustrating and meaningless to them. Consequently, the time they spent on the test was longer than expected. Just like the DIALANG, there were a few cases in which students got much better results than others. After talking to those students, the researcher knew that the same problems-using resources online happened in VST due to their misunderstanding of the importance of the test purpose.

How to Improve the VST

The original version of VST is quite a long test containing a 14000-word family which makes students feel exhausted to finish it all, so the researcher decided to cut it down into a shorter version for students so that they could finish with ease. According to the results of this pilot, the 6000-word family test is sufficient for the students.

The Initial Analysis of the VST Scores

The researcher attempted to find out the differences between the two groups in VST by using the line graph (Figure 3.11) below:

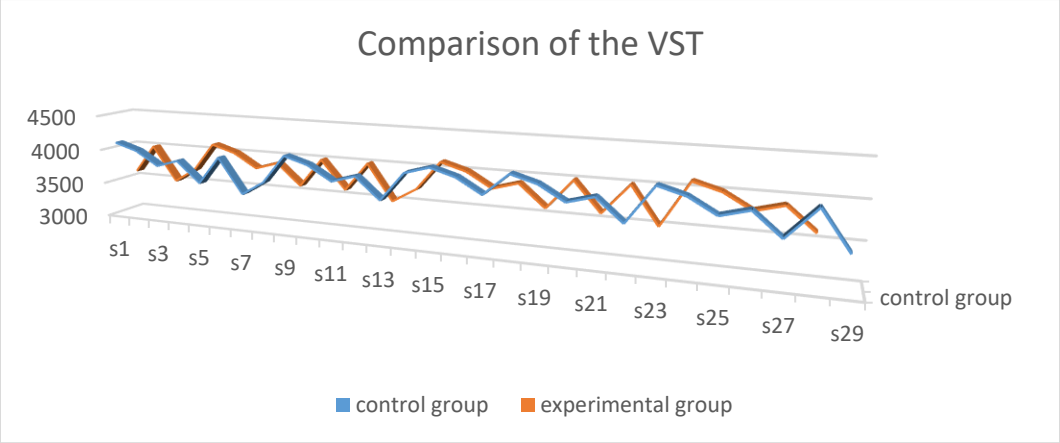


Figure 3.11 The comparison of students' pre-tests in VST

As it can be seen that students' vocabulary size fluctuated between 3600 to 4100, which indicates that the participants in both groups do not have a great difference. In other words, it is reasonable to conduct the experiment since they were at the same level.

The Test of the Vocabulary Knowledge Scale (VKS)

For the VKS test, there are pre-test and post-test conducted before and after the experiment, respectively. Since the content of the pre-test and post-test is part of the learning material, so pre-test and post-test are identical except for the order of items. For the convenience of data collection, the researcher posted the Chinese version of the VKS test on an online testing platform called *wenjuanxing* (shown in Figure 3.12 below), and then the researcher required students to take the VKS test in the classroom setting with their mobile device under his supervision within the time limit (40 minutes).

Figure 3.12 The sample of VKS test

Students' Opinions

From the students' perspectives, there was not any difficulty reported by the participants in finishing the tests. However, some students reported that for the completion of sentence-making options in the VKS test, they might skip the blank because they thought it was troublesome for them to type the sentence. Besides, as the guide of the test-taking process, the researcher noticed that the function of the spelling check in mobile devices might help students in the sentence-making procedure, which may affect the language output of students.

How to Improve the VKS Test

The paper-based VKS tests will be utilized for the formal study since they may give students the feeling of standardization, which could stimulate students to do it with carefulness so that their genuine performance could be presented in the tests.

Initial Data Analysis of the VSK Tests

The preliminary comparison of the data obtained in the VKS test is shown in the following tables. In Table 3.5, the comparison of the pre-test scores of the VKS between the control and experimental groups is presented. As it can be seen that the mean scores of the two groups are similar to each other, which indicates the two groups have similar overall performance in terms of scores. The standard deviation (SD) of the two groups resembles each other, which shows that the intra-group differentiation in the performance of the VKS test among the individual students in both groups is quite similar. Besides the p-value= 0.63 > 0.05, so the scores of the VSK test in the experimental and control group are not significantly different. Therefore, it offered a reasonable and fair basis for the researcher to compare the students' performance of the two groups after the experiment.

Table 3.5 The results of the VKS pre-test

Groups	Number	Mean	SD	P-value
Experiment	28	44.3	6.6	0.63
Control	29	45.2	7.6	

Table 3.6 below shows the results of the post-test. As we can see, the means of the score in both groups after the experiment increase. The data of standard deviation changes as well, which indicates that the intra-group differences in both groups changed. The SD value of control group is 13.3 which is much higher than the experiment group. It informs the researcher that the gaps in VKS post-test among the students' performance in control group become more obvious than that of

experimental group. The p-value is 0.0004 < 0.05, which indicates that there is a significant difference in scores of VKS post-test between the control group and experimental group.

Table 3.6 The results of the VKS post-test

Groups	Number	Mean	SD	P-value
Experiment	28	94.4	8.1	0.0004
Control	29	70.3	13.3	

The comparison between the pre-test and post-test from Table 3.7 below shows that the mean scores of both groups increased after the experiment, However, the experimental group's mean score outweighed the control group's mean score, which indicated that students in both groups have improved performance in VKS, but the experimental group's performance was better. For standard deviation, the difference between the two groups is similar in the pre-test, while it had an obvious disparity in the post-test. The possible explanation could be that before the experiment, due to the unacquaintance with the learning content, the individual differences among students in both groups were not apparent. After the experiment, the individual differences began to become obvious in both groups, especially for the control group. The gap of P-value in the pre-test shows that two groups of data had no significant difference, while after the experiment, two sets of scores showed a greatly significant difference.

Table 3.7 Comparison of the results in pre-test and post-test

Tests / Group	Pre-test			Post-test		
	Meanscores	SD	P-value	Meanscores	SD	P-value
Experimental Group	44.3	6.6	0.63	94.4	8.1	0.0004
Control Group	45.2	7.6		70.3	13.3	

Problems and Solutions

Four training phases were conducted smoothly. However, there were some problems reported by the participants.

For phase 1-video demonstration, students reported that the video demonstration was in English, so they could not understand it totally. The solution to this problem is the instructor's explanation while playing the video.

Students reported no problems in the phase 2-guide in using the video-editing app. However, the researcher noticed that students' video clips had some flaws, such as the absence of subtitles or their voice merging into noisy BGM (background music), which caused problems in sharing. The solution to these problems is to set requirements for the format of videos in terms of sound, subtitles, clarity, and so on. Students reported no difficulty in the training of utilizing the Rain Classroom, the WeChat-embedded mini program.

For the last training session- keeping the learning logs, students reported a few issues. Firstly, some students claimed that it was difficult for them to take pictures in daily life due to the spread of the coronavirus. Secondly, it was also not easy to find images matching the words with the abstract notion, such as the conjunction "although" in the figure. Lastly, some students did know how to put the sentences onto the picture.

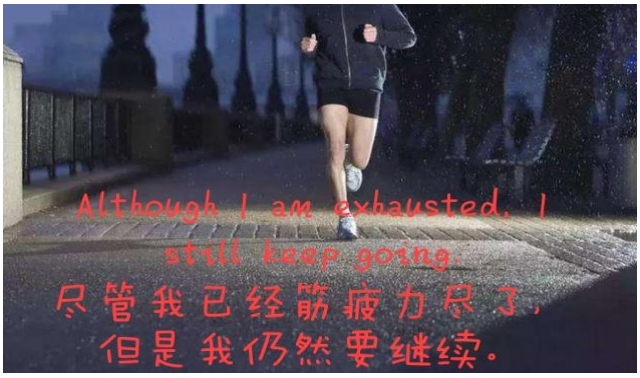


Figure 3.13 Sample of students' learning log.

To solve the problems mentioned above, first, students would be allowed to search for some pictures related to their daily life experience online; second, students could discuss the word when they had trouble matching it with specific pictures. Third, the researcher would provide training for editing the pictures. When the experiment was being conducted, some unexpected problems emerged. The most troublesome one was the poor signals of the wireless internet which might cause the latency of the internet. To solve this problem, the researcher could use the signal amplifier to support the internet connection. Students who did not own a computer might need to use it for searching or editing videos or pictures. The researcher could contact the computer lab for access to using the computers in the lab.

Summary of Modifications

Due to the complexity of this study, the researcher was now fully aware of the importance of some details which might cause problems in carrying out the

experiment smoothly. Some modifications needed to be made to ensure the quality of the experiment. The summary of the modifications is listed in Table 3.8

Table 3.8 Summary of the modifications made from the pilot

Sessions	Elements to be changed	Before the pilot	After the pilot
Training Session	Video for demonstration	No explanation	Explanation was provided
	Video editing	No detailed standards	Detailed standards: 1.adding bilingual subtitles 2.volume of the video should be clear enough
	Learning log	No training in picture editing	The training for editing pictures were provided.
Procedure	Language proficiency test	No supervision, out of class	Under supervision with limited time in class
	Vocabulary size test	Too long	Cut down into 6000 word-family
	VKS test	Online test	Paper-based test

For the training session, the researcher explained the demo video to the students, including the main idea, the structure, and ways of connecting target words with daily life experience. In the training of video editing, the researcher set detailed requirements for the students, such as the video must contain bilingual subtitles, and the volume of the video had to be loud enough. For the tests the language proficiency test was supervised by the instructor with limited time. The VST will be adapted into a shorter version: a 6000-word family. The test of VKS was carried out in the form of a paper-based test. The results from the initial analysis showed that students made progress in vocabulary learning, especially in using the word.

3.10 Summary

In this chapter, the researcher depicted the setting and design of the study as well as the instruments of the research. Then he specified the conceptual framework, research procedure, and data analysis. In addition, ethical considerations were given. In the last section, the pilot study, initial analysis, and modifications to the pilot study were described.

CHAPTER 4
RESULTS

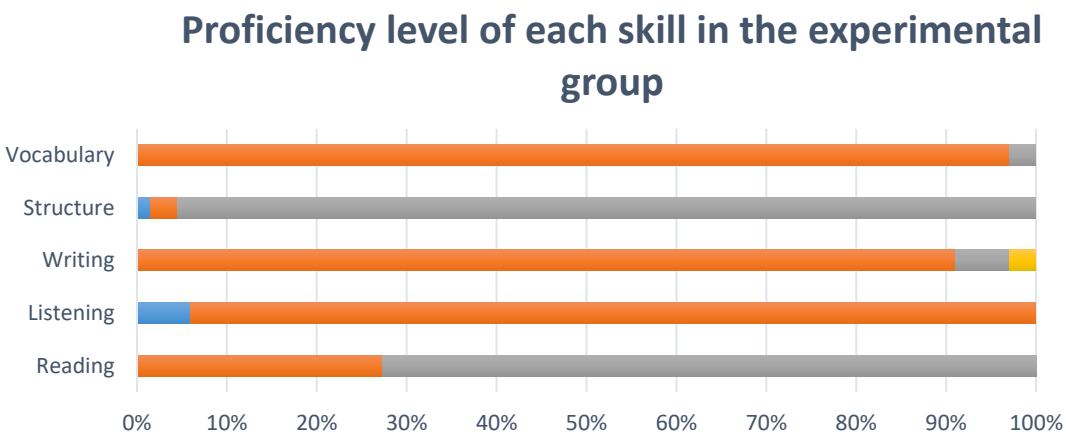
In this chapter, the study's results were presented in relation to four distinct research questions focused on the Seamless Mobile-Assisted Vocabulary Learning Environment (SMAVLE). The initial section scrutinized the effects of SMAVLE on Chinese college students' English vocabulary learning. After this, the second section examined the differences in vocabulary learning outcomes between students using SMAVLE and those using Seamed learning. Additionally, the third section explored what features of SMAVLE contributed significantly to the facilitation of English vocabulary learning by Chinese college students. The fourth section provided results related to students' perception of SMAVLE. Lastly, the chapter concluded with a comprehensive summary, encapsulating the responses to all the research questions.

4.1 Response to Research Question 1

What are the effects of Seamless Mobile-Assisted Vocabulary Learning Environment (SMAVLE) on Chinese college students' English vocabulary learning?

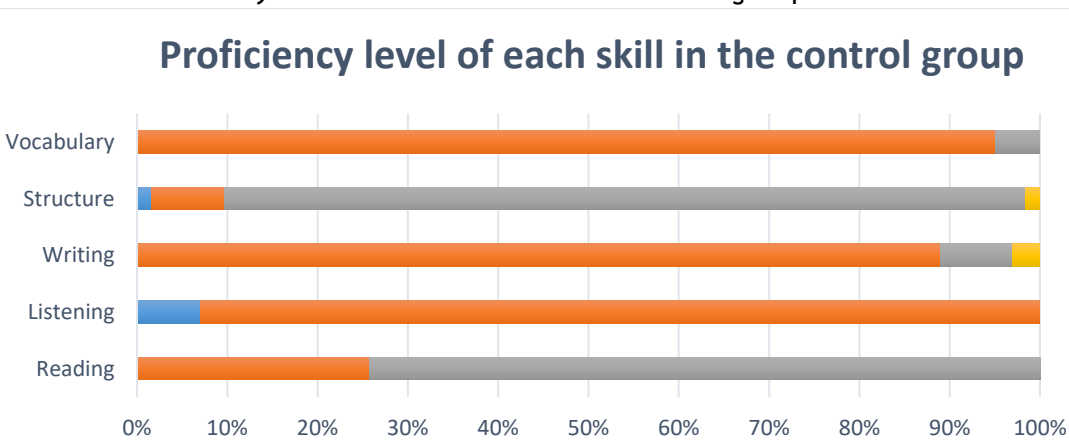
The DIALANG test was administered at the onset of the experiment to verify the homogeneity of language skills among the participants in both the Experimental Group (EG) and the Control Group (CG). **Table 4.1** and **Table 4.2**, which illustrate the proficiency levels across five linguistic domains-reading, listening, writing, structure, and vocabulary-reveal a comparable distribution of language skills between the two groups.

