

Seamless Learning of Chinese as a Foreign Language: Enhancing Productive Vocabulary Growth and Lexical Richness in Writing

ABSTRACT

Second language learners frequently struggle with writing due to limited vocabulary knowledge and insufficient exposure to authentic language input. Thus, it is crucial to research and adopt a useful learning model that promotes productive vocabulary growth and lexical richness to improve learners' writing performance. This makes it essential to explore the seamless learning of Chinese as a foreign language (CFL), which has been shown to enhance language teaching and learning practices. The aim of this research is to investigate the usefulness of seamless Chinese vocabulary learning (SCVL) through a "sentence-paragraph-essay" artifact-making writing process to enhance CFL learners' vocabulary growth and lexical richness in writing. To achieve this goal, the theoretical concept of seamless learning, which emphasises continuous learning across different contexts, has been employed, along with a conceptual framework for Chinese vocabulary learning. A design-based research (DBR) methodological approach was adopted, which involved developing solutions to problems and testing interventions. The study was conducted using the social media platform DingTalk by delivering a seamless Chinese HSK Level 4 course through four DBR stages in a 16-week intervention. The study involved 32 international students from three universities in Chinese mainland, exhibiting different Chinese proficiency levels of "Low, Medium and High performance". The learners used their mobile devices to create artifacts using the target vocabulary, which were then uploaded to the DingTalk platform to showcase their vocabulary knowledge. In this research, a mixed methods approach was employed, whereby both quantitative and qualitative data were obtained. For the quantitative data, questionnaires were administered to 32 CFL learners, and 2,301 created artifacts from the same 32 learners across the four stages were obtained. Qualitative data were collected through interviews, learners' feedback, and open-ended questionnaires. The quantitative data were subsequently analysed using one-sample t-test, two-way ANOVA, and post-hoc tests, while thematic analysis was used to analyse the qualitative data. The quantitative findings indicated a significant increase in the adoption of SCVL over time to improve productive vocabulary growth in terms of Type-Token Ratio and Lexical Frequency Profile. Moreover, the adoption of SCVL resulted in a noticeable improvement in the lexical richness of Chinese writing, as evidenced by an increase in lexical diversity and sophistication, and a decrease in lexical errors. Learners had positive experiences and perceptions of SCVL and believed that it improved their Chinese writing. Meanwhile, the qualitative findings of this study found that despite initial skepticism and unfamiliarity, learners found the

experience of using SCVL to be valuable and rewarding. The DingTalk platform was found to be particularly helpful and was positively perceived by the learners. Overall, the study provides valuable insights into the potential benefits of SCVL for improving vocabulary and writing performance among CFL learners. This research contributes significantly to the field of language learning and teaching by advancing a model of “Seamless Chinese Vocabulary Learning in Promoting Vocabulary Growth and Lexical Richness in Writing”..

Keywords: Seamless learning; Chinese as a foreign language (CFL); Vocabulary Growth; Lexical Richness; Writing; design-based research (DBR).

1. INTRODUCTION

1.1 Background of Study

Educational technology applications have dramatically influenced the ecology of learning and teaching in educational settings, as evidenced by the global pandemic (e.g., COVID-19) (Yin, 2022). The COVID-19 pandemic brought extraordinary disruption to education institutions both locally and globally (Godber, 2021; Yin, 2022). Education in Chinese Mainland was also affected by the COVID-19 pandemic. All levels of educational institutions under the Chinese Ministry of Education experienced negative impacts, where learners were ‘forced’ to learn from home since face-to-face learning was removed to prevent COVID-19 transmission. Under these conditions, educators and learners, researchers and university educators were compelled to adopt “Emergency Education” (Godber, 2021; Yin, 2022), which led to challenges in transitioning from traditional face-to-face educational pedagogical approaches to remote virtual platforms.

As asserted by some scholars (Chen & Xiao, 2022; Iwamoto & Chun, 2020; Yan, 2021), many higher education institutions in Chinese Mainland relied on traditional platforms (e.g., ChaoXing; MOOC) to conduct online learning activities in a formal learning setting. On one hand, such traditional methods are still used at the state level to guide learners throughout the whole learning process, as evidenced by a number of studies focusing on institutionally monitored formal online learning (e.g., Huang et al., 2020; Sobaih et al., 2020; Zafitsara et al., 2022). Yet, on the other hand, during COVID-19, a variety of teaching and learning modes, such as blended learning, hybrid learning, and seamless learning via technological devices, were implemented (e.g., Ali, 2020; Masita 2020; Zafitsara et al., 2022).

For educators and researchers, these TEL modes have the potential to dramatically improve language teaching (e.g., Kayalar, 2022; Luluk, 2021). However, for learners, to what extent do these technology-enhanced learning modes enhance their learning performances and outcomes? Also, do the diversified learning methods and learning environments provided by information technology offer new learning experiences, perceptions, and even challenges? With such questions in mind, higher educational institutions nowadays have begun to experiment with the employment of these new technology-enhanced learning modes, which can be of value from the psychological, pedagogical, and technical perspectives.

Many studies in the field of technology-enhanced language learning have focused on the comparison between traditional classroom-based learning and online learning (Gon & Rawekar, 2017; Ubaedillah & Pratiwi, 2021), and have examined specific experiences within blended learning programs that combine both approaches (Alowedi, 2020; Armellini et al., 2021). Additionally, some research have also explored the use of technology in both formal and informal language learning settings (Godber & Atkins, 2021;

Ramalingam et al., 2021; Zhou et al., 2022). Integration appears to be challenging, possibly due to the relatively short time and resource requirements of conducting research on multiple learning contexts in a single study. Again, many scholars (e.g., Kayalar, 2022; Luluk, 2021; Xiao et al., 2021; Yan, 2021) have suggested that learning cannot focus solely on one aspect of an educational form, whether formal or informal; rather, it is critical to integrate both forms in a synergistic relationship. Hence, a challenging problem that arises in this domain is how to integrate the potential connection between formal and informal settings for both educators and learners (e.g., Luluk, 2021; Wu & Zhao, 2021; Xiao et al., 2021). Furthermore, many scholars argue that technology should not be the focus of the process of using technology to assist teaching (e.g., Chan et al., 2006; Xiao et al., 2021; Wong & Looi, 2019). No matter how technology changes, the core of education is the learners (e.g., Kayalar, 2022; Xiao et al., 2021; Wong & Looi, 2019). In the context of the digital age, investigating and subsequently improving learners' language learning performance and outcomes are important issues to address. Hence, there is a pressing need to try a specific approach to seek improvements to the current issues mentioned above.

Due to this, the concept of seamless learning, which celebrates the idea of allowing learners to learn whenever they are triggered to learn without having any boundary, has emerged and has continued to develop (Abdullah & Hashim, 2021; Xiao et al., 2021; Zhou et al., 2022). The phenomenal rate of technological advancement in education has greatly aided the concept of continuous and seamless learning, where learners can learn anywhere and at any time (Foomani & Hedayati, 2016). Therefore, when future crises occurs (e.g., COVID-19 pandemic), seamless learning may offer profound opportunities in this context. The seamless learning model allows learners to integrate their learning experiences from various sources and in different settings, encompassing both in-school and out-of-school contexts, individual and social learning, and the physical world and online space (e.g., Abdullah & Hashim, 2021; Kayalar, 2022; Luluk, 2021; Xiao et al., 2021). Hence, this research was carried out in the context of seamless learning.

1.2 The Need of Seamless Learning in CFL

Evidence pertaining to successful language learning as a pivotal role in quality communication and clear self-expression in a routine standard of living has been made apparent in past studies, both in the professional arena and personal domain (e.g., Wong et al., 2016; Wu & Zhao, 2021). However, this facet is difficult to ascertain in the context of foreign language or second language (L2) learning owing to the role of teacher-centric delivery as the dominant form of pedagogy (Liu, 2019; Wong et al., 2016; Xiao et al., 2021). Hence, certain universities in Chinese Mainland have implemented the practice of learners being educated in a formal class for 45 minutes in tandem with another 45-minute class for informal Chinese learning. The rationale behind this bold decision highlights the necessity for learners to engage in learning activities based on the principle of “learning for practice” or “learning by using” (“学中用” “用中学”) (Li, 2019; Wong et al., 2016).

In a way, the teacher-centric method is deemed an efficient method of delivering a new lesson (e.g., Cui, 2003; Lu, 2012), especially in a formal setting with limited contact hours. In a class that lasts for 45 minutes, learners typically engage in a 90-minute in formal Chinese class in Chinese Mainland. However, prominent academicians argue that teacher-centric delivery fails to last for a long class hour, thereby forcing learners to learn passively; this also hinders the ability of learners to translate the acquired knowledge from the formal classroom sessions to real-life scenarios (Liu, 2019; Wong et al., 2016; Xiao et al., 2021).

Seamless learning, on the other hand, offers a transformative approach to education. It is defined as a learning model rooted in mobile technology, serving as a bridge between traditional classroom learning and informal learning (e.g., Abdullah & Hashim, 2021; Kukulska-Hulme, 2015). Moreover, it ensures a continuous and fluid learning experience, unrestricted by time or place (Abdullah & Hashim, 2021; Kukulska-Hulme, 2015; Wong et al., 2016; Wu & Zhao, 2021). By applying the principle of seamless learning to CFL learning, seamless CFL learning aims to integrate contextualisation, authenticity, socialisation, and learner autonomy (or self-directed learning), which contemporary language learning theorists have claimed to be essential ingredients for successful language learning (e.g., Harmer 2001; Swain & Lapkin 2000; Tedick & Walker 2009). Research has shown that language learning should be situated in authentic and social contexts (i.e., informal learning settings) to make learning meaningful and therefore facilitate the development of linguistic skills for authentic communicative needs (e.g., Kayalar, 2022; Wong et al., 2021).

Social media offers opportunities for language educators to create successful learning environments and the prominent advancement of technology in the educational sector has substantially aided the continuity of the learning experience across diverse environments (Abdullah & Hashim, 2021). Due to this, seamless CFL learning recognises the concept of enabling learners to assimilate knowledge when the stimulus to learn is triggered without any restrictive boundaries (Abdullah & Hashim, 2021). Thus, it becomes plausible to apply the concept of seamless learning and social media platform “DingTalk” to

Chinese language learning. Accordingly, the fundamental functions to align the idea of seamless learning are demonstrated below (Table 1).

DingTalk, a social media platform that operates on Android, iPhone, Mac, and Windows operating systems, is a techno-pedagogical model that actively links formal language learning in the classroom with language application and reflection processes in learners' daily lives and involves learners in the continuous creation of social media as an online platform (Yan, 2021; Zhang, 2021). Presently, it has been updated to version 6.0.30 with the addition of a multi-terminal free communication platform. DingTalk is an ideal social media platform for seamless learning in this research, owing to its high compatibility with the concept of seamless learning. Furthermore, the modern generation of youngsters resides in a dynamic world where the concept of physical space and digital space intersects and the novelty of network technology has been ingrained into their lives (Kayalar, 2022; Wu & Zhao, 2021). Equipped with their current devices which guarantees ready-to-hand access (Wong & Looi, 2011; Zhang, 2021) to an abundance of information sources, the untapped potential for the evolution of a new trend in technology enhanced learning is limitless. Hence, the implementation of seamless learning in supporting Chinese language learning and vocabulary learning has garnered immense support and feasibility.

Table1. The Learning Tools of DingTalk Platform

Tools	Functions	Ideas of Seamless Learning
 (Group)	• Supports sharing videos, pictures (including emojis), text, and files (Word, Excel, PowerPoint PDF or Zip, etc.) • Enables group chat. • Allows hosting video conferences and live broadcasts. • Authorises public announcements. • Includes the ability to set up a DING reminder and assign homework.	• Learn anytime, anywhere. • Assess the consistency of learning progress. • Uncover the integration between formal and informal learning. • Reflect the correlation between the input and output of language elements.
 (Message)	• Chatting includes instant text, voice call, and video call.	• Demonstrate the suitability of learning records.
 (Ding Drive)	• Serves as an individualised and group repository for learners to store and edit new words that they have just learnt.	• Seamlessly and rapidly switch between multiple learning tasks.
 (Learning circle)	• Learners can choose their personal preference, post their own photos and sentences online and communicate with each other in Chinese. Any member of the Learning Circle can comment, like, etc.	• Facilitate the interaction between learning partners, learners, and educators.