Table 4.1 Proficiency level of each skill in the experimental group



	Reading	Listening	Writing	Structure	Vocabulary
A1	0%	6%	0%	1.5%	0%
A2	27.30%	94%	91%	3.0%	97%
B1	72.70%	0%	6%	95.5%	3%
B2			3%		

Table 4.2 Proficiency level of each skill in the control group



	Reading	Listening	Writing	Structure	Vocabulary
A1	0%	7.0%	0.0%	1.6%	0%
A2	25.80%	93.0%	89.0%	8.1%	95.1%
B1	74.20%	0.0%	8.0%	88.7%	4.9%
B2			3.0%	1.6%	

In the experimental group, as depicted in **Table 4.1**, the majority of students were assessed at the A1 level in all skills, with notable homogeneity in listening skills where 100% of students achieved A1 level. The control group, presented in **Table 4.2**, showed a similar trend, with a predominant A1 level assessment in listening (93%) and a vast majority at A1 level in vocabulary (95.1%). A small percentage of students attained higher than A1 level in various skills, but these instances were scattered among different students and thus did not disrupt the overall language proficiency homogeneity of the groups.

Specifically, in the EG, for reading and structure, the majority were at B1 level (72.7% and 95.5% respectively), while in the CG, reading skills were mostly at the A2 level (74.2%), and a significant majority were at B1 level for structure (88.7%). Such distributions confirm that both the EG and CG maintained a consistent proficiency across all skills, ensuring a level playing field for subsequent interventions.

In conclusion, the uniformity in the initial language proficiency levels as per the DIALANG test criteria confirmed that the students' language abilities were homogeneous at the start of the study, which was essential for the validity of any subsequent comparative analysis of the interventions' impacts on language learning.

To answer research question 1, a detailed within-group analysis was carried out using data from the Vocabulary Size Test (VST) and the Vocabulary Knowledge Scale (VKS) for the EG. Based on the analysis of the VST results, it is possible to gain insight into changes in vocabulary size, which represents the scope of vocabulary breadth. Moreover, the VKS results provide insight into the depth of vocabulary knowledge, including aspects of vocabulary recognition and usage. As a result of these assessments, a holistic picture has emerged of quantitative improvements in vocabulary competence caused by SMAVLE implementation.

4.1.1 Analysis of VST Results for the Experimental Group

Participants in EG were administered the Vocabulary Size Test to establish a baseline vocabulary size; the results were shown in **Table 4.3**. Based on scores of 66 participants, the average vocabulary size of the EG was 2701.52 words, with a standard deviation of 201.908 and a standard error mean of 24.85. These figures indicate a relatively consistent vocabulary size across the group with a moderate spread around the mean. After implementing SMAVLE, the post-intervention VST results, presented in **Table 4.3**, showed moderate improvements. Within the same cohort, the average post-test vocabulary size of the EG increased to 2892.42 words, with a reduced standard deviation of 172.14 and a lower standard error mean of 21.19. This reduction in both standard deviation and standard error mean suggests that the post-intervention

vocabulary sizes were not only higher on average but also more consistent among the participants, indicating a more uniform improvement across the group.

Table 4.3 The mean difference between the pre-test and post-test of the EG group in VST

Test	N	Mean	Std. Deviation	Std. Error Mean
EG-pre	66	2701.52	201.90	24.85
EG-post	66	2892.42	172.14	21.19

Table 4.4 Paired Samples Test of EG in pre and post tests of VST

		Paired Differences					t	df	Sig.(2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	pre - post	-190.90	90.685	11.163	-213.202	-168.616	-17.10	65	.000

To determine the statistical significance of the observed improvements in vocabulary size as measured by the VST, a paired samples t-test was conducted on the pre- and post-intervention scores of the EG, as show in **Table 4.4**. The statistical analysis disclosed a substantial mean increase of 190.90 words, with the negative sign here conventionally indicating that the post-test scores were higher than the pre-test scores-a positive outcome for the intervention. The dispersion of these differences, indicated by a standard deviation of 90.685, and the precision of the mean estimate, given by a standard error of 11.163, both substantiate the robustness of the observed improvement. The 95% confidence interval for the mean difference, which extends from -213.202 to -168.616, does not straddle zero and is hence indicative of a statistically significant change. This is further supported by a t-statistic of -17.103, reflecting the magnitude of difference relative to the variability in the data, with a p-value of .000 at 65 degrees of freedom. Such a p-value, which falls well below the conventional threshold of .05 ($P<0.05$), decisively suggests that the increase in vocabulary size due to the SMAVLE intervention is not a product of random chance.

To sum up, the results showed a 7.07% increase in vocabulary size, underscoring the effectiveness of SMAVLE in facilitating vocabulary development for the EG. These results substantiate the effect of SMAVLE in enhancing vocabulary breadth, though the degree of improvement is moderate.

4.1.2 Analysis of VKS Results for the Experimental Group

The Vocabulary Knowledge Scale (VKS) was used to measure baseline vocabulary knowledge in the Experimental Group (EG) prior to the utilization of the SMAVLE intervention. A mean score of 44.95 was obtained with a standard deviation of 1.06, indicating a fairly uniform understanding of vocabulary among the participants (SD = 8.63, SEM = 1.06, N = 66).

Table 4.5 The mean difference between the pre-test and post-test of the EG group in VKS

Test	N	Mean	Std. Deviation	Std. Error Mean
EG-pre	66	44.95	8.63	1.06
EG-post	66	70.95	7.97	0.98

After adoption the SMAVLE, participants were reassessed on their vocabulary knowledge, as EG-post shown in **Table 4.5**. Results showed a significant increase in participants' vocabulary knowledge, resulting in a mean score of 70.95. The increase of 26.0 points not only represents a significant improvement in vocabulary knowledge but also illustrates tighter scores around the new average (SD = 7.97) and a narrower standard error mean (SEM = 0.98). Such decreases in standard deviation and standard error mean imply a strengthened consensus in levels of vocabulary knowledge after adopting SMAVLE to EG, as individual scores converged more closely around the group mean. Table 4.5 encapsulates this transformative journey in vocabulary knowledge in the post-test, showcasing statistical evidence of the EG's enhanced performance. In a word, the results do not merely record the effects of the SMAVLE intervention; they also illustrate a significant improvement in vocabulary depth, with the EG displaying an enhanced level of vocabulary knowledge.

Table 4.6 Paired Samples Test of EG in pre and post tests of VKS

		Paired Differences					t	df	Sig.(2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	pre - post	-26.00	1.61	.199	-26.398	-25.602	130.61	65	.000

A paired samples t-test was conducted to examine the significance of this improvement (as show in **Table 4.6**), revealing a mean difference of -26.00 points between the pre- and post-intervention VKS scores. This negative sign denotes an increase, as the VKS post-test scores were anticipated to be higher than the pre-test

scores. The test yielded a highly significant t-value of -130.61 (t=130.61) at 65 degrees of freedom (df=65), with a practically null two-tailed p-value (.000), ($p<0.05$) firmly indicating that the increase in vocabulary knowledge is statistically significant and not due to random chance. The 95% confidence interval of the difference was exceptionally narrow, ranging from -26.398 to -25.602, which further reinforces the significance and precision of the observed improvement.

To sum up, the VKS results, corroborated by the t-test, do not merely suggest an effect of the SMAVLE intervention but demonstrate a significant and quantifiable enhancement in vocabulary depth within the EG. The robustness of these findings is manifest in the augmented VKS scores, which articulate a clear advancement in the participants' vocabulary knowledge.

Overall, the data derived from the Vocabulary Size Test (VST) and the Vocabulary Knowledge Scale (VKS) provide a quantifiable indicator of the impact of SMAVLE on the vocabulary learning process of Chinese college students. According to VST results, the mean vocabulary size of the Experimental Group (EG) increased by 7.07% from 2701.52 words to 2892.42 words. The VKS results revealed a rise in mean scores after the intervention from 44.95 to 70.95. As detailed in aforementioned information, these findings provide evidence of the changes in vocabulary breadth and depth that participants experienced over the course of the intervention.

4.2 Response to Research Question 2

What are the differences in vocabulary learning of Chinese college students using SMAVLE compared with those using Seamed Learning?

To address this question, SMAVLE was compared with traditional Seamed Learning in a rigorous comparative analysis. Both experimental groups (EG) and control groups (CG) were analyzed using the VST and VKS results.

4.2.1 Analysis of VST and VKS Results within Control Groups

Having previously detailed the results for the EG, this section focused on the CG to assess their performance independently. A within-group analysis would reveal the effects of vocabulary learning achieved through conventional Seamed Learning.

Table 4.7 The mean difference between the pre-test and post-test of the CG group in VST

	Mean	N	Std. Deviation	Std. Error Mean
CG-Pre	2693.55	62	228.230	28.985
CG-Post	2798.39	62	284.283	36.104

For VST test, **Table 4.7** presents the CG's VST scores before and after the Seamed Learning intervention. The data shows that the CG started with a pre-test mean score of 2693.55 (SD = 228.230, SEM = 28.985, N = 62). After the intervention, the post-test mean score was 2798.39 (SD = 284.283, SEM = 36.104, N = 62).

Table 4.8 Paired Samples Test of CG in pre and post tests of VST

		Paired Differences					t	df	Sig.(2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	pre - post	-104.83	158.29	20.104	-145.03	-64.63	-5.22	61	.000

Besides, as showed in **Table 4.8**, The paired samples t-test analysis indicated an improvement with a mean increase of 104.83 words (note the negative sign due to statistical conventions), a standard deviation of 158.29 for the differences, and a standard error mean of 20.104. The 95% confidence interval for this mean difference ranged from -145.03 to -64.63, which suggests a significant increase in vocabulary size at the .000 level ($t(61) = -5.22$, $p < .005$). This significant p-value indicates that the observed increase is not due to random chance and represents a genuine improvement in the vocabulary size of the control group as a result of the Seamed Learning approach. The magnitude of the t-statistic (-5.215) reflects a substantial effect size and, when coupled with the confidence interval, provides evidence for the effectiveness of traditional methods in enlarging the vocabulary size. However, the mean increase of 104.83 words, while statistically significant, may be considered modest in an educational context.

For the results of VKS, As illustrated in **Table 4.9**, a preliminary analysis of the Control Group (CG) vocabulary knowledge through the VKS revealed a mean score of 46.06 with a standard deviation of 7.326, which suggests a moderate dispersion of scores (SEM = .930, N = 62). Following the completion of the traditional learning phase, the post-test assessment registered an increase to a mean score of 53.55, mirrored by a comparable standard deviation of 7.010, suggesting a sustained consistency in scoring distributions (SEM = .890, N = 62).

Table 4.9 The mean difference between the pre-test and post-test of the CG group in VKS

Test	Mean	N	Std. Deviation	Std. Error Mean
Pre	46.06	62	7.326	.930
Post	53.55	62	7.010	.890

Table 4.10 Paired Samples Test of CG in pre and post tests of VKS

		Paired Differences					t	df	Sig.(2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	pre - post	-7.484	4.397	.558	-8.601	-6.367	-13.40	61	.000

According to a t-test of paired differences showed in **Table 4.10**, the CG's VKS score progression resulted in an average increase of 7.484. In addition, this increment is accompanied by a standard deviation of 4.397 and a standard error mean of .568, illustrating the close relationship between scores. This observation is further reinforced by a 95% confidence interval spanning -8.601 to -6.367, a range that explicitly excludes the null value, demonstrating the substantial nature of the improvement. Based on the statistical analysis, an enhanced CG vocabulary knowledge was demonstrated to be significant, with a significant t-value of -13.40 across 61 degrees of freedom and a p-value approaching zero (.000).

In summary, the VKS pre- and post-test results indicate a significant improvement in the CG's vocabulary knowledge, which is indicative of the effectiveness of the Seamed Learning approach.

4.2.2 Analysis of VST Results Between EG and CG

The assessment of the VST scores between the Experimental Group (EG) and Control Group (CG) is crucial in evaluating the relative effectiveness of the SMAVLE compared to Seamed Learning.

Table 4.11 Comparative Post-Test VST Results Between EG and CG

	Group	N	Mean	Std. Deviation	Std. Error Mean
Vocsize	EG	66	2892.42	172.14	21.19
	CG	62	2798.39	284.28	36.10

Table 4.11 shows that the EG, having experienced the SMAVLE intervention, demonstrated an average vocabulary size of 2892.42 words (SD = 172.14, SEM = 21.19, N = 66). The CG, which was exposed to traditional Seamed Learning methods, showed an average vocabulary size of 2798.39 words (SD = 284.28, SEM = 36.10, N = 62). This initial comparison indicates a higher mean vocabulary size in the EG post-intervention.

Table 4.12 Independent Samples T-Test for Post-Test VST Results

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Vocsize	Equal variances assumed	7.316	.008	2.27	126	.024	94.03	41.26	12.39	175.68
	Equal variances not assumed			2.24	99.21	.027	94.03	41.86	10.97	177.10

The independent samples t-test, accounting for the potential difference in variances between the two groups, provided two results based on the assumption about variances:

Equal Variances Assumed: Under this assumption, the test yielded a t-value of 2.279 with 126 degrees of freedom, and a two-tailed p-value of .024. The mean difference was 94.037 words, with a standard error difference of 41.25. The 95% confidence interval for the difference ranged from 12.39 to 175.68 words.

Equal Variances Not Assumed: This analysis resulted in a slightly adjusted t-value of 2.246 with 99.214 degrees of freedom, and a two-tailed p-value of .027. The mean difference remained the same at 94.03 words, but with a slightly larger standard error difference of 41.86. The confidence interval for the difference was slightly wider, ranging from 10.97 to 177.10 words.

Both versions of the test suggest that the difference in post-intervention vocabulary sizes between the EG and CG is statistically significant. The p-values (less than .05) in both cases indicate that the EG's higher mean vocabulary size is not likely due to chance. Moreover, the positive mean difference (94.037 words) signifies that, on average, the vocabulary size of students in the EG was greater than that of students in the CG by this amount.

In summary, the comparative analysis of the VST results demonstrates that students in the EG, who utilized the SMAVLE, achieved a significantly greater improvement in vocabulary size compared to those in the CG following traditional Seamed Learning methods. The statistical significance of this result highlights the effectiveness of SMAVLE in enhancing vocabulary breadth among Chinese college students.

4.2.3 Analysis of VKS Results Between EG and CG

This segment delves into the differential impact of the Seamless Mobile-Assisted Vocabulary Learning Environment (SMAVLE) and the conventional Seamed

Learning approach, as manifested in the Vocabulary Knowledge Scale (VKS) outcomes for both the Experimental Group (EG) and the Control Group (CG).

Table 4.13 Comparative Post-Test VKS Results Between EG and CG

	Group	N	Mean	Std. Deviation	Std. Error Mean
VKS	EG	66	70.95	7.972	.981
	CG	62	53.55	7.010	.890

By examination of the VKS scores in **Table 4.13**, a distinct disparity between the two pedagogical approaches can be clearly seen. The EG, beneficiaries of the SMAVLE, achieved a mean VKS score of 70.95, a reflection of enhanced vocabulary depth (Standard Deviation = 7.972, Standard Error Mean = .981, Sample Size = 66). Conversely, the CG, subjected to traditional Seamed Learning, registered a lower mean VKS score of 53.55 (Standard Deviation = 7.010, Standard Error Mean = .890, Sample Size = 62), indicating a less pronounced advancement in vocabulary knowledge.

Table 4.14 Independent Samples T-Test for Post-Test VKS Results

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig.(2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
VKS	Equal variances assumed	1.72	.19	13.09	126	.000	17.41	1.33	14.77	20.03
	Equal variances not assumed			13.13	125.47	.000	17.41	1.32	14.78	20.02

In **Table 4.14**, the comparison of vocabulary knowledge, as measured by the VKS, between the students using SMAVLE and those with seamed learning methods was analyzed using a statistical method called an independent samples t-test. This test was conducted in two distinct ways to ensure thoroughness:

For the first analysis, similarity Between Groups is assumed. In this approach, the t-test suggested that the students using SMAVLE improved their vocabulary knowledge significantly more than those who used the seamed learning. The statistical measure, known as the t-value, was 13.09, indicating a strong likelihood that this improvement was not due to chance. This result is further supported by an average difference of 17.41 points in vocabulary scores between the groups. The confidence

interval, which helps understand the range within which the true average difference lies, was between 14.77 and 20.03 points, emphasizing the reliability of these findings.

For the second analysis, the differences Between Groups were allowed. When the assumption about the groups being similar was relaxed, the results remained largely consistent. The t-value changed slightly to 13.13, but the significance of the findings remained the same (p-value = .000). The average difference in vocabulary scores was again 17.41 points, with a slightly adjusted error measure. The confidence interval in this analysis ranged from 14.78 to 20.02 points, reinforcing the conclusion that the improvement in vocabulary knowledge for the SMAVLE group was significant.

In both methods of analysis, the results clearly indicate that there was a notable increase in vocabulary knowledge for the group using SMAVLE as compared to the control group. The consistency of the mean difference across both tests, along with the extremely low p-values, strongly supports the conclusion that SMAVLE was more effective in enhancing vocabulary knowledge than the traditional learning method. This comparative evaluation of VKS results highlights the substantial advantage of the SMAVLE approach in improving vocabulary understanding among Chinese college students.

In essence, this comparative evaluation of the VKS results underscores a statistically substantial superiority of the SMAVLE over traditional Seamed Learning in cultivating deeper vocabulary comprehension among Chinese college students. The marked disparity in VKS scores between the EG and CG not only illustrates the effectiveness of the SMAVLE in promoting advanced vocabulary learning but also highlights its role in the comprehensive development of vocabulary learning.

4.2.4 Summary of Comparative Analysis

In addressing Research Question 2, the study compared the effectiveness of the Seamless Mobile-Assisted Vocabulary Learning Environment (SMAVLE) against the traditional Seamed Learning method. This comparison involved analyzing both the Vocabulary Size Test (VST) and Vocabulary Knowledge Scale (VKS) results from the Experimental Group (EG) and the Control Group (CG).

For VST analysis, the EG, using SMAVLE, showed a more significant increase in vocabulary size than the CG, who were taught through Seamed Learning. The average vocabulary size for the EG post-intervention was notably higher. The independent samples t-test confirmed this result statistically significant, with the EG demonstrating a mean increase that was substantially greater than that of the CG.

For VKS analysis, the EG also exhibited a more substantial improvement in the depth of vocabulary knowledge as measured by the VKS. Statistical analysis

revealed that the increase in VKS scores for the EG was significantly higher than for the CG, indicating a more pronounced effect of the SMAVLE on enhancing vocabulary knowledge.

In summary, the findings from both the VST and VKS analyses demonstrated that SMAVLE significantly outperformed traditional Seamed Learning in both the breadth and depth of vocabulary learning. Students using SMAVLE showed a greater increase in vocabulary size and a deeper understanding of vocabulary, highlighting the effectiveness of this innovative learning approach in enhancing comprehensive vocabulary learning among Chinese college students.

4.3 Response to Research Question 3

What features of SMAVLE contribute significantly to facilitating Chinese college students' English vocabulary learning?

As mentioned in Chapter 1, the seamless mobile-assisted vocabulary learning environment (SMAVLE) has been constructed by the researcher himself. Using multimedia capabilities, the SMAVLE provides an integrated learning platform. For exploring the features or elements within the SMAVLE that facilitates English vocabulary learning among Chinese college students, the use of learners' learning logs and semi-structured interviews will allow us to identify the underlying features or elements that influence the acquisition of English vocabulary by students.

4.3.1 Features retrieved from the students' learning logs

In investigating the effectiveness of SMAVLE on students' vocabulary acquisition, 4,752 learning logs from 66 students were analyzed. This process, as delineated in Chapter 3, involved a systematic coding procedure to identify features influencing their learning. The coding was grounded in both theoretical constructs and emergent themes, ensuring the validity and comprehensive coverage of SMAVLE's features. The features were concluded in **Table 4.15**

Table 4.15 Summary of the features retrieved from students' learning logs

Feature	Frequency (out of 4752 logs)	Example Log Entries
Accessibility	4039 (85%)	"I used the Rain-classroom app in class today. I could access it on my phone, allowing me to study between classes."
Contextuality	3421 (72%)	"I learned the word 'monitor' today. I associated it with the leader of our class, and I took a picture of him for my visual reference."
Feedbackability	4277 (90%)	"My teacher pointed out and explained the correct usage of the word oblivious when I used it incorrectly."
Individuality	3088 (65%)	"I am able to concentrate on the words I find difficult and go at my own pace."
Collaborativity	3564 (75%)	"I watched videos made by my classmates in our WeChat group. I learned a lot from how they used the words, and I feel more motivated to study."
Usability	4277 (90%)	"I was able to use the Rain-classroom app easily. It helped me in my vocabulary learning."
Autonomy	3326 (70%)	"I can focus more on words I find difficult, and learn at my own pace."
Creativity	3326 (70%)	"I took a beautiful picture and put on the new words we learned. It was fun to think about how to use the words in a creative way."
Community	2851 (60%)	"I posted my video in the WeChat group and received feedback from my classmates. It helped me understand the word better."
Multimodality	3754 (79%)	"I created a video clip for the word that incorporated beautiful artworks I found online. Watching the clip helps me to remember the meaning and the concept of the word."

To ensure the reliability of the coding, a systematic procedure was followed. A preliminary set of codes was developed based on established mobile-assisted learning concepts. Concurrently, an open coding approach was applied to the data, enabling the identification of unique features specific to SMAVLE. A subset of logs was independently coded by a second researcher, and a high degree of inter-coder agreement was achieved, confirming the reliability of the coding process.

Besides, the frequency of students' mentioning the theme was taken into consideration. Because the frequency of each identified feature provided an indication

of its prominence in the students' learning experience. However, to deepen the understanding, the context in which these features were mentioned were analyzed. This integration of quantitative frequency data with qualitative insights offered a comprehensive understanding of each feature's role in vocabulary learning.

As a result of our analysis, six main SMAVLE features which already overlapped with the ones in the extant literature were identified, what's more, four additional features that appeared frequently were also discovered in learners' learning logs. Below are detailed descriptions of these features:

1. Accessibility SMAVLE was frequently acknowledged as convenient by 85% of students. The students emphasized the fact that they were able to study anywhere and at any time, which demonstrated how mobility and accessibility removed geographical and temporal constraints from their learning. For instance, one student stated in their log, *"I used the Rain-classroom app in class today. I could access it on my phone, allowing me to study between classes."*

2. Contextuality Approximately 72% of the logs cited the benefits of learning vocabulary in a real-world context. The students commented that this approach helped them to better understand and retain the new words. In relation to their own experiences, they were able to relate the new vocabulary to their own understanding and recall. One student commented, *"I learned the word 'monitor' today. I associated it with the leader of our class, and I took a picture of him for my visual reference."*

3. Multimodality There was a clear indication that multimedia resources enhanced student engagement and comprehension, as 79% of logs mentioned the use of multimedia resources. Word meanings and usages were better understood by students when visual and auditory cues were provided. A student mentioned, *"I took a beautiful picture and put on the new words we learned. It was fun to think about how to use the words in a creative way."* Another student jogged down in the log: *"I created a video clip for the word that incorporated beautiful artworks I found online. Watching the clip helps me to remember the meaning and the concept of the word."*

4. Feedbackability It was noted in approximately 90% of logs that immediate feedback was provided. Through this feature, students were able to correct their mistakes in real-time, which facilitated their mastery of new vocabulary. The teacher gave me feedback on my learning log online. *"I had made an error with one of the words, but now I have a better understanding."* Another student stated, "*My teacher pointed out and explained the correct usage of the word oblivious when I*

used it incorrectly. As a result of this immediate feedback, I was able to understand my mistake and avoid it in the future."

5. Individuality There was an emphasis on individualized learning in approximately 65% of log entries. Learning was tailored to the pace and needs of the students, thus enhancing the effectiveness of their studies. As one student observed, *"I am able to concentrate on the words I find difficult and go at my own pace." "I feel that my learning is more targeted and effective."*

6. Collaborativity The value of peer collaboration was expressed by 75% of students in their logs, with many expressing that they had learned from their peers. The interaction between students and others in their community enhanced their understanding and motivation. For instance, a student stated: *"I watched videos made by my classmates in our WeChat group. I learned a lot from how they used the words, and I feel more motivated to study."*

In addition to the main characteristics of SMAVL, other significant factors were identified by our analysis. Around 90% of the logs recognized technological proficiency, showing that familiarity with digital tools is essential for effective learning. It was noted that 70% of logs indicated autonomous learning, which indicates the importance of self-directed study. The creation of artifacts and the sharing of group projects were responsible for approximately 70% and 60% of the log entries, respectively, demonstrating creative expression and community participation.

To conclude, our detailed analysis of students' learning logs has provided valuable insight into how the SMAVLE and additional factors contribute to successful vocabulary acquisition. This method can be enhanced with the integration of these features, providing a solid foundation upon which to refine and improve the method.

4.3.2 Features retrieved from the students' interviews

As a result of analyzing 16 interviews through content analysis, four major Features of seamless mobile-assisted vocabulary learning have been identified: Multimodal Integration, Ubiquitous Accessibility, Autonomous Engagement, and Digital Mastery.

Table 4.16 Frequency of facilitative features mentioned in the interviews

Features	Frequency
Multimodal Integration	12
Ubiquitous Accessibility	14
Autonomous Engagement	10
Digital Mastery	13

From Table 4.16, it can be outlines the frequency of mention for each facilitative factor in the SMAVLE, as indicated by our interview subjects. These frequencies offer insight into the relative importance and prevalence of each factor among the respondents.

Multimodal Integration: Highlighted 12 times across the interviews, this feature emphasizes the importance of integrating various forms of media to enhance the learning experience.

Ubiquitous Accessibility: Mentioned 14 times, this feature underscores the convenience and flexibility provided by mobile devices, allowing learners to access resources anytime, anywhere.

Autonomous Engagement: Brought up 10 times, this feature emphasizes the value of autonomy in the learning trajectory, allowing learners to take charge of their own learning process.

Digital Mastery: Highlighted 13 times, this feature emphasizes the importance of mastering the necessary technological skills to navigate and utilize mobile-assisted learning tools effectively.

In summary, the factors retrieved show four main facilitative factors in the SMAVLE: multimedia resources, the convenience of mobile devices, a self-directed learning environment, and technological skills. These elements collectively create a rich, flexible, and personalized learning experience for students.

4.4 Response to Research Question 4

What are Chinese college students' perceptions toward the SMAVLE to enhance English vocabulary learning?

In general, the students in the study had positive attitudes toward the Seamless Mobile-Assisted Vocabulary Learning Environment (SMAVLE). Based on their experience, they felt that the SMAVLE was conducive to improving vocabulary learning in many ways, including improvement in spelling, pronunciation, and use of vocabulary, as well as the ability to effectively use words within contexts and environments. Moreover, participants reported feeling more motivated, autonomous, and confident in tackling vocabulary-making tasks, as well as more autonomy in managing their learning activities. In conclusion, Chinese EFL students perceive that the SMAVLE can be beneficial to their vocabulary development. Detail of the specific data analysis is provided in the analysis of questionnaires, learning logs, and interviews.