(Homework)

- A tool for learners to submit their homework and collect their learning outcomes.



(Ranking)

- A program for educators to record learners' artifacts resulting in diverse outcomes. This includes weekly ranking, monthly rankly, and final ranking in total.

1.3 Importance of Vocabulary in Learning Chinese

The learning of vocabulary has been acknowledged as playing a fundamental role in language learning (e.g., Hasnine et al., 2020; Liu, 2019; Ren, 2000). Nation (2001) provided a comprehensive definition of vocabulary and stated that “receptive vocabulary” and “productive vocabulary” were widely used in L2 learning (Laufer, 1998), with the former referring to words that learners could recognise and understand when they appeared in context, and the latter referring to words that learners could reproduce and use appropriately. As per the various publications of the corpus, the academic community segregates productive words into spoken and written words (Cao & Tian, 2020; Zhang, 2019; Zhang et al., 2021). The learning of a word usually goes through a process that progresses from receptive knowledge to productive knowledge, and a learner's lexical knowledge forms a continuum from knowledge of receptive vocabulary to knowledge of productive vocabulary (Wang, S. & Wang, H. Z., 2021; Zhang, 2019). As previously mentioned, successfully acquire a language plays a pivotal role in the quality of communication and in clear self-expression in daily life. Not only that, it is an accepted fact that the two dimensions that indicate this are speech and writing (Cao & Tian, 2020). CFL learners primarily learn Chinese vocabulary for verbal and written communication (Lu, 2020; Xu, 2017). Although CFL learners are often placed in a target language environment to provide them greater opportunities for speaking the language, they face immense challenges in writing in Chinese; hence, this research was conducted with a focus on the written aspect of learning the Chinese language, since writing is a significant factor in determining a learner's Chinese language competence, proficiency level, and ability to express ideas (Ren, 2011; Xu, 2017). To achieve this, this research focuses on productive vocabulary, which refers to the vocabulary that learners use to accurately write in a language.

When it comes to learning vocabulary, a fundamental prerequisite is to develop a set of professional and authoritative vocabulary syllabi that would channel the process of language learning (Chen, 2017; Liu, 2019). To assist international students in learning Chinese vocabulary, China developed the Syllabus of Chinese Vocabulary and Chinese Characters (汉语水平词汇与汉字等级大纲) in 1991, while “The Graded Chinese Syllables, Characters and Words for the Application of Teaching Chinese to the Speakers of Other Languages” (汉语国际教育用音节汉字词汇等级划分) was a national standard that was launched in 2010. The “National Graded Vocabulary List” (2010) was used for the purpose of this research to focus only on certain aspects of vocabulary. Additionally, an international standardised test, known as the Chinese Proficiency Test (HSK or Hanyu Shuiping Kaoshi), was launched by the Chinese Ministry of Education to assess non-native Chinese speakers' abilities in using the Chinese language. The HSK 1.0 Word List was officially launched in 1996, while the HSK 2.0 Word List was introduced in 2010. In 2021, it was updated to the HSK 3.0 Word List. The HSK 3.0 Word List was partially implemented on July 1, 2021, with the aim to gradually provide an overall guidance for the HSK examination for the coming years. In the

current transition period, the HSK 2.0 Word List continues to serve its role as the vocabulary syllabus for the global six levels of the Chinese Proficiency Examination (Table 2).

Table 2. The Vocabulary Size of Different New HSK Level

Six Levels of HSK 2.0 Word List	Vocabulary Size
HSK (Level 6)	Over 5,000
HSK (Level 5)	2500
HSK (Level 4)	1200
HSK (Level 3)	600
HSK (Level 2)	300
HSK (Level 1)	150

The effort taken by the Chinese government to develop the HSK vocabulary lists reflects the significance of the necessity to master Chinese vocabulary, particularly in the field of teaching and learning CFL. Thus, this research placed great emphasis on enhancing the process of learning Chinese vocabulary for international students by utilising the SCVL approach. The aim was to optimise the learning process and aid international students in comprehending and communicating successfully in written Chinese.

Since the 1980s, vocabulary research on L2 writing has attracted the attention of experts and scholars in China as well as abroad in areas such as vocabulary growth, vocabulary breadth and depth, lexical richness, lexical access, and others (e.g., Laufer & Nation, 1995; Liu, 2019; Read, 2000; Wu, 2016; Zhang et al., 2021). Furthermore, vocabulary growth proved to be a strong predictor of success in reading and writing in general language proficiency as well as academic achievement (e.g., Laufer & Nation, 1995; Laufer & Goldstein, 2004; Wu, 2016). Likewise, lexical richness is a strong evidence-based indicator of written language skills. Both vocabulary growth and lexical richness were tailor-made for research such as this project on written Chinese vocabulary. Consequently, this research aims to advance vocabulary growth and lexical richness in writing as reflected in learners' social media learning outcomes on the seamless online learning platform DingTalk.

1.3 Objective

The primary purpose of this research is to advance a model of “Seamless Chinese Vocabulary Learning in Promoting Vocabulary Growth and Lexical Richness in Writing”. Following the process of model advancement, this study will also assess the utility of seamless Chinese vocabulary learning (SCVL) in enhancing CFL learners' vocabulary growth and lexical richness in writing. Hence, this research study will address the following three objectives.

RO 1: To examine the extent of SCVL in enhancing productive vocabulary growth of Chinese writing.

RO 1a: To investigate whether seamless learning activities are able to enhance the number of vocabulary used for sentence/ paragraph/ essay artifact-making.

RO 1b: To examine the HSK Level 4 vocabulary distribution in essay artifacts across the four learning stages.

RO 2: To investigate the extent of SCVL in enhancing the lexical richness of Chinese writing.

RO 2a: To discover the variety of lexical diversity of learner sentence/ paragraph/ essay artifacts produced across the four learning stages.

RO 2b: To indicate the variations in the lexical sophistication of essay artifacts across the four learning stages.

RO 2c: To identify variances in lexical errors of essay artifacts across the four learning stages.

RO 3: To explore learners' experiences, perceptions, and improvements in vocabulary learning through the utilisation of SCVL.

RO 3a: To investigate learners' experiences in the utilisation of SCVL.

RO 3b: To discover learners' perceptions of the DingTalk platform use in an SCVL environment.

RO 3c: To verify the effectiveness of the SCVL framework in enhancing vocabulary learning in Chinese writing.

1.4 Research Question

In its endeavor to address the aforementioned objectives, this research study aims to address the following research questions.

RQ 1: To what extent is SCVL able to enhance productive vocabulary growth of Chinese writing?

RQ 1a: Do seamless learning activities enhance the number of vocabulary used for sentence/ paragraph/ essay artifact-making?

RQ 1b: How does the HSK Level 4 vocabulary distribution in essay artifacts vary across the four learning stages?

RQ 2: To what extent does SCVL enhance lexical richness of Chinese writing?

RQ 2a: How does lexical diversity in sentence/ paragraph/ essay artifacts produced vary across the four learning stages?

RQ 2b: How does the lexical sophistication of essay artifacts vary across the four learning stages?

RQ 2c: How do lexical errors in essay artifacts produced vary across the four learning stages?

RQ 3: What are learners' experiences, perceptions, and improvements in vocabulary learning through the utilisation of SCVL?

RQ 3a: What are learners' experiences in the utilisation of SCVL?

RQ 3b: What are learners' perceptions of the DingTalk platform use in an SCVL environment?

RQ 3c: To what extent do learners perceive that SCVL has improved their vocabulary learning of Chinese writing?

1.5 Research Hypothesis

A research hypothesis is a statement created by researchers when they speculate upon the outcome of a research or experiment (e.g., Brondolo, 2021; Jain, 2020; Scantlebury et al., 2020). The hypothesis is generated via a number of means but is usually the result of a process of inductive reasoning where observations lead to the formation of a theory (Mourougan & Sethuraman, 2017). As stated by Mourougan and Sethuraman (2017), research usually starts with a problem. Questions, objectives, and hypotheses provide a specific restatement and clarification of the problem statement/research question (Mourougan & Sethuraman, 2017). Thus, regarding the above-mentioned research objectives and questions, the present research proposes the following twelve research hypotheses. To align the hypotheses with the research questions, Table 1.3 shows the hypotheses in this research.

Table 3. Research Hypotheses

H1	Seamless learning activities significantly enhance the number of vocabulary used for sentence artifact-making across the four learning stages.
H2	Seamless learning activities significantly enhance the number of vocabulary used for paragraph artifact-making across the four learning stages
H3	Seamless learning activities significantly enhance the number of vocabulary used for essay artifact-making across the four learning stages.
H4	There is a statistically significant difference in vocabulary distribution of essay artifacts across the four learning stages.
H5	The diversity of vocabulary use in sentence artifacts produced significantly increase across the four learning stages.
H6	The diversity of vocabulary use in paragraph artifacts produced significantly increase across the four learning stages.
H7	The diversity of vocabulary use in essay artifacts produced significantly increase across the four learning stages.

H8	The rates of advanced words use significantly increase across the four learning stages.
H9	The rates of lexical errors in Chinese writing significantly decrease across the four learning stages.
H10	The learners' experiences with the SCVL are favourable.
H11	The learners' perceptions of the DingTalk platform use in an SCVL environment are positive.
H12	The learners perceive that SCVL significantly improve their vocabulary learning of Chinese writing.

In terms of hypotheses testing, they will be discussed in the subsequent chapters.

1.6 Population of the Study

The target population for this study comprised 32CFL learners from three universities in Chinese mainland, exhibiting different Chinese proficiency levels of “Low, Medium and High performance”.

2. METHODOLOGY

This chapter delineates the methodology of the research and provides an overview of the research design. This research makes use of a mixed methods research design to answer the research questions. The research sampling, data collection, and the data analysis processes are described. This is followed by a discussion of the research study’s validity, reliability, trustworthiness, and ethical considerations. Finally, a short summary of the research methodology closes the chapter.

2.1 Research Design

Different methods have been proposed to classify L2 learners’ seamless vocabulary learning. According to the recent work of Song and Hwang (2020), mixed research designs were found to be the dominant adopted approach to measure seamless L2 vocabulary learning. Based on this, this research design integrated both quantitative and qualitative methods to investigate CFL learners’ productive vocabulary growth and the lexical richness of Chinese writing in a mixed-method research design.

The rationale for primarily using mixed methods was to enhance and supplement the quantitative findings with qualitative insights, however, the qualitative method also served to check, explain, and assist with the quantitative results. In other words, using mixed methods allowed the researcher to combine the quantitative and qualitative research techniques, methods, approaches, and concepts into a single research project (Cresswell & Plano Clark, 2018; Yin, 2006). As a methodology, it allows the use of multiple philosophical approaches to answer the research questions rather than restrict the researchers’ options (Cresswell & Plano Clark, 2018; Johnson et al., 2007). It is a method in which the investigator collects both quantitative and qualitative data, according to Creswell and Plano Clark (2018), Creswell (2015), Yin (2006), and Johnson and Onwuegbuzie (2004). The two datasets were analysed and discussed, with the results based on the complementary strengths of both qualitative and quantitative data to better answer the research questions. This would not have been possible if only quantitative or qualitative data were collected. According to Bryman (2012), it is advantageous to use different methods of data collection to compensate for any perceived weaknesses in the research process. As asserted by Johnson and Onwuegbuzie (2004), “If you visualise a continuum with qualitative studies anchored at one pole and quantitative research anchored at the other, mixed methods research covers the large set of points in the middle area,” (p. 15). The combination of quantitative and qualitative methods is academically acceptable and desirable, giving “greater prominence to the strengths of the data collection and data analysis techniques with which qualitative and quantitative research are each associated” (Bryman & Bell, 2015, p. 644).