4.4.1 Results from the questionnaire

The survey consists of twelve Likert scale items designed to examine the ways in which students perceive the SMAVLE, as well as to explore how they feel about the SMAVLE. This section was, therefore, completed by only 66 of the students in the experimental group. The results showed that the majority of students in the experimental group had a favorable opinion of the SMAVLE. Below is a detailed discussion of the items' responses:

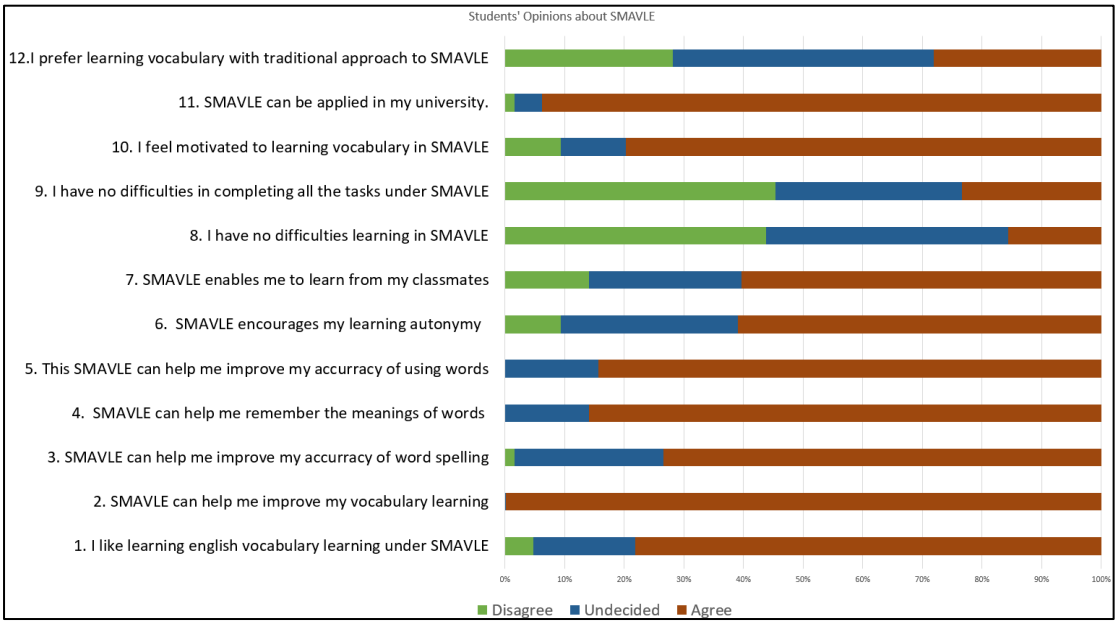


Figure 4.1 Students' Opinions about SMAVLE

As showed in Figure 4.1, it revealed a comprehensive positive inclination towards this mode of learning. Specifically, a significant majority of the respondents affirmed their preference for learning English vocabulary through this medium, with an appreciable 78.12% enjoying the use of SMAVLE, which underscored the platform's user-friendly and engaging nature. This positive reception was further reflected in the students' perceptions of their vocabulary improvement; a striking 92.19% concurred that SMAVLE had favorably impacted their vocabulary learning, indicating an effective alignment with their educational needs.

When dissecting the specific areas of vocabulary development, such as spelling accuracy, understanding of word meanings, and the correct application of words, the responses were overwhelmingly affirmative, with over 70% of students agreeing that SMAVLE aids significantly in these areas. This suggests that the multimodal approach of SMAVLE, which likely includes visual and auditory stimuli, caters

effectively to the diverse learning styles of students, thus enhancing their retention and application of new vocabulary.

In the realm of learning dynamics, the data paints a picture of an environment that fosters autonomy and collaborative learning. More than half of the respondents (60.94%) acknowledge that SMAVLE encourages self-directed learning, an essential component for higher education students who are increasingly seeking control over their educational journey. Similarly, the collaborative feature of SMAVLE is recognized as beneficial by a majority of the students, with 59.38% agreeing that it allows them to learn from their peers, pointing towards a communal learning experience that extends beyond the traditional classroom setting.

However, the survey also illuminates some areas of contention and potential improvement. A portion of students reported difficulties with learning and task completion within SMAVLE, with approximately 42.19% experiencing challenges. This indicates a need for further investigation into the user experience to enhance the interface and support mechanisms of the platform. Additionally, the students' motivation to engage with vocabulary learning within SMAVLE is high (73.44%), suggesting that the platform's design successfully stimulates interest and dedication to language acquisition.

Concerning the implementation of SMAVLE at a university level, a vast majority (93.75%) consider it a feasible and effective approach to vocabulary instruction, which implies a strong potential for SMAVLE to be integrated into the university curriculum. Finally, the preference for SMAVLE over traditional methods is apparent, though not unanimous, with 62.5% of respondents favoring the mobile-assisted approach or remaining undecided. This reflects a transitional phase in educational methodology preferences, highlighting a gradual shift towards technology-assisted learning while also recognizing the value of traditional methods for certain learners.

In conclusion, the survey results attest to the overall efficacy and appeal of SMAVLE in facilitating English vocabulary learning among Chinese college students. The findings point to the importance of maintaining the platform's strong suits-such as its support for autonomy and collaborative learning-while addressing the challenges faced by students to optimize the learning experience. Moreover, the readiness to incorporate SMAVLE into university teaching strategies suggests a promising avenue for future educational practices.

4.4.2 Results from the learning logs

The experimental group was asked to jot down their experiences in the SMAVLE in a learning log. After creating a learning log of five words for one day (excluding Sundays), they were expected to record their experiences and feelings. Once a week, they were expected to submit learning logs to the researcher. The final section of the learning log mainly focused on the reflection on their progress, their experiences with the activities, and their feelings. The participants were required to provide their opinion on the effectiveness of the vocabulary learning environment pertaining to vocabulary acquisition, learning autonomy, the application of the environment, and any difficulties encountered during the whole process until the experiment was over.

According to the analysis of the participants' learning logs, the participants acknowledged their own progress in learning the target words after the teacher's instruction; however, the rate at which they improved was relatively slow. Their confidence was also reported to have increased gradually. The most common benefits of the SMAVLE also emerged from these logs (see Table 4.17 for some sample excerpts from students' learning logs).

Firstly, the students commented that they were provided with ample opportunities to create their vocabulary entries at any time and at any place they liked. This allowed them to devote more time to their own assignments during their free time. The second advantage was that they could practice at their own pace without being distracted by their peers or interrupted by their teachers, as would be the case in a traditional English class where teachers require all students to submit assignments immediately. In their opinion, seeing short clips made by their peers would allow them to be more involved in the context. Thirdly, the benefit of the mobile application is its ease of use. As a result of the absence of any pressure, students could take the initiative and use their creativity to construct their own sentences at their convenience, anytime and anywhere. Mobile applications students adopted to complete the tasks were described to be user-friendly. They also said they did not feel afraid of making mistakes since they could get feedback after completing vocabulary exercises, as they did not fear losing face. Fourthly students were exposed to new words through multiple channels, and their output volume of words increased. Students reported that the short clips they viewed gave them inspiration from peers on how to use the words, and they never thought they could produce so many English sentences related to their daily lives. Fifthly, by incorporating new words into daily life, students became more empathetic, resulting in increased enjoyment of vocabulary

learning. Students reported that the picture with example sentences they made impressed them more deeply than ordinary sentences; Lastly, the students unanimously agreed that the SMAVLE was feasible and appropriate for vocabulary practice.

Despite this, some comments were negative regarding the vocabulary material and the tasks. Several students mentioned that certain words in the list were too long, abstract, and too difficult for them to understand. On the other hand, some students reported that they often forgot new words and phrases that they had used in sentences previously, even if they had used those words and phrases in the past. A few students also said that they found it difficult to find pictures that matched the sentences they made despite the fact that they could think of situations in which the words would be used in daily life.

In conclusion, the results of the learners' learning logs demonstrated that the SMAVLE had a significant effect on their ability to acquire vocabulary as well as their confidence in using the words. It was appreciated by the students that there was an abundance of opportunities for vocabulary practice, the freedom to practice at their own pace, and the ease of use of the mobile application. Some negative comments were also reported, particularly in relation to the difficulty of some exercises which are related to artifact creation and the difficulties associated with learning new words. In a word, students were able to improve vocabulary learning with ease by using the SMAVLE.

Table 4.17 Sample excerpts from students' learning logs regarding their opinions about the SMAVLE

	Students' ID	Chinese	English
1	202112050328	我觉得这方法不错，我可以在自己的节奏下学习新的单词和短语。	I think it's a good method, I can learn new words and phrases at my own pace.
2	202112050329	可以随时随地添加新的词汇到我的词汇表中。很方便，不需要手写了。	Can add new words to my vocabulary list anytime, anywhere. It's convenient, no more handwriting
3	202112050410	我喜欢这样的方法，它让我可以通过多种方式学习新的词汇，例如在短视频里学到的词。	I like that it allows me to learn new vocabulary in a variety of ways, such as words learned in short videos.
4	202112050411	在我的个人空间里学习，这让我感觉更加舒适和自在。	It makes me feel more comfortable and at ease to learn in my personal space.

Table 4.17 Sample excerpts from students' learning logs regarding their opinions about the SMAVLE (Cont.)

	Students' ID	Chinese	English
5	202112050416	我很喜欢这个环境，因为它让我可以在不同的设备上使用，无论是手机、平板还是电脑。	I love this environment because it allows me to use it on different devices, whether it's my phone, pad or computer.
6	202112050422	这个环境让我可以通过听、看和做进行新的单词和短语的学习。	This environment allows me to listen, watch and do to learn new words and phrases.
7	202112050423	不必担心被老师催促，它让我可以在自己的时间内完成任务。	Not having to worry about being rushed by the teacher, it allows me to complete tasks in my own time.
8	202112050425	这种方式让我可以与其他同学分享我的词汇表，这让我感觉更加有归属感。	This approach allowed me to share my vocabulary list with other students, which made me feel more like I belonged.
9	202112050502	这个方法很不错，它让我可以自己制定学习计划，根据自己的需求和兴趣学习。	This approach was great in that it allowed me to make my own study plan and learn according to my needs and interests.
10	202112050506	这个环境让我能够更好地掌握新的单词和短语，因为我可以在不同的场景中使用它们。	This environment allows me to better grasp new words and phrases because I can use them in different scenarios.
11	202112050223	这个环境让我可以在学习过程中获得实时反馈，帮助我更好地理解和记忆新的单词和短语。但是有时候找不到匹配的图片	This environment allows me to get real-time feedback as I learn, which helps me better understand and remember new words and phrases. But sometimes I can't find the matching pics
12	202112050225	这种方法让我能够在不同的难度级别上学习新的单词和短语，但是如果单词太长或者抽象，我就无法顺利造句	This method allows me to learn new words and phrases at different difficulty levels, but if the words are too long or abstract, I can't make sentences successfully
13	202112050226	虽然我造出了句子，但是我却拍不到相对应的图片，是单词的问题吧	Although I can make a sentence, I can't take a picture of the corresponding word, so it's a word problem
14	202112050228	这个环境让我能够更好地理解和运用新的单词和短语，因为它提供了丰富的例句和语境。但偶尔觉得繁琐	This environment allows me to understand and use new words and phrases better because it provides rich example sentences and context. But occasionally it feels cumbersome

Table 4.17 Sample excerpts from students' learning logs regarding their opinions about the SMAVLE (Cont.)

	Students' ID	Chinese	English
15	202112050229	我喜欢这个环境，因为它让我可以在学习过程中与其他同学互动和交流，分享我的学习心得和经验	I like this environment because it allows me to interact and communicate with other students in the learning process and share my learning experiences and tips
16	202112050305	这种方式让我有机会造句了，而且是描述生活中的场景，这时候才发现，好多词不会用	This way gives me the opportunity to make sentences, and to describe scenes in my life, when I realize that I don't know many words to use
17	202112050306	喜欢这个环境，因为它让我可以在学习过程中积累更多的词汇量，提高我的英语水平。	I like this environment because it allows me to build up more vocabulary and improve my English as I learn.
18	202112050317	这个方法最好的一点就是注重于应用，但是同时也让我们手足无措，因为我们很少写英语句子。	The best thing about this method is that it focuses on application, but at the same time it leaves us at our wits' end because we rarely write English sentences.
19	202112050318	我喜欢这个环境，因为它让我可以在学习过程中发挥自己的创造力，构建自己的句子使用场景。	I like this environment because it allows me to use my creativity in the learning process and construct my own scenarios for sentence usage.
20	202112050324	这种方法让我能够更好地理解和欣赏英语文化，因为在查找单词的时候，我看到了一些单词的背景知识。但是有时候还是好难照到匹配的照片呐。	This approach has allowed me to better understand and appreciate English culture because I see some background knowledge of the words when looking them up. But sometimes it's still so hard to take a picture that matches.

4.4.3 Results from the interview

As one of the tools for collecting data, semi-structured interviews were chosen to gain a deeper understanding of the effects of the SMAVLE on students and their understanding of the effects of SMAVL on them. As part of the experiment, both interviews and questionnaires were conducted simultaneously, both after the experiment was conducted, in order to obtain information about the learners' thoughts and feelings and to determine whether they were corroborated by each other. A total of 16 interviews were conducted with the consent of the participants. The usual sample size for interviews in social science research is between 10 and 30 individuals, which is considered to be a relatively small sample size but still valid. In qualitative

research, 10 to 20 interviewees are generally deemed sufficient to provide useful information (Morse, 1994). An audio recording and transcription were then made by the researcher. Using a content analysis methodology, the students' perspectives were categorized into four broad themes following the coding and interpretation of the data in accordance with Creswell (2009). There are four broad themes that can be identified when analyzing student perspectives: learning experiences, learning habits, learning autonomy, and difficulties and challenges. A diagram illustrating this can be found in Figure 4.2.

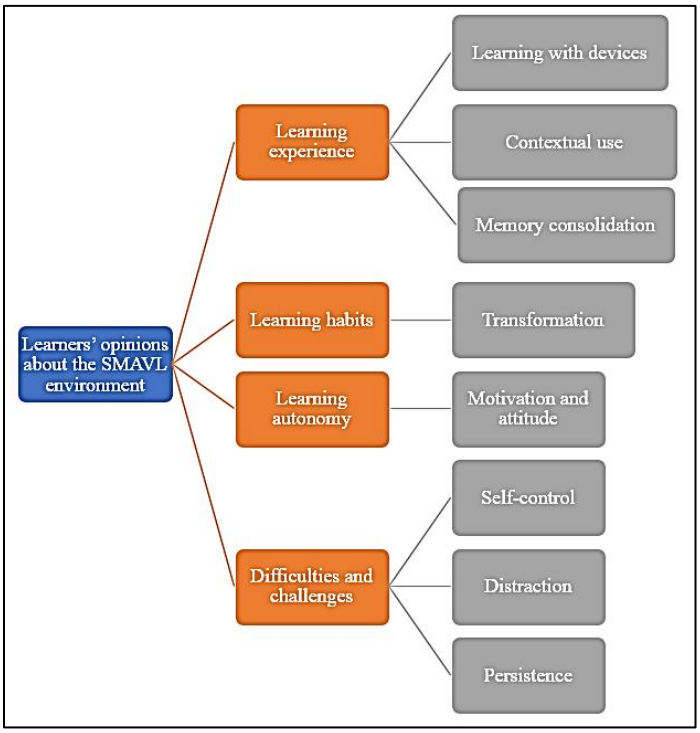


Figure 4.2 Summary of learners' opinions about the SMAVLE

The majority of students reported that the Seamless Mobile-Assisted Vocabulary Learning (SMAVL) environment provided them with a positive learning experience with vocabulary learning to improve their mastery of words, particularly in terms of word usage. In addition, they never thought that the common device that most people use today, the mobile phone, would help them create their own sentences with daily context, thus improving their memory of words. Following are some excerpts from the transcript of the interview that can be used to illustrate these points:

"I really loved this learning process. It's great to have mobile device in the classroom. With SMAVL, I can practice at my own pace. I used to make mistakes in

making sentences, but this learning method could help me use words accurately."--**SS01M**

"Our learning approach is really great. I'm feeling really empowered using my own device for my studies. SMAVL lets me study in a way that works best for me, and that's been a game changer for me. It used to be hard for me to choose words properly, but now I'm much better at it."--**SS06F**

"When I read others' work illustrated by daily pictures, I can make my own sentence with the picture, and thus when I saw the scene in daily life, I can recall the meaning of the words and use it... --**SS08M**

"I've found it very beneficial to see other people's work that connects everyday images to language learning. Seeing these pictures motivates me to make my own sentences, which helps me remember them and use them in real life. It's like these images make the corresponding words come to life in my daily interactions." --**SS07F**

"Using images in daily life to illustrate language learning is so helpful. Seeing others do it has inspired me to try it myself, creating my own sentences. Now, when I see similar situations in my day-to-day life, I can recall and use the vocabulary that I have learned. The world is like a living language workbook for me." --**SS11M**

In terms of learning habits, the SMAVL could help students reshape their vocabulary learning habits, even "transform" them. The following interviews prove that the SMAVLE can help students become more independent and proficient in their learning. Furthermore, it can also help students to become more motivated and engaged in their studies.