Moreover, the data collected via mixed methods is well suited to deal with a relatively small number of respondents within a limited period of time and also catered to the cost-funding restrictions of this research project. With that in mind, it is essential to note the logistical considerations in the preparation and planning of this research. Saunders et al. (2012) postulated that the veracity of data and findings,

the repeatability of the methods of investigation, as well as the positive academic critique of the findings are impacted by the time and duration of the research, finance and other resources, need for compliance with established ethical standards, as well as the choice of appropriate techniques for data collection and analysis. This requires clarity in the design of the project, especially in the context of this research where access to learners is limited by distance and the COVID-19 restriction policy of China. Thus, even though the researcher was based in Malaysia and the subject learners were based in Chinese Mainland, the researcher was able to partake in an online doctoral course in China in the first three semesters, and after gaining ethics approval from Universiti Teknologi MARA, the research was conducted in Chinese Mainland. Thereafter, an SCVL research study was conducted in Chinese Mainland in 2022, with 32 CFL learners involved to investigate and explore their vocabulary growth and lexical richness in writing. However, as evidenced by Chen et al. (2017) and Wong et al. (2016), merely employing quantitative methods would have compromised the research by such limitations. The results gained would also be of an academically challengeable value, particularly in the face of the number of variables such as inherent motivation and attitude to learning of a diverse learner body (Cresswell & Plano Clark, 2018; Johnson et al., 2007). In view of this, qualitative elements were added to the research.

It is worth noting that the researcher was a part-time university lecturer employed by a third party but has no financial, emotional, or cultural interest in the social media platform or its manufacturer and developer. In this research, the use of DingTalk as a seamless learning platform was intended to promote Chinese vocabulary learning and artifact-making (sentence, paragraph, and essay artifacts) of writing, which were created by learners using the target vocabulary. In choosing mixed methods approaches, the pragmatic perspective was able to balance the limitations of other approaches. Furthermore, the researcher was able to reflect on the planning and assessment of the results in this approach and eliminated personal choices and influence (Johnson & Onwuegbuzie, 2004, p. 19). Taking advantage of the potential of integrating and complementing the two approaches was considered very important (Sandelowski, et al., 2012).

Besides that, the research objectives and questions presented in Chapter 1 show that the quantitative component of the research was prioritised and that it employed an embedded design. As stated by Creswell and Plano Clark (2018), in an embedded design, the researcher may add a qualitative component to a quantitative research design (e.g., experiment design) or a quantitative component to a qualitative research design (e.g., thematic analysis). Researchers incorporate these supplementary components into the embedded design to enhance the overall design to a certain extent (Creswell & Plano Clark, 2018). Nonetheless, the current research proposed a quantitatively led mixed methods research design to achieve the goal of increasing CFL learners' productive vocabulary growth and lexical richness of Chinese writing. This is in accordance with the enhancement/ complementary goal described above, where the qualitative data (e.g., interviews, comments) were thus used to not only clarify and support the quantitative findings, but to add a new perspective to the present research by giving room to the learners' emic views on SCVL in writing. Figure 1 below shows the mixed methods research design for this research.

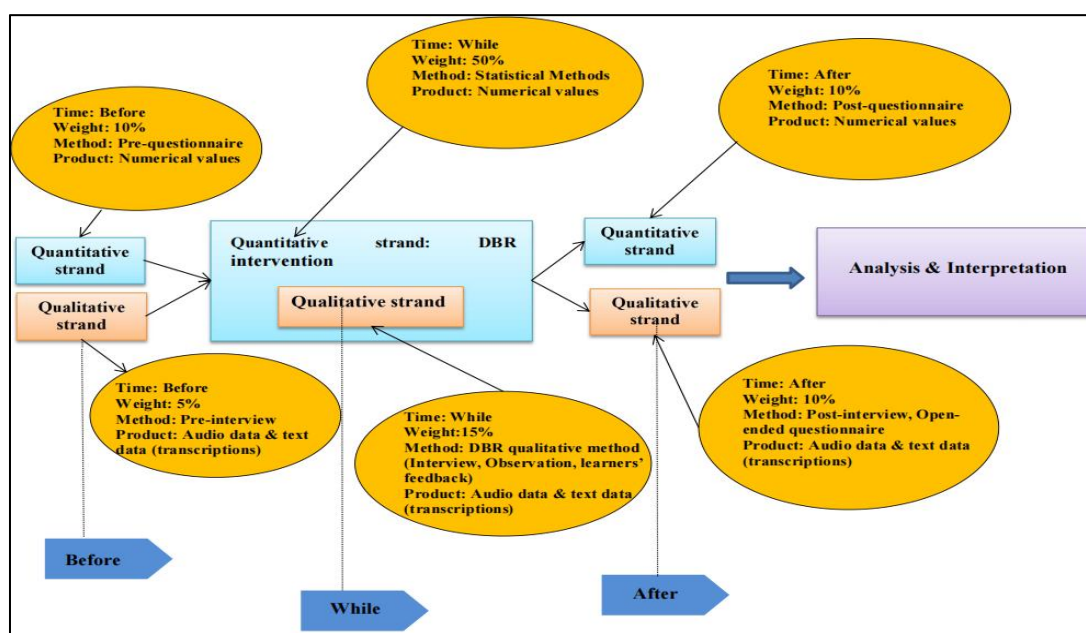


Figure 1. Mixed Methods Research Design Procedure

In this embedded design, quantitative methods took precedence and were employed to analyse the questionnaires and the numerical values associated with all artifacts created by learners throughout the four DBR stages. The DBR approach spanned a 16-week intervention, with each four-week interval comprising a stage, and each week within that stage constituting a mini-cycle. During each weekly mini-cycle, learners focused on creating sentence artifacts, with the opportunity to produce a paragraph artifact every two weeks. Upon completing a four-week stage, learners were tasked with generating an essay artifact. This same process was repeated across all four stages, making up 70% of the overall mixed-methods research design. Following that, interviews, learners' feedback, and other qualitative research methods (30%) were used to better answer the research questions based on the complementary strengths of both quantitative and qualitative data in this research. Furthermore, the collection of data using quantitative and qualitative instruments along four intervention stages, before, during, and, after the SCVL study increased the overall validity of the research. Also, this research employed multiple data sources to draw on both the strengths of quantitative and qualitative research and minimise the weaknesses by using only one approach (Creswell, 2007; Creswell & Clark, 2011). This enabled the triangulation of data and the comparison of several datasets to avoid any potential biases (e.g., Creswell & Clark, 2011, 2018; Johnson & Onwuegbuzie, 2004; Yin, 2006). Triangulation was necessary to increase the internal and external validity and reliability within the research, as well as to gain a more multi-dimensional perspective (e.g., Moon, 2019; Natow, 2020; Steils & Hanine, 2022). This research was therefore able to take a holistic and comprehensive approach to the research topic.

2.2 Samples

In this research, 32 CFL learners were selected using purposive sampling technique. Purposive sampling is a non-random sampling technique that does not require underlying theories or a specific amount of respondents. Simply put, the researcher determines what needs to be highlighted and then seeks out people who can and are willing to provide the information through knowledge or experience (Archibald et al., 2015; Odendaal et al., 2016; Saunders, 2010). To determine the cause, this research study on SCVL was conducted at a university as a class-based study, and the learners had a relatively high demand for CFL learning. Thus, it was easy to access the data that this research required from

them. Hence, the first consideration was not to study the entire population of Chinese Mainland. Furthermore, due to time and financial constraints as well as accessibility for this research project, the option of purposive sampling was selected (e.g., certain areas may be restricted or difficult to sample due to the COVID-19 pandemic). Moreover, as many scholars have stated, the purposeful selection of samples was important in mixed methods research (e.g., Archibald et al., 2015; Dawadi et al., 2021; Tongco, 2007), particularly to aid in the implementation of the qualitative study. In other words, purposive sampling was used to assist the researcher in gathering qualitative responses, resulting in better insights and more precise research results.

Therefore, purposive sampling method was applied to select the participating learners in this research. The steps in purposive sampling (Tongco, 2007) are shown below.

Step 1: Decide on the research questions.

Step 2: Determine the type of respondents needed.

Step 3: Determine the principle of sampling.

Step 3. Define the criterion for sampling.

Step 4. Find respondents based on the defined criterion.

Step 5. Keep in mind the importance of reliability and competency in assessing potential respondents (Tongco, 2007).

Next, the principle and criterion for sampling are presented in the following sections.

2.3 Principle of Sampling

As discussed above, the research questions were proposed in Chapter 1. According to the research objectives and scope, CFL learners were determined to participate in this research. Thus, in terms of the principle of sampling, as this research employs a purposive sampling method to recruit the CFL learners, sample selection followed the researcher's or instructor's practical criteria, such as geographical proximity, the CFL learners' accessibility, and the participation and reflection required in a research study (e.g., Creswell, 2015; Dawadi et al., 2021; Ge et al., 2021; Tongco, 2007). Hence, the researcher's geographical proximity and CFL learners' easy accessibility, practicality and achievability of the research were the principles applied to all the available CFL learners of the universities and colleges in Chinese Mainland.

Based on the researcher's geographical proximity and CFL learners' easy accessibility, to access the samples successfully, locations near the researcher's hometown and workplace were selected where potential learners pursuing their degree education were currently studying the Chinese language. According to the data from 'Studying in China' of Chinese Service Centre for Scholarly Exchange (CSCSE), 2022, cities of Nanjing, Wuhan and Xi'an with 42 universities and colleges were selected (refer to Appendix A). Next, the researcher officially contacted the universities and colleges which offered CFL courses through an email which announced the research purpose and criterion to recruit the potential CFL learners of HSK Level 4 for the research. Formal emails were sent to the 42 targeted universities and colleges. Although there were some rejected replies, the rejected reasons were

reasonable and acceptable. For instance, “*Due to the COVID-19 pandemic, the number of international students has greatly decreased* (Translated from one university)”. Examples of three representative emails that had rejected the invitation can be tracked in Appendix B. Only three universities were purposively selected as the research sites as there were also other screening criteria for the purposive sampling in this research. To identify its cause, the emergence of evidence pertaining to the seamless learning of CFL is seen as a forward-looking and complex learning model (Chan et al., 2006; Wong & Looi, 2010a; Wong & Looi, 2010b; Wong et al., 2016). Many scholars believe that even for short-term instructional design, seamless Chinese learning needs a higher institution that has the foresight and wholehearted belief in the implementation of seamless learning (Jin, 2014; Xiao et al., 2021; Wong & Looi, 2011). Moreover, the institution should provide various resources in making seamless learning a success (Wong & Looi, 2011).

Subsequently, according to the principle of practicality of the research, three universities and colleges were further reviewed. As informed by the principle of DBR, there was no need to have a large group. Due to the participatory principle, there is an emphasis on “learner-centredness” (Henderson et al., 2022, p: 247) in the learning sciences (e.g., Barab, 2014; Becker, 2019; Henderson et al., 2022). To facilitate teaching management and in-depth teaching, 14-30 learners were considered very suitable for one DBR stage (Henderson et al., 2022; Ke & Li, 2008; Wong et al., 2016). In addition, Becker (2019) believed that DBR mainly focuses on improving educational practices through iterative analysis, design, development, and implementation, therefore, there was no need for the sample size to be large as a big group may not be practical.

Furthermore, in line with the principle of achievability of the research, according to the research objectives, the samples should be able to do writing tasks in Chinese language. They also should have the ability to make comments or engage in discussions on social media platforms and pass HSK Level 3 based on the criterion for sampling (refer to Section 3.3.2). Hence, suitable and limited samples joined the research.

Therefore, according to above principles, the three Chinese higher institutions which are HB university located in Central China, NC university from Eastern China, and XA University from Western China were selected to recruit the potential CFL learners. According to DataMart (Data source: School of International Education of 3 Universities, 2021) information for 2019/2020 gathered from the internal systems of the three universities, the distribution of the learners according to gender is shown in Table 4.

Table 4 The Distribution of the Learners According to Gender in School of International Education of Three Universities, 2021

Universities	Number of Male Learners	Number of Female Learners	In Total
NC University	44	96	140
HB University	35	78	113
XA University	25	56	81
In Total	104	230	334

Next, ethical clearance was obtained from Universiti Teknologi MARA and a letter seeking approval was sent by the labour dispatch company A (where the researcher was employed) to the three universities and colleges.

After receiving approval from the three CFL school deans, three intermediate-level groups were sent to participate in this research. Following the guidelines for ethics approval from Universiti Teknologi MARA, these learners, under the online learning mode, formed an intact group of 32 international students under the instruction of the researcher. Furthermore, it is worth noting that the arrangement for an intact group of 32 international students was made due to insufficient manpower for the analysis of online data.

Next, according to the school lecture's recommendation, two learners who have high, medium, and low performance in the Chinese course were selected. Thus, six target learners were selected to be interviewed one-on-one before and after the teaching intervention to gain a deeper understanding of their life background, language habits, SCVL process, etc. Notably, purposive sampling was employed to select the learners to gather the qualitative data to support the DBR approach during the research.

2.4 Criterion for Sampling

In this research, to define the criterion for sampling, the main criteria for guiding the recruitment of the CFL learners are listed below.

- (1) CFL learners are able to answer the questionnaire and interview questions in English or in Mandarin.
- (2) They are international students in degree education, not visiting learners or short-term Chinese language learners.
- (3) They have achieved HSK Level 3 but have not yet passed HSK Level 4.
- (4) They are willing and available to complete the whole research process, participate and complete all the seamless learning activities in Chinese language.
- (5) They have the ability to make comments or engage in discussions on social media platforms and perform related writing tasks in the Chinese language.

Other criteria include a good rapport between the researcher and the CFL learners, the availability of time, and adaptability to the environment where the interview and Chinese writing were conducted. Other considerations include:

Language requirement: Language use was restricted to English and Chinese language, which are the languages the researcher was familiar with. Communicating in a language that the CFL learners were

most proficient in could help to clarify their doubts and answer queries that arose during the questionnaire survey, interviews and discussion sessions. It also helped to increase the interaction between the researcher and CFL learners and reduce unnecessary communication breakdowns. However, Chinese was the primary language used by the researcher-interviewer during this research study. The interviews that were in Chinese were transcribed first and later translated into English.

CFL proficiency requirement: The HSK Level 3 minimum CFL proficiency requirement was to prepare the CFL learners to join in the learning of HSK Level 4 learning contents which were the selected learning materials for this research. Otherwise, it would have been more difficult for them to create artifacts, comment and write essays.

Mobile devices: The overarching learning principle of DingTalk was seamless learning; a learning mode where a learner experiences continuity of learning across a combination of locations, times, technologies or social settings. Under this approach, they were allowed to carry mobile devices on a 1:1 (one-device-per-learner), 24/7 basis to stimulate and support their language learning both within and beyond the classrooms. They were also given personal DingTalk accounts to carry out the SCVL activities. Next, the CFL learners' background with different Chinese proficiency levels are presented.

2.5 Research Instruments

The instruments of the research consisted of (i) record board, (ii) questionnaire, (iii) interview, and (iv) information box which are explained below.

2.5.1 Record Board

Quantitative methods took precedence in this research, emphasising the analysis of numerical values from all artifacts created by CFL learners across the four DBR stages. To answer both RQ1 and RQ2, the Record Board functions (as illustrated in Plate 1) within the DingTalk platform was utilised. The purpose of employing this function is to collect the artifacts created by learners. These artifacts encompassed sentences, paragraphs, and essays created by a total of 32 CFL learners. These collected artifacts serve as essential resources for evaluating the learners' improvement and application of the target vocabulary within the SCVL environment.

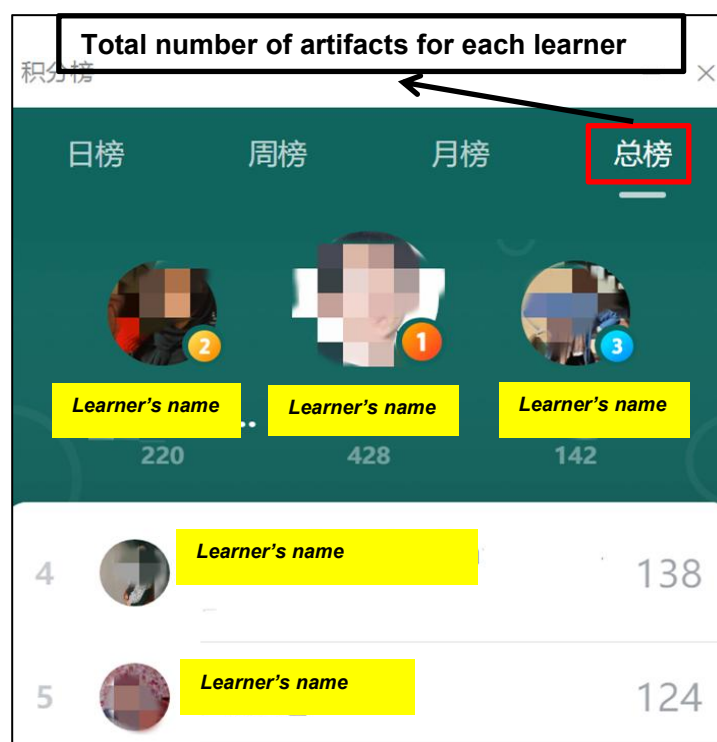


Plate 1 Record Board Screenshot: Number of Artifacts for the Top Five Learners

It is important to note that each learner owned a personal mobile device on a 1:1 (one-device-per-learner) basis, available to them 24/7. This provision aimed to stimulate and support their language learning endeavors, both within and outside the classroom. These personal mobile devices were equipped with essential features, including a built-in camera, WiFi access, Internet browser, English/Chinese text input, and various other smart functions. Additionally, learners were granted personal DingTalk accounts to facilitate their participation in the SCVL activities.

The SCVL activities were structured as follows: Each week, learners concentrated on creating sentence artifacts, and after every two weeks, they were required to produce a paragraph artifact. Subsequently, upon completing four weeks (or one stage), learners were tasked with generating an essay artifact. This same sequence of activities was repeated across four stages.

2.5.2 Questionnaire

To address RQ 3 quantitatively, the questionnaire (refer to Appendix A) employed in this research was adapted and modified based on the work of Chai et al. (2016) and subsequently administered to the 32 CFL learners. To ensure the questionnaire content was able to address the research questions, it underwent scrutiny not only by the supervisor but also underwent a validation process by three CFL experts from three universities in Chinese Mainland. The three experts comprised of a senior CFL lecturer and two associate professors in linguistics with over ten years of Chinese language teaching and research experience. Their comments can be found in Section 3.9 for reference. The questionnaire was then piloted to determine the reliability to ensure that all items would consistently measure the intended constructs when used again for the main study (e.g., Azraii et al., 2021; Gray, 2017). Thereafter, the refined questionnaire items were employed in the main study (Table 3.1).

Table 5 Questionnaire Design

Section	Items	Studies Supporting the Design
Section i: Background Information	• Age • Gender • National Status • Years of Study • HSK Level 3 scores	Alina (2019); Foomani & Hedayati (2016); Huang & Qian, (2003); Jiang & Bai (2020); Meng (2021)
Section ii: Chinese Learning Condition	• Motivation • Career plan • Time to study Chinese every day • Comment on “teacher-centric” • Preferences for “teacher-centric” • Type of Chinese class • Chinese learning style	Jiang & Bai, (2020); Lan & Lin (2016); Lin (2019); Meng (2021); Mo (2015)
Section iii: Aim for Chinese vocabulary Learning	• Vocabulary teaching methods • Vocabulary knowledge • Vocabulary learning goals • Opinion on mobile device and social media platform in vocabulary learning • Vocabulary learning enhancement	Alahmadi & Foltz (2020); Jiang & Bai, (2020); Lan & Lin (2016); Lin (2019)
Section iv: Perceptions of Chinese Vocabulary Learning	• Perceptions, Affectivity and Motivation towards Informal Chinese Vocabulary Learning	Chai et al. (2016); Jiang & Bai, (2020); Meng (2021); Rindaningsih et al. (2021)
Section v: Seamless Chinese Vocabulary Learning	• A: Seamless Chinese HSK Level 4 vocabulary learning experience (8 items); • B: Perception towards SCVL platform (DingTalk) (12 items); • C: Chinese vocabulary growth and lexical richness (10 items)	Chai et al. (2016); Farley et al. (2015); Foomani & Hedayati (2016); Jiang & Bai (2020); Lan & Lin (2016); Murphy et al. (2014); Rindaningsih et al. (2021, 2022)
Section vi: Open-ended Questions	• Learning performance, perceptions and challenges • Other comments	Chai et al. (2016); Foomani & Hedayati (2016); Jiang & Bai, (2020); Rindaningsih et al. (2021, 2022)

The questionnaire contains five parts

Background information (5 items)

Chinese learning condition (7 items)

Aim for Chinese vocabulary learning (5 items)

Perceptions of Chinese vocabulary learning (10 items)

Seamless Chinese vocabulary learning (A, B, C) (30 items)

Open-ended questions (2 items).

The two open-ended questions at the end of the questionnaire were intended to give the subjects the opportunity to add further information on their perceptions towards SCVL.

In particular, “(v) Seamless Chinese Vocabulary Learning (A, B, C)” was employed as the Seamless Chinese Vocabulary Learning Questions (SCVLQ) that were conducted after this research. The SCVLQ included 30 items answered using a five-point Likert scale to elicit the learners’ experiences and perceptions towards SCVL.

SCVLQ A: Seamless Chinese HSK Level 4 vocabulary learning experience (8 items);

SCVLQ B: Perception towards SCVL platform (DingTalk) (12 items);

SCVLQ C: Chinese vocabulary growth and lexical richness (10 items).

The questionnaire was prepared in English to measure the learner’s understanding and the validity of the findings on seamless Chinese learning (Chai et al., 2016).

2.5.3 Interview

In this research, to address RQ 3 qualitatively, interviews were deemed necessary to delve deeper into certain responses provided by the learners. Interviews offer insights and perceptions that enable the researcher to fulfill the research objectives while also providing crucial information that other quantitative methods may not capture (Cohen et al., 2007). This aligns with the chosen mixed-method approach for the research. Consequently, a series of learner-researcher interviews were conducted as part of this research. During these interviews, Mandarin was used as the medium of communication, and subsequently, the researcher transcribed and translated the recorded interviews.

In addition, within the scope of this research, six out of the 32 international students who were actively monitored throughout the study underwent in-depth interviews (refer to Appendix B). These open interviews encompassed approximately 30 questions, and there were 28 questions for the semi-structured interviews. These interviews were conducted both before and after the research study. These particular learners were selected based on recommendations from educators and included individuals representing high, medium, and low performance levels in the Chinese course. The one-on-one interviews conducted before and after the teaching intervention aimed to gain a deeper understanding of their background, language habits, experiences with SCVL, and more.

Furthermore, the study involved 32 CFL learners, all of whom actively participated in at least one semi-structured interview across the four DBR stages (refer to Appendix C). In each stage, 4-5 questions were posed to these learners to elicit their insights regarding their learning experiences and perceptions of SCVL’s use. These interviews, crucial for guiding the DBR process and addressing RQ 3, allowed the researcher to gather spontaneous ideas from learners regarding their impressions of SCVL, perceptions of the DingTalk platform as a learning tool, the potential benefits of SCVL for Chinese vocabulary improvement, challenges encountered during the research study.