"I've noticed a big change in the way I learn from this environment. I've started watching videos and trying to make my own sentences with pictures instead of just memorizing words. It's an easier way to learn. With the convenience of my mobile phone, I've developed new habits that make learning more fun."--**SS12M**

"I found myself having marked shift in my learning habits thanks to this environment. I no longer just memorize words mechanically; instead, I watch videos and spell out the words. This method feels more engaging and effective. The ease and convenience of using my mobile phone for vocabulary learning has been instrumental in forging this new learning habit."--**SS02F**

As for the autonomy of learning, the SMAVL gave them the possibility of creating their own learning space, which is quite beneficial for them. Being able to manage their learning process with segmented time made them more motivated to finish tasks. Their attitude toward the learning process changed since they had more

control over the way they learned. This autonomy also allowed them to customize their learning experience, which improved their engagement and performance.

“The SMAVLE has changed my attitude toward vocabulary learning. I used to study, and I felt passive, but now I feel more in control of what I'm learning. I can tailor where and when I study to my liking, and this flexibility keeps me motivated.” **-SS03M**

“In my opinion, the freer, more personalized approach to learning vocabulary has allowed me to learn vocabulary faster, and it also has made a big difference in the way I use vocabulary in my everyday life. This would be a great change from traditional learning methods.”

For the last theme, they reported the difficulties and challenges they encountered during the whole learning process. Self-control, distraction, and persistence are frequently mentioned by them.

“Sure, you allowed us to use our phones in class for studying, so we could take out our phones. But there are always distracting messages that pop out and disturb us, like class announcements, all kinds of notices, and the like. Besides, some people can’t control their desire to play with their phones, which is the biggest challenge.”-**SS07F**

“Since cell phones have many functions, like watching movies, playing games, chatting, and so on, using them for studying means overcoming many distractions; self-control is key, and if you can’t stick with it, it’s all for nothing. Laziness and procrastination are big problems among college students.”**-SS04M**

“One of the challenges of using mobile devices for learning is definitely dealing with distractions. There are so many other activities you can do on your phone, like checking social media or playing games. It requires discipline to focus on learning and not get sidetracked.”**-SS05F**

Overall, the results of the interview indicated that students’ vocabulary learning experiences and learning habits were positively impacted by the SMAVLE. Students enjoyed a sense of autonomy, allowing them to customize the way they learn, thus improving both their engagement and performance. However, there were some challenges reported, mainly due to distractions from other phone features and issues related to self-control and procrastination.

4.5 Summary

This chapter presented the results of the Seamless Mobile-Assisted Vocabulary Learning (SMAVL) environment. It detailed the results of various assessments used to

measure the effectiveness of SMAVLE, including the Vocabulary Size Test (VST) and the Vocabulary Knowledge Scale (VKS). These assessments demonstrate significant improvements in the students' English vocabulary skills, especially in the experimental group, highlighting the effectiveness of SMAVLE in enhancing vocabulary learning. Then, the vocabulary learning results between students using SMAVLE and those engaged in seamed learning methods were compared. The results, based on VST and VKS scores, indicated that students using SMAVLE (EG) achieved greater improvements in vocabulary size and depth of knowledge compared to the CG, which underscored the advantages of SMAVLE over traditional methods. After that, the analysis of students' learning logs highlighted four primary facilitative factors - multimedia resources, mobile device convenience, a self-regulated learning environment, and technological skills. Despite certain challenges identified through interviews, such as distractions related to the use of mobile phones and self-control issues, these components contributed significantly to creating a productive learning experience. Lastly, the chapter concluded by investigating the perceptions of Chinese college students towards SMAVLE. Results from questionnaires, learning logs, and interviews revealed that students generally had positive attitudes towards SMAVLE. They found it helpful in improving various aspects of vocabulary learning and appreciated the autonomy, motivation, and confidence it fostered in their learning process. However, some students reported challenges related to the complexity of vocabulary tasks and integrating new words into daily life.

Overall, this chapter provided a comprehensive evaluation of SMAVLE in the context of vocabulary learning among Chinese college students. It concluded that SMAVLE significantly enhanced vocabulary learning, with positive student perceptions and valuable insights into the features making SMAVLE effective, despite some challenges.

CHAPTER 5
DISCUSSION

The purpose of this chapter is to discuss and interpret the results of the research study performed in the Seamless Mobile-Assisted Vocabulary Learning Environment (SMAVLE) presented in the previous chapter. Research findings are discussed in relation to the variables embedded in the framework to enable a profound understanding of their implications and relevance.

5.1 The Effects of SMAVLE on Chinese College Students' English Vocabulary Learning

Based on the study's results, it was concluded that SMAVLE effectively enhanced the learning of English vocabulary among Chinese college students. A detailed analysis of the Vocabulary Size Test (VST) and Vocabulary Knowledge Scale (VKS) indicated that students in the experimental group had improved substantially both in vocabulary depth and breadth. In terms of vocabulary size, the VST results show an average increase of 7.07%, going from 2701.52 to 2892.42 words, indicating a significant expansion of the vocabulary. A significant increase in vocabulary knowledge was also evident in VKS outcomes, with mean scores increasing by 26.0 points, demonstrating a better understanding of vocabulary use. These improvements, statistically validated, underscore the profound impact of SMAVLE in fostering a more comprehensive and nuanced grasp of English vocabulary among Chinese first-year college students. According to the previous chapter, there are three main aspects related to SMAVLE framework. The discussion of aspects involved in the framework which may cause the results is unfolded below:

5.1.1 Technical Aspects of SMAVLE May Enhance the Vocabulary Learning Process

By implementing SMAVLE, Chinese university students may benefit from enhanced English vocabulary learning which was supported by tech-aspects. Issues related to these technical elements can be discussed as follows:

First and foremost, RAIN CLASSROOM 's integration with WeChat illustrates how social media can be effectively integrated into educational contexts using the popular application WeChat. According to Greenhow and Lewin (2016), incorporating

social media platforms such as WeChat into learning environments can significantly enhance student engagement and motivation. Students benefit from this integration because their interface is familiar, which reduces the learning curve and makes the course more accessible (Manca & Ranieri, 2016). Kukulska-Hulme et al. (2017) recommend such learning platforms for vocabulary acquisition because they provide real-time feedback and interactivity so that students can apply and contextualize new words in real-time.

As a second point, the use of mobile devices in the classroom has been proven to motivate students to pay better attention to and engage with the content. Based on Crompton's (2013) findings, the use of mobile devices in educational settings can significantly increase student engagement and facilitate learning. With smartphones, students can access vocabulary materials and engage in interactive content at any time due to their immediate accessibility and immediacy. The use of "RAIN CLASSROOM" embedded in WeChat further enhances the learning process by utilizing the ubiquity of mobile technology. According to Wang et al. (2019), education content can be integrated into social media platforms such as WeChat to increase student motivation and engagement. WeChat's RAIN CLASSROOM platform provides students with a familiar interface, reducing their cognitive load associated with navigating new technologies and allowing them to concentrate more on the learning content.

Furthermore, making videos on a mobile device while studying outside the classroom may enhance learning. The cognitive theory of multimedia learning, proposed by Mayer (2009), suggests that combining text, audio, and visual elements in learning materials may enhance memory retention and recall. This multimodal approach to learning is facilitated by the integration of multimedia content through mobile devices, which can provide students with multiple ways of engaging with and internalizing new vocabulary. To conclude, the integration of technology into SMAVLE, especially the use of mobile devices and RAIN CLASSROOM embedded in WeChat, have facilitated the learning of vocabulary.

5.1.2 Cultural Aspects of SMAVLE May Improve the Vocabulary Learning Effects

Cultural elements in SMAVLE are crucial for enhancing English vocabulary learning among Chinese university students. These aspects ensure that the learning materials are not only linguistically relevant but also culturally resonant, thus making the learning experience more engaging and effective.

First, SMAVLE aims to provide culturally relevant materials that are consistent with Banks' (2007) recommendation for multicultural education, which emphasizes the importance of incorporating cultural perspectives into teaching materials. Through this approach, students will not only retain their interest, but also develop a deeper understanding of the language in a broader cultural context. Meanwhile, Godwin-Jones (2011) argues that emerging technologies are capable of creating immersive learning experiences for languages. Students are able to acquire a deeper understanding of the language and its cultural nuances through the use of technology-mediated cultural immersion programs. SMAVLE encourages students to create outputs relevant to their own authentic experiences, in order to cater to the fact that cultural factors play a significant role in vocabulary acquisition.

The second aspect of SMAVLE is that it connects formal and informal learning; by utilizing mobile technology to deliver culturally relevant content inside and outside the classroom, SMAVLE bridges the gap between formal and informal learning. It has been observed by Vavoula and Sharples (2009) that the use of mobile learning can greatly enhance the experience of learning in authentic contexts. By offering opportunities for learners to learn in different environments, SMAVLE supports a holistic approach to vocabulary learning, thereby connecting different learning scenarios and providing learners with more opportunities to bridge learning environments.

Finally, SMAVLE promotes cultural literacy through the acquisition of language skills. As well as improving language skills, SMAVLE also enhances cultural competence by incorporating cultural elements. According to Liddicoat and Scarino (2013), language learning is intrinsically intercultural and requires knowledge of a language's cultural norms and values. SMAVLE's cultural aspects provide valuable insight into the culture of an English-speaking nation, which enhances the learning experience as a whole.

5.1.3 Theoretical Aspects of SMAVLE and their Effects on Vocabulary Learning

The SMAVLE is underpinned by several key learning theories that significantly enhance its effectiveness in vocabulary learning. This section delves into how these theoretical foundations-constructivist learning, dual coding theory, autonomous learning, and the production-oriented approach-contribute to the learning process, supported by scholarly literature.

1. Constructivist theory: As a result of the use of constructivist learning theories in SMAVLE, Chinese university students have been able to learn vocabulary more efficiently. Based on Piaget's (1954) proposal and

Vygotsky's (1978) development, this theory suggests that learning involves actively constructing knowledge rather than passively absorbing it. Learners are engaged in interactive and experiential learning activities through which they can actively construct their understanding of English vocabulary through SMAVLE, which embodies this theory. By engaging learners in interactive and experiential learning activities, SMAVLE facilitates the active construction of an understanding of English vocabulary by engaging them in interactive and experiential learning activities. In the context of SMAVLE, constructivist learning is achieved by encouraging exploration, experimentation, and active participation in vocabulary learning. Kirschner et al. (2006) support this approach, pointing out that active learning environments are crucial to facilitating effective knowledge construction. It is Bruner (1990)'s description of the constructivist core learning process that learners connect new vocabulary to prior knowledge and experience by integrating tasks and authentic contexts of learning outputs into its platform. Furthermore, the application of vocabulary in SMAVLE is consistent with the contextual learning model favored by Lave and Wenger (1991), which proposes that learning is most effective in contexts that correspond to real-world situations. Based on this model, SMAVLE emphasizes the importance of authenticity in the learning experience by providing learners with opportunities to apply vocabulary to meaningful real-world situations. This constructivist approach in SMAVLE is also in line with Vygotsky's (1978) conception of the Zone of Proximal Development (ZPD). When used as a scaffold, the SMAVLE provides learners with the support and resources that enable them to reach a higher level of understanding than they would have been able to achieve independently. In the process of learning vocabulary, learners take greater ownership of their learning, which is consistent with Palincsar (1998) findings on the benefits of scaffolding in promoting independent learning.

To conclude, the constructivist learning principles incorporated in SMAVLE provide a dynamic and effective approach to vocabulary acquisition. As SMAVLE engages learners in active, contextualized learning experiences, it facilitates deep cognitive processing for vocabulary, embodied in constructivist learning theory's core principles.

2. Dual Coding Theory: The theory suggests that combining verbal and visual

information simultaneously leads to improved memory and comprehension. SMAVLE provides a multimodal learning experience that enhances memory retention by combining text, audio, and image elements in vocabulary learning activities. It was proposed by Paivio (1986) that information is better processed through both verbal and visual channels in order for learning to be more effective. By incorporating multimedia elements, such as video creation and sharing, SMAVLE illustrates this theory by allowing learners to learn vocabulary using both auditory as well as visual means. Firstly, this theory facilitates memory retention and comprehension. Due to the distinct but complementary ways in which visual and verbal information are processed by the brain, Clark and Paivio (1991) have demonstrated the effectiveness of dual encoding in enhancing memory effects. It is through this multimodal approach that the students are able to engage more fully with language, which in turn enhances memory and recall. Secondly, the incorporation of multimedia elements in SMAVLE accommodates different learning styles, which is a key factor in effective language learning. In Mayer's (2001) cognitive theory of multimedia learning, individuals can learn more effectively using words and pictures than when using just words. A variety of learning preferences are accommodated by SMAVLE, which allows for the use of both words and images to enhance accessibility and effectiveness. As mentioned, SMAVLE uses video creation and sharing in a manner consistent with the principles of dual coding theory, and Mayer and Anderson (1991) stress that multimedia, including video, can significantly enhance learning outcomes. Students are able to engage with vocabulary in a dynamic and interactive way when they create and share videos, reinforcing learning through active construction and presentation. The dual representation of vocabulary in SMAVLE promotes deeper cognitive processing as well. Sadoski and Paivio (2001) argue that dual encoding of information enables learners to engage in deeper cognitive processes, which are essential for the acquisition of language. The use of SMAVLE may allow students to better comprehend and retain information through the use of both verbal and visual exposure to vocabulary.