2.5.4 Information Box

Since the DBR approach was used as one of the qualitative methods in this research to guide, design, and support learners' SCVL process, gathering learners' feedback was crucial and relevant to obtain their true voice in learning (e.g., Barab & Squire, 2004; Becker, 2019). To qualitatively address RQ 3, the purpose of employing the Information Box function (Plate 2) on the DingTalk platform was to gather feedback from CFL learners during their SCVL. In total, there were 70 pieces of feedback from CFL learners in the Information Box. The source of feedback data is presented in Appendix F.

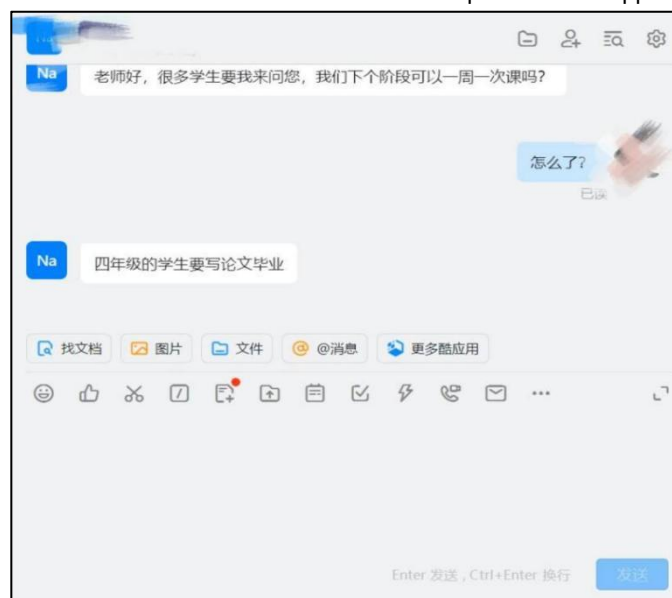


Plate 2 One Learner's Feedback in the Information Box

2.6 SCVL Design and Procedure

This section introduces the application of the DBR approach, which was embedded in the mixed methods research design. Additionally, the application of DBR in SCVL is explained, which includes DBR and seamless learning, four DBR stages supporting SCVL, SCVL designs, teaching designs, and roles of the researcher. Finally, the SCVL procedures are discussed.

2.6.1 DBR and SCVL

As stated by Brown (1992), DBR is a versatile empirical data-gathering method that utilises qualitative methodology and draws inspiration from the learning sciences educational movement founded by educational researchers like Brown and Collins in the early 1980s. DBR aims to expand the scientific understanding of learning by designing and implementing learning innovations and activities in natural contexts, with the goal of improving instructional methodologies. Additionally, scholars have argued that DBR interventions are assessed on a wide range of indices using multiple methodologies (e.g., Anderson & Shattuck, 2012; Becker, 2019; Barab & Squire, 2004). Seamless learning is a relatively new concept, and learning philosophies are still evolving as the nature and scope of technology-enhanced learning continues to expand and change in practical uses across diverse contexts (Wong et al., 2015; Xiao et al., 2021). Regarding the nature and characteristics of this research project, Wong et al. (2016) asserted that the current implementation of seamless CFL learning is based on the initial FSL framework (Wong et al., 2010), which is a teacher-driven framework. Consequently, this has informed the selection of the DBR approach for this research. Additionally, this research employed the mixed

methods research design. DBR, as one of the qualitative methods, was used to guide, design, and support learners' SCVL process. Based on this, the design principles for SCVL were derived from DBR (Table 6). As can be seen from Table 3.3, the nine Design Principles (DP) for seamless learning were proposed to guide SCVL. Seamless learning typically occurs in real-world contexts, allowing CFL learners to use their mobile devices to apply learned vocabulary that encompasses both formal and informal learning (DP 1). It also allows learners to employ their own mobile devices as a learning hub to apply learned vocabulary outside of class (DP 2). Next, the SCVL design requires that CFL learners apply what they learned across time (DP 3) and locations (DP 4). Also, they were allowed to do individual and social learning (DP 5). Furthermore, the social media platform DingTalk served as a seamless learning space where CFL learners were able to do seamless learning activities (DP 6). Many seamless learning activities were also designed so that learners were able to apply seamless learning to mediate knowledge construction (DP 7). Most importantly, CFL learners adopted the SCVL design to consolidate their learning (DP 8) and perform self-directed learning (DP 9)

Table 6 Design Principles for SCVL

Design Principles for Seamless Learning	Implications for SCVL Design
1. Real-world implementation: Use seamless learning in real-world situations.	• Create real-world activities that are relevant to CFL learners and are connected to formal and informal learning contexts.
2. Personalise: Employ learners' own mobile devices as a learning hub.	• Design learning activities so that CFL learners make use of their mobile devices to apply learned vocabulary outside of class.
3. Anytime: Apply seamless learning across time.	• Design seamless learning activities that CFL learners can engage in whenever they are curious to learn.
4. Anywhere: Apply seamless learning across locations	• Design seamless learning activities so that CFL learners learn outside of class, informally, and in different learning scenarios.
5. Anyone: Apply seamless learning encompassing individual and social learning.	• Design seamless learning activities that CFL learners can do both individually and in groups.
6. Affordances: Provide a seamless learning space.	• Social media platform DingTalk serves as a seamless learning space where CFL learners are able to do seamless learning activities.
7. Mediation: Apply seamless learning to mediate knowledge construction.	• Design seamless learning activities that allow CFL learners to seamlessly and rapidly switch between multiple learning tasks.
8. Outcome: Apply seamless learning to do learning consolidation.	• Design seamless learning activities that enhance CFL learners' knowledge synthesis.
9. Autonomy: Apply seamless learning autonomously.	• CFL learners are able to achieve self-directed learning.

2.6.2 Four DBR Stages Supporting SCVL

DBR emphasises eventual adoption in school practices and therefore must be situated in real-life learning environments where there is no attempt to hold variables constant (Roschell et al., 2010). Hence, a 16-week intervention was divided into four DBR stages. As shown in Figure 3.2, there are two parts of the DBR process that support SCVL: “Before the DBR” and the “Iterative process of four DBR stages”.

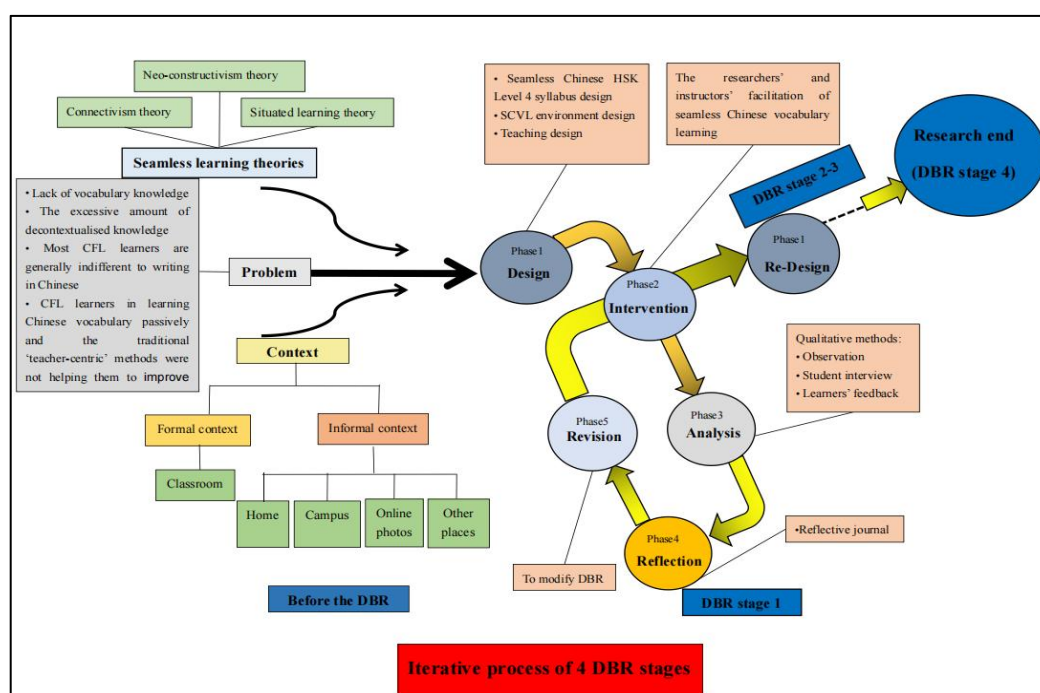


Figure 2 The Process of DBR in Supporting SCVL

Before the DBR, it was crucial to address and define the research problems. Other research was referenced to learn how other researchers have viewed and solved similar problems (McKenny & Reeves, 2012, p. 85). This provided the researcher with an understanding of the context within which to execute an intervention. Furthermore, a theory-guided design of the DBR was then implemented in this research. The DBR of SCVL was conducted based on the five phases as supported by the neo-constructivism theory, connectivism theory, and situated learning theory, namely “design-intervention-analysis-reflection-revision” throughout the entire process. The key points of DBR stages are shown in Table 7.

Table 7 Four DBR Stages of SCVL

Stage	Key Points	Note
DBR Stage 1	Details of activities shown in Section 3.5.4	Week 1 to Week 4 (March–April 2022)
Phase 1	Design	• Seamless Chinese HSK Level 4 syllabus design • Seamless learning environment design

		• Teaching design
Phase 2	Intervention	The researchers' and instructors' facilitation of SCVL activities
Phase 3	Analysis	Adopting qualitative methods (e.g., interview, learners' feedback) for analysis
Phase 4	Reflections	Reflective journal
Phase 5	Revision	To modify DBR
DBR Stage 2	Details of activities shown in Section 3.5.4	Week 5 to Week 8 (April – May 2022)
Phase 1	Re-design	• Seamless Chinese HSK Level 4 syllabus design • Seamless learning environment design • Teaching design
Phase 2	Intervention	The researchers' and instructors' facilitation of SCVL activities
Phase 3	Analysis	Adopting qualitative methods (e.g., interview, learners' feedback) for analysis
Phase 4	Reflections	Reflective journal
Phase 5	Revision	To modify DBR
DBR Stage 3	Details of activities shown in Section 3.5.4	Week 9 to Week 12 (May – June 2022)
DBR Stage 4	Details of activities shown in Section 3.5.4	Week 13 to Week 16 (June – July 2022)

As demonstrated in Table 7, four DBR stages were instrumental in supporting SCVL. The subsequent section provides a succinct summary of the learning design and the educator's roles and actions within each of these stages.

In DBR Stage 1, the researcher dedicated the initial four weeks to establish a fundamental understanding of SCVL for both the educator and learners. The aim was to develop strategies and skills necessary for effectively carrying out the SCVL process and to acquaint them with the platform. The primary focus of this stage was to enable learners to master the concepts, strategies, and skills of SCVL, become familiar with the functions of the DingTalk platform, engage with the HSK4 Learning Circle, and acquire the skills needed for creating works.

In DBR Stage 2, the goal was to encourage learners to process and share their learning experiences, connecting them with the vocabulary knowledge acquired or constructed in the classroom. The objective was for learners to reflect on this knowledge, create artifacts, and ultimately apply it in real-life contexts. The overall learning effect transitioned from an initial “small test” phase in the first stage to a phase of gradual improvement. The informal learning environment saw an increase in the number of artifacts created, resulting in an impressive learning effect.

In DBR Stage 3, the primary teaching objective was to promote comprehensive learning in sentence and paragraph writing. Simultaneously, it aimed to enhance the quality of Chinese artifact creation. This stage encouraged learners to traverse different learning situations, maintain continuity in their learning experiences, engage in peer evaluation, and develop independent learning skills while seamlessly integrating these aspects.

In DBR Stage 4, the ultimate goal of cultivating learners’ self-directed learning habits and enhancing their Chinese writing skills was pursued. After experiencing four stages of SCVL, learners successfully integrated the Chinese language into their daily lives. To a considerable extent, this integration enabled them to achieve vocabulary growth and lexical richness in their Chinese writing. Despite the challenges posed by the COVID-19 pandemic, which limited learners’ ability to create cross-scenario situations, many learners exhibited remarkable imagination and creativity in generating opportunities for seamless learning. Furthermore, their independent learning abilities significantly improved.

Four DBR Stages of SCVL highlights the progression and objectives of each DBR stage in support of SCVL and underscores the learners' remarkable adaptability and resilience, particularly in the face of external challenges like the pandemic.

2.6.3 Seamless Chinese HSK Level 4 Syllabus Design

The vocabulary focus of the research was based on the HSK Level 4 syllabus. HSK Level 4 covers a total of 1,200 words, including 600 new words. Hence, to facilitate seamless learning and enable learners to create more artifacts, this research was based on the HSK word frequency analysis in the HSK 2.0 essay corpus, combined with 2,500 words popularly used in modern Chinese. In the meantime, six experienced Chinese language educators from four top universities were commissioned to sample 240 target words from 600 new words as targeted vocabulary in this research. According to the “Syllabus of Chinese Language Program for Foreign Learners in Colleges and Universities” (高等学校外国留学生汉语教学大纲, 2002), there are 700 new words to be learned at intermediate level, which lasts for twenty weeks with twenty class hours per week for a total of four hundred class hours. Therefore, thirty-five words are taught each week. According to the 16-week teaching schedule and the experience from the pilot study, learners were only required to focus on 15 target vocabulary each week for artifact-making and seamless learning activities. Vocabulary selection primarily followed the characteristics of vocabulary, such as communicative, practical, acceptable, and productive (Nation, 2000; Ren, 2011; Zhang, 2019). A total of 240 target words were selected (refer to Appendix D). The key to vocabulary learning is to promote the conversion of receptive words to productive words and apply them correctly and appropriately in the real context (Ren, 2011; Zhang, 2019).

Additionally, the list of selected vocabulary to be included was screened through and approved by other Chinese instructors. All the selected vocabulary served the teaching purpose and adhered to the course curriculum. Participating learners used the same curriculum and syllabus.

2.6.4 SCVL Environment Design

This section addresses the design of the SCVL process and DingTalk seamless learning environment to facilitate learners' CFL learning. Figure 3 depicts the seamless Chinese vocabulary learning (SCVL) framework in promoting vocabulary growth and lexical richness in writing, which was modified based on Wong and Looi (2010a). This framework facilitated learners' learning in two dimensions, namely the SCVL dimension and "sentence-paragraph-essay" artifacts-making dimension.

For the first dimension of SCVL, mobile phones were used as the learning tools to bridge and interweave formal learning within the classroom (learning engagement and consolidation) with informal learning beyond the classroom (individualised contextual learning and online peer feedback and interactions). The intention was to nurture the habit-of-mind of self-directed learning in learners. Meanwhile, for the second dimension of "sentence-paragraph-essay" artifacts-making, the learning content of DingTalk was primarily a proliferation process of vocabulary knowledge, which culminated in the holistic development of language proficiency and eventually to achieve vocabulary growth and lexical richness in writing.

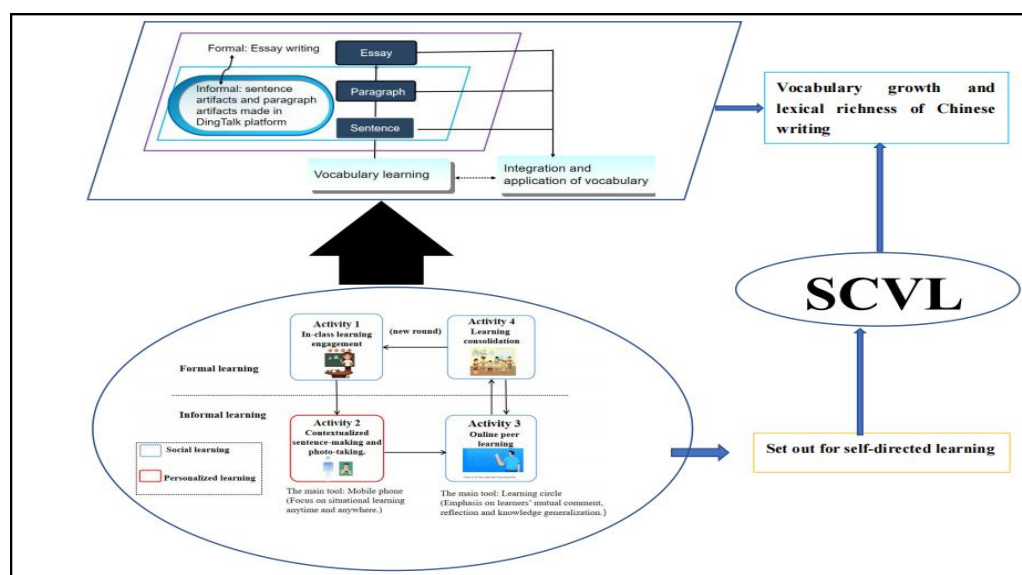


Figure 3 SCVL Framework (Adapted Based on Wong & Looi, 2010a)

The SCVL process was a repeated and non-linear learning process. It consisted of the following four major types of vocabulary learning activities:

In-class learning engagement (Activity 1): In the formal classroom setting, the language instructor facilitated the engagement of the learners in the formal lessons, such as by identifying and learning new words in the HSK Level 4 Standard textbook passages and getting learners ready to participate in subsequent outside-the-classroom contextualised learning activities.

Contextualised sentence-making and photo-taking (Activity 2): As instructed by their Chinese language educator, learners were encouraged to use their mobile phones whenever and wherever they wanted to learn. They were guided to check on the Chinese vocabulary words that they were familiar with using the Pleco dictionary. Learners proactively created artifacts comprised of sentences made using the

target vocabulary and share their daily learning experiences on the HSK Level 4 Learning Circle of the DingTalk social media platform, where there was one page to create a situational topic for learners to post their photos/sentences with the target vocabulary. It was very convenient for Chinese language educators to examine and compare learner-identified contexts according to their understanding of the contexts through their sentences or situational creations with the same target vocabulary. Because of the COVID-19 pandemic, they only carried out these activities at home, on campus, and in other safer places near the university (such as supermarkets, shopping malls, restaurants, and others).

Online peer learning (Activity 3): In this research, DingTalk was utilised as the social media platform for the learners to interact with their friends in their daily life beyond the classroom. Therefore, they applied the vocabulary they learned in a variety of informal contexts. Subsequently, the learners posted their artifacts onto DingTalk for further peer review and social interactions among their classmates, and they gave comments on each other's posts as well.

Learning consolidation (Activity 4): Learners returned to formal learning spaces to consolidate their learning, which also appeared during online peer learning.

In order to implement the seamless learning of CFL, the following three essential components were taken into account.

Vocabulary practice and support with the use of Ding Drive and Pleco Chinese dictionary: The personal and public mobile Ding Drive served as an individual and group repository for learners to store and edit new words that they had just learnt. Instructors helped learners identify unfamiliar words, checked their pronunciations and meanings, and then helped the learners create their own personal vocabulary list in class. At the same time, learners used Pleco's Chinese dictionary when they need to find out the meaning of unfamiliar vocabulary. They referred to the Pleco Chinese dictionary whenever they needed to. Then they used their mobile phones to take photos pertaining to those writings. They practised with the newly learned vocabulary by making sentences. The photos and the sentences constructed by them were uploaded to the Ding Drive (Figure 3.4).

Ding Drive



Pleco Chinese dictionary



Figure 4 Ding Drive and Pleco Chinese Dictionary

Learning Circle: This is the space in which learners shared their daily learning experiences for informal interactions among learners, educators, and peers. Learners first chose an area of interest. They then posted their own photos and sentences online and communicate with one another in Chinese. Everyone in the Learning Circle commented and gave likes to others' posts. Peer discussions were also done here. This Learning Circle served as a vocabulary learning ground in which their vocabulary growth and lexical richness are shown in Figure 5.

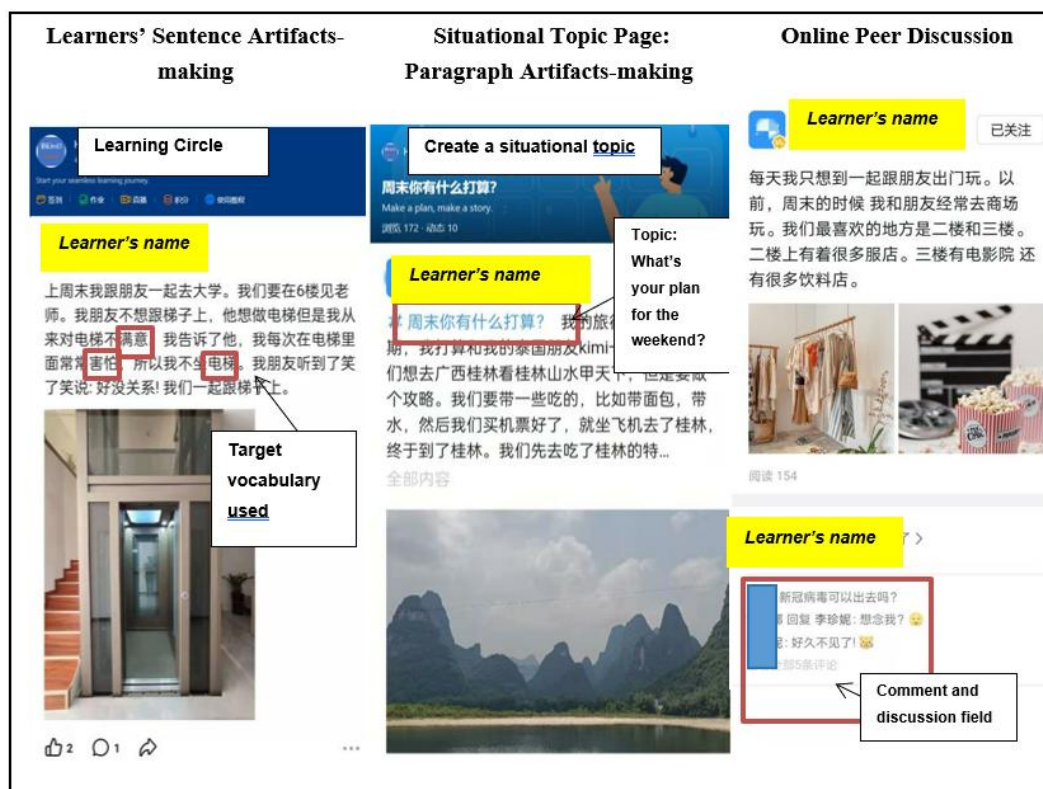


Figure 5 HSK Level Four Learning Circle of DingTalk Platform

Homework: This was the space for learners to submit their essay artifacts. Their learning outcomes at every stage of vocabulary learning were examined. Their artifacts were collected online (Figure 6).