In conclusion, the application of dual coding theory within SMAVLE contributes significantly to the facilitation of vocabulary acquisition. In

accordance with the theory's emphasis on dual representation of information, multimedia elements, particularly the creation and sharing of videos, can provide an enhanced multimodal learning experience. In addition to improving memory retention and comprehension, this approach also takes into account different learning styles, thereby providing students with a more engaging and effective method of acquiring vocabulary.

3. Autonomous learning: As previously discussed, SMAVLE incorporates both informal and formal learning settings. Informal learning, characterized by its experiential nature and lack of a stringent curriculum (Marsick and Watkins, 2001), necessitates that learners within SMAVLE set their own goals and manage their time effectively. This approach resonates with Knowles' (1975) theory, which posits that autonomy in learning is beneficial. It appears that an essential element of autonomous learning in SMAVLE is the learners' capability to discern and select suitable learning resources from the extensive array of online information. This discernment, as highlighted by Siemens (2005) in his connectivism theory, is vital in the digital era. Additionally, learners are encouraged to evaluate their own learning outcomes, aligning with Zimmerman’s (2002) concept of self-regulated learning, which underscores the significance of self-assessment.

The integration of autonomous learning in SMAVLE potentially influences vocabulary learning by fostering engagement, encouraging autonomous learning strategies, and enhancing critical thinking abilities. Nation (2001) suggests that effective vocabulary learning encompasses not only word acquisition but also an understanding of usage and context, a process that might be augmented by autonomous learning practices. Furthermore, based on Craik and Lockhart's (1972) Levels of Processing Theory, it can be inferred that the active involvement of learners in selecting and applying vocabulary resources could lead to more profound cognitive processing.

In summary, the incorporation of autonomous learning theory within SMAVLE may significantly impact the efficacy of vocabulary learning. This approach seems to establish a learner-centered environment where students are motivated to participate actively in their learning journey, setting personal goals and choosing resources that align with their

individual needs. The role of the teacher, consequently, shifts to that of a facilitator and resource advisor. The potential effectiveness of vocabulary learning under this paradigm seems to be supported by various academic theories and research, suggesting the importance of autonomy in contemporary educational practices. However, it is important to note that these outcomes are context-dependent and may vary based on individual learner differences and specific educational settings.

4. The Production-Oriented Approach: Wen (2015) proposes POA based on Swain's output hypothesis (1985), Krashen's input hypothesis (1985), and Allwright's (1984) and Long's (1983) interaction hypothesis. As a result of this approach, which stresses output-driven learning, the traditional approach to teaching languages in China, especially to young adults, has undergone a change.

    The POA approach can be applied to the development of SMAVLE in order to reorient vocabulary learning to emphasize production and usage in context rather than simple acquisition. This idea is consistent with the principles of task-based language teaching advocated by Long (1985) and later expanded by Ellis (2003). POA's emphasis on output-driven tasks suggests that learners in SMAVLE can utilize vocabulary more actively in communicative tasks, improving the relevance and engagement of the learning process (Willis, 1996).

    Moreover, Swain (1995) argues that language production motivates learners to process language more deeply, which leads to a stronger understanding and retention of vocabulary. Vygotsky's (1978) sociocultural theory also emphasizes the importance of social interaction in the learning process, suggesting that interactive tasks in POA could further facilitate vocabulary acquisition.

    While POA integration into SMAVLE is based on a theoretical framework and has the potential to facilitate vocabulary learning in EFL settings, it should be viewed from an exploratory perspective. A variety of factors can influence the effectiveness of such integration, including the characteristics of the learner, the level of education, and the specific educational context in which it takes place. In order to assess POA's effectiveness and its impact on vocabulary learning, further empirical research is necessary.

To sum up, all the aforementioned aspects may cause the positive effects. A careful assessment of SMAVLE and its impact on the acquisition of English vocabulary in Chinese college students should be conducted with academic caution, recognizing that its effectiveness may be contextually specific and that responses may vary. As a result of its integration of mobile technology and social media, specifically WeChat's RAIN CLASSROOM, SMAVLE is in alignment with research conducted by Greenhow and Lewin (2016) as well as Manca & Ranieri (2016) that suggests potential enhancements in student engagement and motivation. According to Mayer's (2009) cognitive theory of multimedia learning, a multimodal approach has the potential to enhance memory retention and the learning experience as a whole. From a cultural perspective, SMAVLE's emphasis on providing linguistically and culturally relevant content is in line with Banks' (2007) multicultural education framework, which seeks to boost both language proficiency and cultural competence, as identified by Liddicoat and Scarino (2013). SMAVLE is theoretically grounded in constructivist learning, dual-coding theory, autonomous learning, and production-oriented learning (POA). In spite of this, the use of SMAVLE as a tool for enhancing vocabulary learning in a real-world environment requires empirical scrutiny and may require ongoing adjustments, highlighting the dynamic interplay between educational technology and its application in varied learning environments.

5.2 Comparative Analysis of Variable Influences on Vocabulary Learning: SMAVLE vs. Seamed Learning

This comparative analysis of SMAVLE and traditional Seamed Learning methods, focusing on the Vocabulary Size Test (VST) and Vocabulary Knowledge Scale (VKS) outcomes, indicates that SMAVLE is significantly superior to Seamed Learning as a method for improving both vocabulary breadth and depth among Chinese college students. The findings indicate that students who used SMAVLE exhibited an increase in vocabulary size, as evidenced by the VST results, as well as a deeper understanding of vocabulary, as indicated by the VKS results. In comparison with traditional Seamed Learning, these results are statistically significant, demonstrating the substantial effectiveness of SMAVLE in advancing students' vocabulary knowledge. It is evident from this study that SMAVLE is more effective than traditional approaches to facilitating comprehensive vocabulary acquisition in an educational setting.

5.2.1 Overview of Key Variables Differentiating SMAVLE from Seamed Learning

The variables described in Chapters 2 and 3 of SMAVLE and Seamed Learning in vocabulary learning are summarized here, and then discussed and analyzed in order to determine what advantages and disadvantages exist between the two approaches as far as learning English vocabulary is concerned.

The first variable that is different would be the method of presentation and interaction. For interactive vocabulary instruction, SMAVLE utilizes the WeChat platform and mobile-assisted presentation. In contrast, Seamed Learning's traditional blackboard-based presentations lack the interactivity and digital dimension of SMAVLE. Second, SMAVLE has a flexible retrieval process, allowing students to use their mobile devices anywhere, anytime. By contrast, Seamed Learning limits students to a fixed time and location for vocabulary learning, which may inhibit spontaneity and contextualization. A third distinction is the nature of the learning artifacts: in SMAVLE, students actively create personalized video artifacts for vocabulary learning, combining attention with retrieval. As opposed to Seamed Learning, which involves passive viewing of pre-existing video clips, Seamed Learning may be less engaging. As a fourth difference, SMAVLE students use a Learning Journal to record their daily experiences. These learning journals incorporate both images and text from their daily lives. This method contrasts with seamed learning. Seamed learning involves students using only text in their learning logs and ignoring SMAVLE's visual context. As a fifth difference, SMAVLE employs a mechanism of online feedback and error correction that facilitates instant and interactive error correction. Using this approach is more dynamic than using traditional written feedback, which may not provide the same level of immediacy and personalization as Seamed Learning. Using technological devices in the classroom is the sixth factor. Mobile devices are being used in the classroom by SMAVLE as a means of increasing student engagement through digital means. This is an advancement in the use of educational technology in the classroom. Unlike Seamed Learning, which adheres to a traditional classroom setup and does not heavily utilize technology, this is a significant departure.

Focusing on the most crucial variables for brevity and emphasis, the following key variables are discussed in understanding why SMAVLE may be more effective than Seamed Learning in enhancing vocabulary acquisition among Chinese college students:

Flexibility in Learning Environment: SMAVLE allows students to use mobile devices for vocabulary retrieval at any time and place, offering significant flexibility that is vital for student motivation and vocabulary mastery. In contrast, students in Seamed

Learning are confined to specific apps during fixed times and locations, which may limit learning spontaneity.

Nature of Learning Artifacts: In SMAVLE, students are encouraged to actively create personalized video artifacts, a process that can foster deeper cognitive processing and memory of vocabulary. On the other hand, Seamed Learning involves passive viewing of pre-made video clips, which may not be as effective as the active creation process.

Feedback and Correction Mechanism: SMAVLE employs online feedback for immediate and interactive error correction, which could be more dynamic and personalized compared to the traditional written feedback in Seamed Learning.

Analyzing these key variables helps explain why SMAVLE might be more effective than traditional Seamed Learning methods in promoting vocabulary learning among Chinese college students.

5.2.2 Flexibility in Learning Environment May Enhance Contextual Vocabulary Learning and Autonomy

In SMAVLE, students can use mobile devices to retrieve vocabulary at any time and location, which may significantly enhance the learning experience. As this flexibility aligns with the principles of self-directed learning and learner autonomy, it is essential to fostering student motivation and mastery of vocabulary. As described by Holec (1981), autonomy in learning is a key component in language education, as it allows learners to be in charge of their own learning process. Based on Benson's (2001) emphasis on learner autonomy in language learning, this control and flexibility results in an increased motivation and a deeper engagement with the material. By providing students with unrestricted access to learning materials in SMAVLE, they are motivated to learn in relevant and meaningful contexts, resulting in more effective vocabulary acquisition. Similarly, Godwin-Jones (2011) advocates that mobile-assisted language learning tools provide flexible and accessible opportunities for engagement with language learning materials, thereby facilitating independent learning. Seamed Learning, on the other hand, may restrict the spontaneity and contextual learning opportunities in the learning process due to its reliance on specific apps during fixed times and locations. According to Vavoula and Sharples (2009), learning vocabulary in an authentic context, as SMAVLE does, is highly beneficial. By limiting the scope of Seamed Learning, learners may be unable to connect their vocabulary learning to their daily lives, thereby affecting the ease and depth with which they understand and retain vocabulary. As a result, SMAVLE's flexibility in the learning environment may play a crucial role in improving vocabulary learning among Chinese college students.

5.2.3 Nature of Learning Artifacts May Enhance Vocabulary Processing

The nature of learning artifacts in SMAVLE, which emphasizes the active creation of personalized video content, significantly enhances vocabulary acquisition, contrasting sharply with the more passive learning artifacts in Seamed Learning. In SMAVLE, students are not just passive recipients of information; instead, they become creators, actively using and applying vocabulary in personalized video projects. This process of creation aligns with constructivist learning theories by Piaget (1954) and Vygotsky (1978), emphasizing that knowledge is built through interaction and meaningful activity. For instance, when students produce a video explaining a specific term, they engage in deep processing of the word, its usage, and context, much like the learning approaches recommended by Mayer (2009) in his Cognitive Theory of Multimedia Learning. The effectiveness of such multimedia artifacts in learning is further supported by Paivio's (1986) Dual Coding Theory. When students combine images, sounds, and words in their videos, they process the information through both verbal and visual channels, enhancing memory and understanding. This multimedia approach is exemplified in studies like those of Sadoski and Paivio (2001), where the integration of verbal and visual elements was shown to facilitate deeper cognitive processing and better retention of information.

In contrast, the Seamed Learning approach, which might include activities such as watching pre-made videos or writing sentences in notebooks, lacks the same level of active engagement. For example, while a student in Seamed Learning might passively watch a video illustrating a new word, a student in SMAVLE would actively create a video using that word, thereby engaging in a more comprehensive learning experience. This difference in engagement levels is crucial, as noted by Swain (1995), who argues that producing language (output) prompts learners to process it more thoroughly than merely receiving it (input).

Therefore, the nature of learning artifacts in SMAVLE - specifically, the active creation of multimedia content - fosters a more engaging and effective learning environment. This approach not only promotes active engagement with language but also caters to various learning preferences, leading to a richer and more nuanced understanding of vocabulary among Chinese college students.

5.2.4 Feedback and Correction Mechanism May Accelerate Vocabulary Mastery

The feedback and error correction mechanisms in SMAVLE are immediate and interactive through the online platform and are important factors in accelerating vocabulary acquisition and facilitating error correction. This approach is consistent with

Hattie and Timperley's (2007) framework for effective feedback, which emphasizes that timely and specific feedback can greatly facilitate the learning process. In SMAVLE, students receive immediate responses to their queries and submissions, a feature that is particularly beneficial to language learning as it allows for rapid error correction and adjustment. This immediacy of feedback is crucial, as noted by Shute (2008), who argues that immediate feedback in an educational setting helps students to quickly recognize and correct errors, leading to better learning outcomes. In addition, the interactive nature of feedback in SMAVLE, which is often achieved through digital platforms, supports a more personalized learning experience. This is consistent with Narciss's (2008) findings that interactive and personalized feedback is effective in meeting individual learning needs, thereby enhancing the overall learning experience.

Contrast this with Seamed Learning, which provides delayed feedback in a traditional offline environment. Delayed feedback may not provide the same level of immediacy and personalization, which may affect the effectiveness of the learning process. Butler and Winne's (1995) research suggest that delayed feedback sometimes hinders the learning process because students may lose the context or immediacy of the learning activity.

In conclusion, the feedback and correction mechanisms in SMAVLE focus on immediacy and interactivity and play a crucial role in improving vocabulary learning outcomes. By providing students with immediate and personalized feedback, SMAVLE not only accelerates vocabulary acquisition, but also greatly assists students in correcting errors in an effective and timely manner, which is consistent with contemporary educational practices that prioritize immediate feedback and learner-centered approaches.