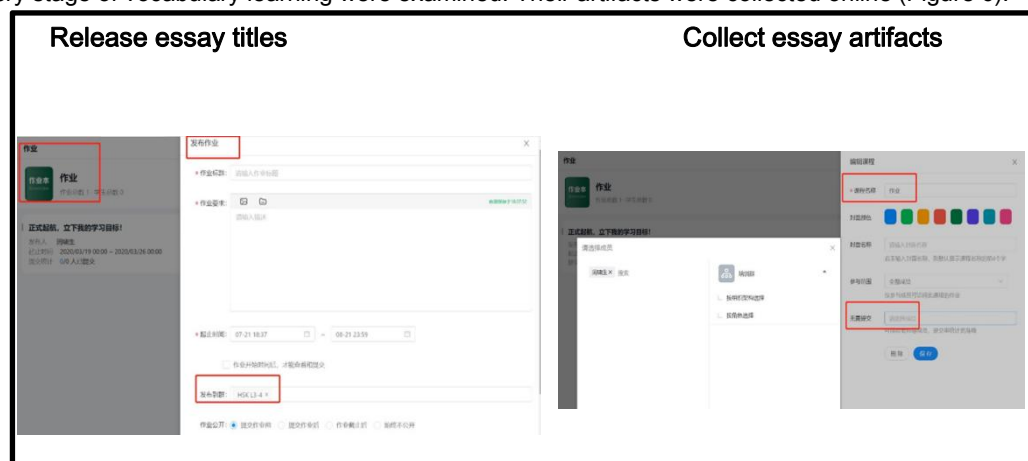


Figure 6 Homework Release and Collect

In sum, the learning of vocabulary began with the educator's input. This was followed by the contextualised learning of words through real-life situations, which led to the authentic use of vocabulary learned. This gradually extended, in a bottom-up manner, to the writing of sentences, paragraphs and ultimately essays.

2.6.5 Teaching Design

As teaching constitutes the primary component of the SCVL research design, the teaching design necessitates elaboration (Becker, 2019; Cui, 2003; Gao, 2020). The teaching process was conducted

within a seamless learning environment and the research was divided into four DBR stages, each lasting four weeks, for a total of 16 weeks. Throughout each stage, learners focused on creating sentence artifacts, paragraph artifacts, and essay artifacts. The same process was implemented across all four stages. Based on this, lesson plans for SCVL study were developed and aligned with the seamless Chinese HSK Level 4 course syllabus. In order to provide a comprehensive representation of the SCVL study, a sample lesson plan (Appendix E) has been included as exemplars.

With the planned research design, the researcher took on multiple roles in this research. These include the roles of a researcher, instructor, interviewer, administrator for the questionnaire survey, non-participating observer during the learner artifacts making session via the Learning Circle function on the DingTalk platform, the person in charge of the audio and video recordings during the interviews, and translator and transcriber of the interview audio and video recordings. However, the existence of an educator-learner relationship along with the researcher-educator relationship contributed to power imbalance, introducing a bias that could cloud the findings. As pointed out by Natow (2020), during the collection of qualitative data such as interviews and open-ended questionnaires, learners' performance and objectives may shift toward pleasing the researcher. Bearing this in mind, to maintain the authenticity and validity of the collected data, researchers utilised open-ended questionnaires. This approach involved comparing the open-ended comments with the interview responses to discern if the learners exhibited a particular motivation to conform to the researcher's expectations or expressed views contrary to their true intentions during the interviews.

Furthermore, from the start of the research, the researcher made it clear to all participating learners that the goal in their responses throughout the course, whether in interviews or open-ended questionnaires, should reflect the reality with candour, not to make and/or keep the researcher happy in any way.

As evidenced by Wong (2015), maintaining a partnership between educator and researcher is challenging because educators are often too busy and frequently undertrained to conduct thorough research. Similarly, in order to significantly create and measure the impact of an intervention, the researcher is often unfamiliar with the implications of an operating educational system's culture, technology, goals, and politics (Becker, 2019; Weinhandl, et al., 2020). In some studies (e.g., Foomani & Hedayati, 2016; Ke & Li, 2008; Weinhandl, et al., 2020) both the instructor and researcher were the same person, yet they were able to play a good role in conducting DBR studies to achieve the objective of their research. For instance, Ke and Li (2008) believed that a researcher can play a good role as an instructor. Due to the nature of DBR, the "design" in DBR serves the dual purpose of teaching and research in real situations, which reflects the consistent position of researchers and instructors. Indeed, if researchers are not instructors, there may exist cooperation problems between them due to unequal relationships (Becker, 2019; Ke & Li, 2008; Yang, 2008). Therefore, some scholars suggest that it is good for a researcher to be the instructor at the same time, as the concept of the research design can be delivered smoothly (Becker, 2019; Ke & Li, 2008; Yang, 2008; Wong, 2015).

Thus, in this research, the researcher played the main role as an instructor to guide and implement the SCVL under the DBR approach. Also, the researcher-cum-instructor played the main role to organise the Chinese HSK Level 4 teaching, set up seamless learning activities, and monitor the artifacts made in the DingTalk Learning Circle.

2.6.6 SCVL Procedures

This section explains the overall research procedures. According to the university schedule, there were 20 weeks per semester. After deducting public holidays and final exams, there were about 16 lectures left. With that in mind, this research was carried out in March 2022 and was completed within a four-month semester period (Figure 7). This was conducted by delivering the Seamless Chinese HSK Level 4 course, which aimed to promote learner vocabulary learning and achieve vocabulary growth and lexical richness in writing.

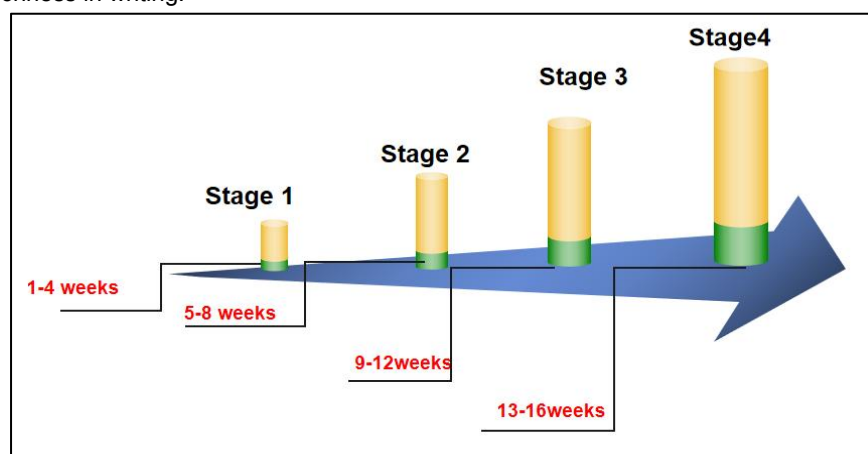


Figure 7 Seamless Learning Procedures with Four Stages

As shown in Figure 7, every four weeks comprised of a stage where every week was a mini-cycle. In each cycle (every week), learners focused on making sentence artifacts, and after every two weeks, they were allowed to make a paragraph artifact. Then, after completing four weeks (or a stage), learners were required to make an essay artifact. The same process was carried out in four stages. Each learner was allowed to carry mobile devices on a 1:1 (one-device-per-learner), 24/7 basis to stimulate and support their language learning both within and beyond the classrooms. Their personal mobile devices had essential affordances such as a built-in camera, WiFi access, Internet browser, English/ Chinese text input, and other smart functions. They were also given personal DingTalk accounts to carry out the SCVL activities. The researcher who was also the Chinese language educator of the class took charge of and designed the lessons.

Thereafter, a pre-research questionnaire was administered to learners to gather information about their Chinese learning background and investigate their perceptions and opinions about the CFL learning and use of seamless learning to support their vocabulary learning to improve their writing, among other things. The SCVL procedures of this research are summarised in Table 8 below.

Table 8 Research Procedure

Prior to the research:						
Briefing on seamless learning:						
Purpose: prepare the learners in understand their learning roles and tasks in participating in this study						
Pre-research questionnaire:						
Purpose: to gather learner's Chinese learning background and investigate learners' perceptions on the use of seamless learning to support their vocabulary learning in enhance the writing.						
Implementation of seamless learning with the focus on teaching sessions.						
<u>Stage 1</u>	Teaching session	Topic	Vocabulary focus	Planned topic in Learning circle	Planned essay title in Homework	Seamless learning activities and reflective activities
Cycle 1	Week 1	Simple love	不仅 , 开玩笑、最好、 共同、幸福、生活、浪漫、缺点、接受、羡慕、爱情、深、性格、幽默、从来	Love & Marriage	My ideal...	<i>Seamless learning activities -</i> <i>Activity One:</i> Time allocation: 40 minutes classroom session <i>Activity Two:</i> Artifacts making DingTalk social media platform outside the classroom <i>Activity Three:</i>

						comment and review each artifact outside the classroom (Time allocation of Activity 2 & 3: 30 minutes)
<u>Stage 1</u>	Teaching session	Topic	Vocabulary focus	Planned topic in Learning circle	Planned essay title in Homework	Seamless learning activities and reflective activities
						<i>Activity Four:</i> Learning consolidation during classroom time (20 minutes) and during online peer learning <i>Reflective activities:</i> Record and observe learners' learning and participation; reflective journal; short interview
Cycle 2	Week 2	A true friend	聚会、互相、逛、短信、联系、平时、讨厌、差不多、麻烦、正好、尽管、真正、困难、无聊、丰富			Repeat the above seamless learning activities and reflective activities
Cycle 3	Week 3	I've made a good	约会、印象、准时、判断、信心、紧张、另外	Friends		Repeat the above seamless learning activities and reflective activities

		impression on the manager	、首先、专业、诚实、正式、留、改变、其次、挺			
Cycle 4	Week 4	Don't be anxious to make money	手忙脚乱、赚、以为、提、调查、原来、提前、计划、保证、提醒、生意、积累、经验、调查、按时			Repeat the above seamless learning activities and reflective activities
<u>Stage 2:</u>						
Cycle 1	Week 5	Buy what's right, not what's expensive	按照、顺利、感谢、打折、不得不、甚至、奖金、责任、肯定、方法、广告、实际、浪费、标准、消息	Does the first impression matter?	One of my shopping experiences	Repeat the above seamless learning activities and reflective activities
<u>Stage 2</u>	Teaching session	Topic	Vocabulary focus	Planned topic in Learning circle	Planned essay title in Homework	Seamless learning activities and reflective activities
Cycle 2	Week 6	The higher the price, the better the quality	竟然、值得、活动、免费、修理、支持、骗、其中、购物、所有、获得、情况、举办、降低、一分钱一分货			Repeat the above seamless learning activities and reflective activities
Cycle 3	Week 7	The best doctor is yourself	估计、空气、咳嗽、严重、窗户、动作、后悔、来不及、反对、超过、植物、散步、指、说明、要是、脾气、减肥、辛苦、烦恼	What do you think of "You get what you pay for"		Repeat the above seamless learning activities and reflective activities
Cycle 4	Week 8	Beauty is not	巧克力、堵车、心情、愉快、只要、放松、压			Repeat the above seamless learning

		rare in life	力、发生、师傅、因此、距离、耐心、态度、到处、缺少			activities and reflective activities
Stage 3						
Cycle 1	Week 9	The sun will shine again after the storm	难道、坚持、主意、饼干、网球、轻松、赢、随便-、通过、可是、正确、理想、汗、经历、暂时	Happiness in my eyes	Difficulties encountered in China	Repeat the above seamless learning activities and reflective activities
Cycle 2	Week 10	Standards of happiness	幸福、成功、方向、富、开心、建议、职业、翻译、将来、发展、困、躺、穷、比如			Repeat the above seamless learning activities and reflective activities
Stage 3	Teaching session	Topic	Vocabulary focus	Planned topic in Learning circle	Planned essay title in Homework	Seamless learning activities and reflective activities
Cycle 3	Week 11	It is good to read, read good books and like reading	流利、厉害、学期、猜、来得及、复杂、只好、精彩、无论、杂志、增加、阅读、然而、看法、同时	Difficulties in learning Chinese		Repeat the above seamless learning activities and reflective activities
Cycle 4	Week 12	Discover the world with your heart	规定、死、也许、商量、并且、保护、盐、勺子、解释、对于、使用、引起、误会、节约、相反			Repeat the above seamless learning activities and reflective activities

Stage 4:						
Cycle 1	Week 13	Drink tea while watching Beijing opera	观众、厚、大概、吃惊、遍、来自、申请、有趣、开心、继续、讨论、由、准备、京剧	My favourite season	An unforgettable trip	Repeat the above seamless learning activities and reflective activities
Cycle 2	Week 14	Taste of life	打印、复印、道歉、戴、理发、零钱、包子、破、眼镜、租、厨房、房东、乒乓球、饺子、刀			Repeat the above seamless learning activities and reflective activities
Cycle 3	Week 15	Man and nature	凉快、热闹、难受、抱、活泼、排队、社会、竞争、受不了、交通、技术、安全、密码、付款、除此之外	Study in China		Repeat the above seamless learning activities and reflective activities
Cycle 4	Week16	The view along the way	放假、酸、推迟、钥匙、参观、旅行、民族、打扮、究竟、普通话、方言、小吃、收拾、出发、辣			Repeat the above seamless learning activities and reflective activities
	Note	• Video recording of each lesson will be done. • Interviews of selected CFL learners will be carried out as to understand the problems encountered by learners.				
Post-research activities	Post-research questionnaire Purpose: to explore learners’ experiences, perceptions and improvements in vocabulary learning through the utilisation of SCVL. Post-research interviews: Purpose: to explore learners’ experiences, perceptions and improvements in vocabulary learning through the utilisation of SCVL.					