Through a comparative analysis of the main variables of SMAVLE and Seamed Learning, we found that SMAVLE has obvious advantages in facilitating vocabulary learning for Chinese college students. The flexibility of the SMAVLE learning environment allows students to utilize their mobile devices for vocabulary searching at their convenience, fosters learner autonomy, and strengthens contextual learning, which is in line with the principle of independent learning principles. Supported by constructivist learning theory and dual coding theory, the learning artifacts approach in SMAVLE, which centers on the active creation of personalized video content, encourages students to engage more deeply with their cognition, leading to a more comprehensive understanding of vocabulary. In addition, SMAVLE's instant interactive feedback mechanism, enabled by the online platform, accelerates vocabulary acquisition and efficient error correction, providing a more dynamic and responsive

learning experience than the traditional, more passive Seamed Learning approach. In short, SMAVLE's innovative integration of technology, interactive content creation, and learner-centered approach is vastly superior to traditional methods, making it a more effective tool for comprehensive vocabulary acquisition in educational settings.

5.3 Integrated Analysis of SMAVLE's Key Features for Enhancing Vocabulary Learning

The analysis of SMAVLE, through the examination of student learning logs and interviews, reveals key facilitative factors contributing to effective vocabulary acquisition among Chinese college students. The learning logs indicate that students value SMAVLE for its accessibility, contextuality, multimodality, feedbackability, individuality, and collaborativity. These features emphasize the importance of mobile accessibility, real-world contextual learning, the use of multimedia resources, immediate feedback, personalized learning experiences, and peer collaboration in enhancing vocabulary mastery. Additionally, technological proficiency, autonomous learning, creative expression, and community participation were identified as significant contributors to effective learning. Interviews further corroborate these findings, highlighting multimodal integration, ubiquitous accessibility, autonomous engagement, and digital mastery as central to the SMAVLE experience. These elements, collectively, underscore the effectiveness of SMAVLE in providing a rich, flexible, and personalized learning environment, substantially aiding in the acquisition of English vocabulary among Chinese college students. Seven features in SMAVLE are discussed below:

1. The accessibility feature of SMAVLE allows students to access learning materials anytime and anywhere, which plays a crucial role in improving vocabulary learning skills of Chinese university students. As discussed by Crompton (2013) in the context of m-learning, this feature removes geographic and time constraints, thus providing a learner-centered educational environment. SMAVLE allows students to practice vocabulary and use related resources on their mobile devices at their convenience, thus fostering a continuous, integrated learning experience. This accessibility means more than just physical availability; it also means adapting to the learner's contextual needs and schedule, making learning more adaptable and personalized. In the area of vocabulary learning, the importance of regular and repeated exposure to new words has been demonstrated in language learning research. As noted by researchers such as Dempster (1988), SMAVLE provides students with the ability to review

and practice vocabulary in a variety of contexts and at times that best suit them, thus supporting the spacing effect, which suggests that dispersed learning leads to more effective memory retention over time. In addition, anytime, anywhere access to learning materials allows for just-in-time learning and review, which is critical for consolidating new vocabulary and helping it transfer to long-term memory.

In summary, the accessibility of SMAVLE allows students to engage in vocabulary learning in a flexible and contextualized manner, which greatly contributes to more effective and sustainable vocabulary acquisition. This approach is in line with contemporary educational trends towards learner-centered and context-aware mobile learning environments.

2. The concept of contextuality in vocabulary learning, especially facilitated by SMAVLE, plays a key role in improving vocabulary acquisition among Chinese university students. This approach is in line with the principles put forward by Godwin-Jones (2011), who emphasized the effectiveness of mobile apps in facilitating contextualized language learning outside of the traditional classroom setting. By integrating authentic contexts into the learning process, SMAVLE enables students to connect new vocabulary to their everyday experiences, thereby deepening understanding and aiding memorization. The effectiveness of context in vocabulary learning is further confirmed by Nation (2001) who emphasizes the importance of learning vocabulary in context for deeper comprehension and retention. Nation argues that exposure to words in different, authentic contexts helps to develop a more nuanced understanding of word usage, including connotations and collocations. This approach is consistent with the findings of Ellis (2008), who argues that learning vocabulary in context leads to more effective and sustained language acquisition because it mimics the way native speakers learn their first language. Furthermore, the context in SMAVLE supports the theory of incidental learning, whereby learners acquire knowledge in an informal and often unconscious way. This theory, discussed by Hulstijn (2003), suggests that incidental learning of vocabulary is achieved through repeated exposure to words in different contexts, thus increasing the likelihood of memorization. The use of mobile technology to provide contextual vocabulary learning opportunities in SMAVLE is consistent with

this theory and provides students with a more natural and intuitive way of learning language. In conclusion, the contextual features of SMAVLE, which are based on the principles of contextual and incidental learning, greatly contribute to the effectiveness of vocabulary learning for Chinese university students. By being exposed to vocabulary in real-life situations, students can gain a deeper understanding and long-term retention of new words, which is consistent with contemporary approaches to language education that emphasize the importance of context in language acquisition.

3. Mayer's principles of multimedia learning provide a theoretical basis for understanding the effectiveness of multimodality in education. Mayer (2009) argues that individuals are more likely to retain information when it is presented in both verbal and visual format in his book Multimedia Learning. Dual-channel information processing facilitates a deeper understanding of information and enhances its retention. Additionally, second language acquisition research emphasizes multimodality in language acquisition. Guo & Roehrig (2011) emphasized how multimedia resources can significantly improve language comprehension and engagement, especially in ESL settings. Multimodality in SMAVLE enables students to interact with vocabulary through multiple sensory channels. Students may hear a word pronounced, observe it used in a sentence, and watch a video clip illustrating its meaning. This approach is in line with Paivio's (1986) dual coding theory, which states that information processed through both visual and verbal channels is more likely to be retained. According to Fleming & Mills (1992) in their study of VARK learning styles, multimodal content can accommodate different learning styles in language learning. In addition to providing a variety of ways to engage with vocabulary, SMAVLE integrates multimodal resources to enhance vocabulary learning, resulting in rich, engaging, and diverse learning experiences for students. In a digital age, this approach helps vocabulary learners learn more effectively based on empirical research and theoretical frameworks.
4. As Shiute (2008) points out that immediate feedback plays a key role in education. By helping students recognize and correct errors quickly, timely feedback can greatly improve learning outcomes, according to Shiute's research. Furthermore, feedback is crucial to language acquisition.

Narciss (2008) discusses how personalized feedback can address individual learning needs and enhance language learning. The feedbackability of SMAVLE ensures that learners receive immediate feedback during language use, which is essential for effective language learning. A similar feature is consistent with the theory of second language acquisition that emphasizes feedback as an integral component of language development. In Corrective feedback and teacher development, Ellis (2009) argues that learners' understanding of language norms and rules requires corrective feedback. norms and rules. SMAVLE's immediacy of feedback aligns with the formative assessment principle, which states that learners' skills are continuously shaped and improved through ongoing feedback. Black and Wiliam (1998) argued for the importance of formative assessment, including immediate feedback, for effective learning. Therefore, SMAVLE's feedbackable features facilitate effective vocabulary learning by providing timely and interactive feedback. Research in educational psychology and language acquisition supports the use of this approach in order to enhance the learning process by allowing students to understand and correct their language usage immediately.

5. The notion of personalized features of SMAVLE is consistent with Holec's (1981) account of learner autonomy, which emphasizes the importance of self-directed learning for effective language learning. Holec highlights the benefits of allowing learners to control their own learning process in a way that is consistent with their individual needs and preferences. In addition, the role of personalized learning in language education is further supported by Benson (2001), who emphasizes the value of tailoring the learning journey to the individual needs of the learner. This approach increases motivation and engagement, which are key factors in successful language learning. In SMAVLE, personalization ensures that students can focus on vocabulary that they find challenging and learn it at a pace that suits them, which is particularly relevant to vocabulary learning. This personalization of learning is consistent with Vygotsky's (1978) concept of the Zone of Proximal Development (ZPD), which states that learning occurs best when educational activities are appropriate for the learner's current level of ability. Finally, the importance of accommodating individual differences in language learning, including factors such as

motivation and learning strategies, has also been emphasized in research on second language acquisition, especially in works that focus on the psychology of language learners (Dörnyei, 2005).

In conclusion, personalization as a key feature of SMAVLE can facilitate a more relevant and effective vocabulary learning experience. By adapting to individual learning styles, preferences, and progress, SMAVLE is consistent with established theories of learner autonomy and recognizes the diversity of learner needs, contributing to more engaging and successful vocabulary learning.

6. The collaborative features in SMAVLE emphasize peer interaction and cooperative learning, which play an important role in facilitating vocabulary learning. This is consistent with Vygotsky's (1978) sociocultural theory, which emphasizes the importance of social interaction in cognitive development and argues that collaborative learning among peers leads to more effective educational outcomes. Additionally, research in the field of language learning supports the value of collaboration. Storch (2005) demonstrated in her collaborative writing study that working with peers significantly improved language skills and comprehension. In SMAVLE, this collaborative approach enabled students to participate in a community of practice, share insights and co-construct knowledge, a concept also introduced by Wenger (1998), who discusses the benefits of such communities in learning. Almost simultaneously, the principles of collaborative learning discussed by Johnson and Johnson (1999) emphasize the importance of collaborative learning environments to enhance student engagement and learning outcomes. In summary, the collaborative nature in SMAVLE fosters an interactive and cooperative learning environment that is essential for effective vocabulary learning. This approach, based on well-established educational theory and research, improves language skills and comprehension and is a key factor in successful vocabulary acquisition.

To conclude, in SMAVLE, key features like accessibility, contextuality, multimodality, feedbackability, individuality, and collaborativity synergistically enhance vocabulary learning among Chinese college students. Accessibility, as highlighted by Crompton (2013), removes geographical and temporal constraints, allowing students to engage with vocabulary exercises anytime, anywhere, fostering continuous and

integrated learning. Contextuality, in line with Godwin-Jones (2011) and supported by Nation (2001) and Ellis (2008), provides real-world contextual learning, aiding comprehension and retention. Multimodality, grounded in Mayer's (2009) principles and supported by Guo & Roehrig (2011), enriches learning experiences through diverse sensory channels, catering to different learning styles. Feedbackability, crucial for language learning as per Shute (2008) and Narciss (2008), offers immediate feedback for real-time error correction. Individuality aligns with Holec's (1981) learner autonomy, allowing personalized learning experiences, while collaborativity, based on Vygotsky's (1978) sociocultural theory and further explained by Storch (2005), fosters an interactive environment, enhancing language skills and comprehension. These features collectively create a rich, flexible, and personalized learning environment in SMAVLE, effectively facilitating vocabulary acquisition and aligning with contemporary educational practices.

5.4 Chinese College Students' Perceptions toward the SMAVLE

Based on the results from chapter 4, analysis of learning logs and interviews further indicated that SMAVLE was well received by students, who appreciated its ease of use, flexibility, and interactivity. Students highlighted the advantages of SMAVLE in providing a personalized learning experience, increasing autonomy, and promoting deeper understanding and use of vocabulary. Students' overall perceptions of SMAVLE were positive. All qualitative data were used to support students' perspectives which were categorized into four broad themes: Learning experience, learning habits, learning autonomy, the challenges, and difficulties they faced during the learning process.

5.4.1 Learning Experience

The Seamless Mobile-Assisted Vocabulary Learning Environment (SMAVLE) has brought a positive learning experience to Chinese university students, which is reflected in their improved ability to understand and apply English vocabulary. This enhanced learning experience includes not only the technical aspects of vocabulary spelling and pronunciation, but also the contextual and practical usage of vocabulary. According to student feedback, SMAVLE effectively integrates vocabulary into real-life scenarios and promotes deeper understanding and memorization of vocabulary. This approach fits well with the principles put forward by Nation (2001), who emphasized the importance of contextual learning in vocabulary acquisition. In addition, the use of SMAVLE helps to increase students' motivation and self-confidence in vocabulary-

related tasks. This is in line with the findings of Kukulska-Hulme et al. (2017), who concluded that mobile technology can create a more engaging and interactive learning experience, which in turn increases learner motivation. The fact that students can access learning materials at any time and customize the learning process according to their individual needs encourages a more proactive and self-directed attitude towards learning, which is essential for effective language learning. These ideas are further supported by Hulstijn's (2003) theory of contingent language learning, which suggests that language acquisition is most effective when real-life situations are simulated in natural, unstructured environments.SMAVLE exemplifies this theory by emphasizing vocabulary learning in everyday contexts, providing students with a learning environment that is both authentic and conducive to natural language acquisition SMAVLE exemplifies this theory. In short, the learning experience provided by SMAVLE represents a significant advancement in vocabulary learning technology. By deepening vocabulary understanding through context and real-world usage, and increasing students' motivation and self-confidence, SMAVLE demonstrates its effectiveness as a language learning tool for Chinese university students.

5.4.2 Learning Habits

SMAVLE's impact on students' learning habits signaled a shift toward a more self-directed and efficient approach to vocabulary learning, facilitated by the inherent flexibility and accessibility of the mobile learning platform that SMAVLE presents. Students moved beyond traditional rote memorization techniques to more dynamic, practical, and application-based learning strategies. This evolution of learning habits coincides with Holec's (1981) emphasis on the importance of learner autonomy in language education. Holec's writings emphasize that when learners take control of their own learning process, they tend to learn the material more deeply and effectively. Knowles (1975) argues that self-directed learning not only enhances the learner's sense of responsibility for his/her own education, but also leads to a more meaningful and personalized learning experience. In the case of vocabulary learning, this shift to interactive and applied learning is critical because it allows students to use new words in context in real-world situations, thereby enhancing retention and comprehension of vocabulary. The integration of technology into language learning, especially through mobile platforms like SMAVLE, supports the findings of Kukulska-Hulme and Shield (2008) in their book "Mobile Assisted Language Learning". They emphasized how technology can change traditional learning habits by providing learners with new ways of engaging with language content, thus facilitating a more effective and enjoyable learning experience. In conclusion, the impact of SMAVLE on students' learning habits

represents a paradigm shift in vocabulary learning strategies. By promoting learner autonomy and adopting a more interactive and practical approach to learning, SMAVLE is consistent with contemporary theories of language education and self-directed learning. This shift helps to promote more effective and personalized vocabulary learning among Chinese university students.

5.4.3 Learning Autonomy

The introduction of SMAVLE significantly enhanced students' learning autonomy and enabled them to take greater control of their language learning process. This shift to self-directed learning was supported by Little (1991) who emphasized that empowering learners to take control of their own learning process is an important aspect of effective language education. According to Little, self-directed learning not only fosters a sense of ownership and responsibility, but also leads to a more personalized and meaningful educational experience. In a SMAVLE environment, students can customize the learning experience to their needs and preferences, thereby increasing their engagement and motivation. This approach coincides with the findings of Benson (2001), who emphasized the importance of learner autonomy in language education. Benson argued that when learners are given the freedom to direct their learning, they are more likely to be motivated and remain engaged in the language content. The flexibility of the SMAVLE allows students to engage in vocabulary learning activities that are appropriate for their individual ability levels, thereby promoting more effective language learning. activities, thereby facilitating more effective language acquisition. Oxford (2003) emphasizes the importance of strategies that cater to individual learning preferences and styles, noting that such strategies contribute significantly to successful language learning. In conclusion, the contribution of SMAVLE in improving the learning autonomy of Chinese university students is significant. By allowing students to direct their own learning process, SMAVLE supports established theories of learner autonomy and is consistent with contemporary understandings of effective language education practices.

5.4.4 Difficulties and Challenges

While SMAVLE brought many advantages to the vocabulary learning process, students also faced challenges and difficulties, mainly related to distraction and self-regulation. These issues reflect broader concerns in the field of mobile learning, as discussed in the academic literature. Distraction was a major challenge highlighted by students and is a well-known issue in mobile learning environments. As Kukulska-Hulme and Shield (2008) point out the versatility of mobile devices can lead to distraction. They argue that while mobile devices provide unprecedented access to

learning materials, they also bring with them a number of distractions, such as social media notifications and other non-educational applications, which can hinder the learning process. Self-regulation in learning is another challenge faced by students using SMAVLE. Zimmerman (2002) emphasized that effective learning requires students to manage their time, set goals, and stay focused, which is especially challenging in mobile learning environments without the traditional classroom structure and routines. Finally, students' references to procrastination in language learning in this study are consistent with findings in Steel's (2007) study: A meta-analysis and theoretical review of five self-regulation failures. Steel (2007) emphasized that procrastination is usually exacerbated in less structured learning environments and severely hinders academic performance. In the case of SMAVLE, the flexibility and autonomy offered by the platform requires students to demonstrate a high degree of self-discipline in order to effectively manage their learning activities.

In conclusion, while SMAVLE offers an innovative approach to vocabulary learning, it also presents challenges related to distraction and self-discipline. Addressing these issues is critical to maximizing the potential benefits of mobile-assisted language learning. Educators and developers must consider strategies to minimize distractions and support students in developing effective self-regulation skills.

5.5 Summary

This chapter has comprehensively discussed the implications and findings derived from the implementation of the Seamless Mobile-Assisted Vocabulary Learning Environment (SMAVLE) in the context of enhancing English vocabulary acquisition among Chinese college students. The analysis centered on the comparative effectiveness of SMAVLE versus traditional Seamed Learning methods, underscoring the pivotal role of SMAVLE in improving both the breadth and depth of students' vocabulary knowledge. The discussion synthesized insights from various perspectives, integrating technical, cultural, and theoretical aspects to provide a holistic understanding of the effectiveness of SMAVLE.

In technical terms, the integration of mobile technologies, such as the WeChat-based RAIN CLASSROOM, was found to significantly elevate student engagement and motivation. This technological integration facilitated a learner-centered educational approach, making vocabulary learning more accessible and engaging. Culturally, SMAVLE's emphasis on contextuality and relevance to students' real-world experiences was shown to enhance vocabulary comprehension and retention, thereby bridging the gap between formal and informal learning environments.

The theoretical underpinnings of SMAVLE, including constructivist learning theories, dual coding theory, autonomous learning, and the production-oriented approach, were identified as crucial elements in its success. These theories informed the design and functionality of SMAVLE, contributing to a more dynamic, interactive, and student-centered learning experience. The emphasis on active participation, multimodal learning, and immediate feedback further accentuated the effectiveness of SMAVLE in vocabulary acquisition.

From the student perspective, the analysis of learning logs and interviews revealed positive attitudes towards SMAVLE. Students appreciated the platform's accessibility, flexibility, and interactive nature, which contributed to enhanced learning experiences, improved learning habits, and increased learning autonomy. However, challenges such as distractions and difficulties in self-regulation were also identified, highlighting areas for further improvement in the implementation of mobile-assisted learning environments.

Overall, the discussion in this chapter underscores the significant impact of SMAVLE in facilitating effective vocabulary learning among Chinese college students. It demonstrates the advantages of incorporating mobile technology in education, particularly in language learning, while also acknowledging the challenges that need to be addressed for its optimal use. The findings and insights from this study provide valuable contributions to the field of mobile-assisted language learning and offer practical implications for educators and researchers in developing and implementing similar educational technologies.

CHAPTER 6
CONCLUSIONS

A conclusion is presented in the final chapter of the thesis. As a starting point, the first section summarizes the findings of the study and its contribution to the field. In the second section, some implications of the study are discussed. In the third section, the limitations of the study are discussed as well as some promising directions for future research are suggested.

6.1 Summary of the Study

The main objective of this study was to investigate the effectiveness of the Seamless Mobile-Assisted Vocabulary Learning Environment (SMAVLE) in enhancing English vocabulary learning among Chinese college students. Furthermore, the study sought to identify the factors in the SMAVLE that improved the learning process for English vocabulary for these students. It was also intended to capture students' perceptions of the SMAVLE and its effectiveness for the development of English vocabulary learning. Additionally, the study examined the learning outcomes of the SMAVLE compared to traditional seamed learning. To gain an understanding of the nuances of vocabulary learning under SMAVLE, the study employed a mixed-methods approach, drawing on quantitative and qualitative data obtained from Vocabulary Size Tests (VST), Vocabulary Knowledge Scales (VKS), as well as students' learning logs, questionnaires, and interviews.

As the result of this study, the SMAVLE was found to be effective at improving EFL learners' vocabulary learning. Over the course of the study, the experimental group, which utilized the SMAVLE, outperformed the control group, which was exposed to the seamed mobile-assisted learning environment. Through an innovative combination of formal and informal learning models, digital and physical learning, and personalized and social learning, SMAVLE appeared to have been able to facilitate student' learning of vocabulary. In addition, this study further emphasized the significance of the incorporation of images in sentence construction during vocabulary learning. Based on this evidence, it seems that the simultaneous processing of verbal and visual information, as posited in the Dual Coding Theory, can indeed contribute to vocabulary memory.

6.2 Summary of Key Findings

The research conducted presents compelling evidence that emphasizes the superior effectiveness of the SMAVLE as opposed to Seamed Learning methods in the context of English vocabulary learning among Chinese college students. These key findings elucidate the potential advantages of utilizing SMAVL and offer valuable insights into the evolving landscape of educational technology and mobile learning.

Firstly, the SMAVLE demonstrated significant efficiency in seamlessly integrating formal and informal learning experiences, essentially bridging the gap between classroom-based instruction and real-world language use. This proved advantageous over the Seamed learning, which often delineates a clear divide between formal learning within classrooms and informal learning outside of them. The SMAVLE enabled students to continuously engage with and apply their vocabulary learning experiences across different contexts, thus enhancing practical language use.

Secondly, SMAVLE offered an alternative learning environment that supports personalized and socially interactive learning experiences. Unlike Seamed learning, which typically follows a one-size-fits-all approach, SMAVLE accommodates diverse learning needs, styles, and paces, and encourages interactive learning experiences. The collaborative aspect of SMAVLE supports instant feedback and knowledge sharing, thereby enriching the learning process.

Thirdly, the SMAVLE enabled ubiquitous learning, allowing students to learn across different times, locations, and through a multitude of device types. This characteristic of seamless learning offers learners the flexibility to engage with their learning materials whenever and wherever they choose a feature less available in Seamed learning, which generally necessitates specific times and locations for learning to occur.

Several facilitating factors that enhanced the SMAVLE were identified. These included the enriching role of multimedia resources, the convenience and ubiquity of mobile devices, the ability to foster a self-regulated learning environment, and the promotion of digital literacy and technological skills. These factors contrast with Seamed learning, which often relies on traditional resources and is limited by location-specific and device-specific constraints.

However, this study also revealed challenges associated with SMAVLE, specifically mobile-related distractions and self-control issues. This underlines the need for strategic guidance and effective regulation in the implementation of SMAVLE to mitigate these challenges. Unlike Seamed learning, which often benefits from a more structured environment, SMAVLE requires learners to exhibit a greater degree of self-regulation.

In conclusion, these findings provide an in-depth understanding of the potential and challenges of implementing SMAVLE in comparison to Seamed learning for vocabulary acquisition among Chinese college students. While demonstrating the innovative benefits of SMAVLE in vocabulary learning, learner autonomy, and preparing students for lifelong learning in a digitally pervasive era, the study also highlights the need for mindful management of potential distractions and the cultivation of effective self-regulation skills.

6.3 Theoretical and Practical Implications

Theoretical Implications

Seamless Learning: This study substantiates the theoretical framework of seamless learning. It demonstrates how diverse learning contexts, such as in-class formal learning and outside-class informal learning, can be bridged. It highlights how personalized learning paths can be designed and how social learning interactions can be facilitated, thereby providing empirical evidence to the seamless learning concept in the context of mobile-assisted vocabulary learning.

MALL: The research offers insights into the potential of mobile devices as flexible learning tools. It extends the MALL theory by demonstrating how various digital devices can create a learning continuum, providing ubiquitous access to learning resources, and supporting a smooth transition between different learning tasks, contributing to effective vocabulary learning.

Dual Coding Theory: This study extends the application of the dual coding theory to the domain of SMAVLE. By demonstrating that images incorporated into sentence constructions enhance vocabulary retention, it provides empirical evidence supporting the theory's proposition of simultaneous verbal and visual information processing.

Practical Implications

For Educators: Teachers may use these findings to develop teaching strategies and lesson plans that incorporate SMAVL. They could also be made aware of the challenges like mobile-related distractions and self-control issues and plan their strategies accordingly. Curriculum developers could include mobile-assisted tasks in the syllabus, emphasizing a seamless learning environment.

For Learners: The study can help students understand the benefits and challenges of the SMAVLE. It emphasizes the importance of self-regulation in this learning environment and can encourage students to cultivate their digital literacy skills for effective learning.

For Policymakers: This research can inform policies related to integrating technology into language learning. Policymakers could focus on developing regulations that promote digital literacy, managing distractions in digital learning environments, and fostering self-regulation skills among learners.

For Future Researchers: This study offers a basis for further research into the effectiveness of SMAVLE across different contexts and its long-term impact. It also highlights areas of exploration like the development of strategies to enhance self-regulation and manage distractions within the SMAVLE.

6.4 Limitations of the Study

Implementation of SMAVLE: Despite the successful implementation of SMAVLE, the process was not without challenges. Technical glitches, internet connectivity issues, and unfamiliarity with mobile learning tools may have impacted the learning experience. Workload for Instructors: The SMAVLE approach increased the workload for instructors significantly. They were required to create multimedia resources, monitor learners' progress on multiple platforms, and provide feedback without the assistance of automated tools. This labor-intensive process might have constrained the effectiveness of the implementation.

Digital Divide: Although SMAVLE offers benefits such as convenience and flexibility, there were differences in students' access to and proficiency with digital devices and internet connectivity. This digital divide among students may have affected their engagement with and benefits from the SMAVLE.

Limited Long-term Assessment: The study was conducted over 12 weeks, which may not be sufficient to examine the long-term effects of SMAVL on vocabulary acquisition and retention. Future research could address these limitations, focusing on strategies to facilitate the smoother implementation of SMAVL, reduce the workload of instructors, bridge the digital divide among students, and examine the long-term effects of SMAVL. Automated feedback tools could be particularly beneficial in alleviating the burden on instructors while providing timely and helpful feedback to learners.

6.5 Recommendations for the Future Research

This study has underscored the potential of SMAVLE in vocabulary learning and the consequent improvement of pedagogical practices in language education. The implications derived from these findings reveal opportunities for future research, particularly in the following areas:

Firstly, the advancement of technology presents a significant opportunity to develop dedicated, learner-centric language learning applications. These applications, inculcating the principles of SMAVLE, can be designed with features aimed at enhancing seamless learning. They could offer personalized learning paths for students that adapt based on their progress, allowing each learner a unique and tailored experience. Social interaction features could be introduced to foster a community of learners who can learn from each other. Multimedia resource libraries could provide varied learning materials, catering to different learning styles. Importantly, automated feedback and correction mechanisms should be considered to provide immediate and contextual learning guidance to students. Finally, progress tracking tools could allow learners and teachers to monitor vocabulary acquisition in real-time, thereby facilitating timely intervention and support.

Secondly, future studies should leverage technological advances such as artificial intelligence (AI) and machine learning (ML) to simplify and streamline experimental processes. This could involve using AI and ML for more efficient data collection and processing, reducing manual intervention and minimizing errors. This approach would also allow for a more robust and comprehensive analysis of the gathered data.

Thirdly, while this study has made significant strides in understanding the immediate impacts of SMAVLE on vocabulary learning, it is crucial for future research to examine its long-term effects. This could involve longitudinal studies designed to monitor vocabulary retention over extended periods and provide insights into the long-lasting effectiveness of SMAVLE.

Fourthly, this study has highlighted the digital divide as a significant challenge in SMAVLE implementation. Future research should aim to address this challenge, exploring effective strategies to make digital language learning resources more accessible and equitable. This could involve researching low-cost technological solutions, government and institutional policies for technology access, and community initiatives to promote digital literacy.

Fifthly, the added workload on instructors in a SMAVLE has been identified as a significant challenge in this study. Future studies should explore solutions to optimize instructor involvement. This might involve the development of automated feedback tools that can provide immediate, personalized responses to learners, thereby reducing the instructor's manual correction load. Alternatively, implementing peer feedback mechanisms might also help reduce instructor workload while promoting collaborative learning.

Lastly, this study has focused on vocabulary learning. However, SMAVLE might also be effectively applied to other aspects of language learning, such as grammar, pronunciation, or listening skills. Future research could explore these potential applications, thus providing a more comprehensive view of the possibilities of SMAVLE in language education. As technology continues its rapid evolution, the opportunities to enrich language learning experiences are expanding. It is hoped that future research will continue exploring these opportunities, refining and enhancing SMAVLE for more effective and engaging language learning outcomes.