According to the syllabus requirements of the three schools in the three different universities, a Chinese HSK Level 4 course was a compulsory course for 3 credits, and 48 contact hours are allocated for 16 weeks. With the adoption of seamless learning for the HSK Level 4 course, mobile technology as an intermediary and social media as a platform was used to conduct SCVL.

The learners were engaged in a formal class for 45 minutes in tandem with another 45-minute class for informal Chinese learning based on the principle of “learning for practice” and “learning by using” (“学中用” “用中学”) (Li 2019; Wong et al., 2016). Based on the pilot study with four CFL learners on artifact creation, the proportional time (formal-informal) arrangements of the research was 2:1, where a formal class for 60 minutes was run in parallel with another 30-minute class for informal Chinese learning per week. Thus, there were two learning sessions each week to cover two hours of formal lectures and one hour of informal lectures.

For each learning session, the instructor allocated 40 minutes of classroom session to the teaching of new vocabulary (Activity 1) according to the weekly lesson plan for the HSK Level 4 syllabus based on the standard textbook and prepared the learners to participate in subsequent contextualised learning activities outside of the classroom. With the target vocabulary learned in every session in the formal classroom, learners took photos or looked for suitable pictures to make sentence artifacts and post them onto the DingTalk social media platform (Activity 2). In the next step, the learners actively commented on, corrected, and reviewed each other’s artifacts as part of the online peer learning (Activity 3). This process helped the learners to receive constructive feedback from their peers, allowing them to improve their understanding of the course material and develop new skills. Additionally, online peer learning fosters collaboration, communication, and critical thinking skills among learners, and encourages them to take ownership of their learning experience.

According to the interviews, during the pilot study, the estimated time that learners took to make 1-2 sentence artifacts was approximately 20-30 minutes. Therefore, both Activity 2 and Activity 3 took a total of 30 minutes. The instructor also joined their online peer learning to comment on and review each other’s artifacts.

At the end of the learning cycle, the learners returned to formal learning for 20 minutes each session as part of the learning consolidation (Activity 4). Errors on the sentence artifacts were discussed in the formal learning settings for corrections.

Subsequently, with the ongoing seamless learning and the weekly learning consolidation, learners further enhanced their vocabulary knowledge to reduce lexical errors. Hence, learners continued to do seamless learning activities in similar cycles that consisted of four activities per cycle. Four weeks represented the completion of one research stage.

For reflection, during each cycle, the instructor recorded and observed the learners’ formal and informal learning problems as well as ideas on how they tackled the problems.

2.7 Data Collection

For the data collection, the various data sources collected during the research are depicted in Table 9.

Table 9 Data Types and Number of Data Collected During the Research

Data Type	Before	DBR Stage 1	DBR Stage 2	DBR Stage 3	DBR Stage 4	After
Interviews	6	25	19	24	24	6
Artifacts	/	483	555	610	653	/
Learners' feedback	/	25	17	19	9	/
Open-ended questionnaires	/	/	/	/	/	29
Research questionnaires	32	/	/	/	/	32

2.7.1 Artifacts

In this research, sentence artifacts, paragraph artifacts and essay artifacts shared and created by learners on the DingTalk platform were collected to address both RQ 1 and RQ 2.

Table 10 Number of Artifacts Made by Learners Across Four Stages

Artifacts	Stage 1	Stage 2	Stage 3	Stage 4	In Total
Sentence artifacts	387	461	518	555	1921
Paragraph artifacts	64	62	64	62	252
Essay artifacts	32	32	32	32	128

The number of Chinese artifacts were counted by the Record Board function of the DingTalk platform and was manually keyed into Microsoft Excel to further calculate the numerical values (e.g., TTR, Uber index value), as shown in Table 10. It is important to note that all posted short artifacts consisted of sentences constructed using target vocabulary. Specifically, a "sentence artifact" was defined as comprising 30-50 words, while the creation of a "paragraph artifact" on the situational topic page necessitated 80-100 words. For an "essay artifact", narrative writing is required with a length of 150-200 words based on the "Syllabus of Chinese Language Program for Foreign Students in Colleges and Universities" (高等学校外国留学生汉语教学大纲, 2002). In accordance with this, a total of 2,301 artifacts were created by the 32 CFL learners across the four stages and were subsequently collected and analysed in the following sections.

2.7.2 Questionnaire

The questionnaires were conducted and administered to the 32 participants before and after the research. The purpose was to gather learner's Chinese learning background and triangulate their perceptions on the use of seamless learning to support their learning. A pre-research questionnaire was used to investigate learners' attitudes and opinions on learning Chinese and learning HSK Level 4 vocabulary, while a post-research questionnaire was used to gather learners' perceptions of using the

DingTalk platform and their overall experience on seamless learning. Consequently, a total of 64 pre- and post-questionnaires were collected from the 32 CFL learners and were subsequently analyzed in the following sections.

2.7.3 Qualitative data

Qualitative data, comprising interviews, learners' feedback, and comments on the open-ended questionnaire from the questionnaire, were collected (refer to Appendix F). These qualitative data were gathered to facilitate a comprehensive analysis of the learners' progression towards achieving vocabulary growth and lexical richness in their writing endeavors.

Regarding the interview data, it is important to note that interviews with 32 CFL learners during the DBR iterations, as well as the interviews with the six selected target learners, were conducted after the learners had completed the assigned course. These interviews were completed within one month, and each session typically lasted between 30 minutes to one hour. All CFL learners determined their own locations; most of them preferred to be interviewed in their houses or in an empty classroom in their university. With consent from the learners, all the interviews were video and audio recorded. The two forms of media were used as backup in case one of them failed while the recording took place. Before conducting each interview, technical matters were addressed to create a good image for the respondents and reassure them that everything had been taken care of for the interview sessions. After the interviews were transcribed, they were sent to the CFL learners for them to validate. Furthermore, all interview questions underwent validation processes by three CFL experts from separate universities in Chinese Mainland. They were also validated by the research supervisors of this research.

Additionally, a dataset comprising 70 pieces of feedback from CFL learners was collected throughout the four DBR stages within the SCVL environment. Notably, 29 out of the 32 open-ended questionnaires that were distributed to learners upon course completion were returned, contributing to the overall dataset. This high response rate, at 90.63%, reflects the robustness of data collection efforts.

In summary, the data collected involved data from four intervention stages before, during, and, after the SCVL research study, which included pre- and post- research questionnaire, interviews, artifacts, and CFL learners' feedback.

2.8 Data Analysis

In this research, two types of quantitative and qualitative data were collected. Regarding the quantitative data in this research, they were analysed using SPSS 26 (Statistical Packages for the Social Sciences). SPSS 26 is a popular choice for researchers in the social sciences because the framework and interface are relatively self-explanatory and there are multiple online tutorials if assistance is required (Zhao, 2020). Firstly, quantitative data was entered and saved in a Microsoft (MS) Excel® 2013 format, and were then inputted into an SPSS 26 file format. Both files were kept secured and both files were utilised throughout the data analysis process. Next, the data collected were analysed according to the research questions as shown in Table 11. The selected data analysis approaches address each of the research questions proposed. The analytical tools were also selected to serve the purpose of addressing these research questions.

Table 11 Data Analysis Approaches to Address Research Questions

Research Question	Quantitative Analysis	Analysis Tool
1. To what extent is SCVL able to enhance productive vocabulary growth of Chinese writing?	Descriptive statistics Mean, SD • Mean TTR values • Mean LFP rates Inferential statistics • ANOVA test • P <0.05 Null hypotheses accepted	• Microsoft Excel • Chinese word segmentation system: http://corpus.zhonghuayuwen.org/CpsWParser.aspx • SPSS 26 • TTR formula $TTR = \frac{\text{Number of word types} \times 100}{\text{Total number of word tokens}}$ • Adapted Chinese Lexical Frequency Profile (LFP)
1a. Do seamless learning activities enhance the number of vocabulary used for sentence/paragraph/essay artifact-making?	Descriptive statistics • Mean, SD • Mean TTR values Inferential statistics • ANOVA test • Null hypotheses accepted (P <0.05) Stage 1: TTR 1 Stage 2: TTR 2 Stage 3: TTR 3 Stage 4: TTR 4 • TTR 4 > TTR 3 > TTR 2 > TTR 1	• Microsoft Excel • Chinese word segmentation system: http://corpus.zhonghuayuwen.org/CpsWParser.aspx • SPSS 26 • TTR formula $TTR = \frac{\text{Number of word types} \times 100}{\text{Total number of word tokens}}$
1b. How does the HSK Level 4 vocabulary distribution in essay artifacts vary across the 4 learning stages?	Descriptive statistics • Mean, SD • Mean LFP rates Inferential statistics • ANOVA test • Null hypotheses accepted (P <0.05) Stage 1: LFP 1 Stage 2: LFP 2 Stage 3: LFP 3 Stage 4: LFP 4 • LFP 4 > LFP 3 > LFP 2 > LFP 1	• Microsoft Excel • Chinese word segmentation system: http://corpus.zhonghuayuwen.org/CpsWParser.aspx • SPSS 26 • Adapted Chinese Lexical Frequency Profile (LFP)

2 To what extent does SCVL enhance lexical richness of Chinese writing?	Descriptive statistics Mean, SD • Mean Uber index values (U) • Mean Advanced word rates (LS) • Mean lexical error rates (LE) Inferential statistics ANOVA-test	• Microsoft Excel • https://www.languagedata.net/editor/(汉语阅读分级指南针) • SPSS 26 • Uber index value: $\text{Uber index} = (\log_{\text{Tokens}})^2 / (\log_{\text{Tokens}} - \log_{\text{Types}})$ • Advanced word rate: LS = Number of advanced word tokens / Number of word tokens $\times 100\%$ • Lexical error rate: LE = Number of error words / Total number of word tokens $\times 100\%$
Research Question	Quantitative Analysis	Analysis Tool
2a. How does lexical diversity in sentence/paragraph/essay artifacts produced vary across the four learning stages?	Descriptive statistics Mean, SD • Mean Uber index values Inferential statistics U value $\rightarrow$ Lexical Diversity DBR Stage 4 > Stage 3 > Stage 2 > Stage 1 Null hypotheses accepted (P < 0.05)	• Microsoft Excel • https://www.languagedata.net/editor/(汉语阅读分级指南针) • SPSS 26 • Uber index value. $\text{Uber index} = (\log_{\text{Tokens}})^2 / (\log_{\text{Tokens}} - \log_{\text{Types}})$
2b. How does the lexical sophistication of essay artifacts vary across the four learning stages?	Descriptive statistics Mean, SD • Mean advanced word rates (LS) Inferential statistics Advanced word rate $\rightarrow$ Lexical Sophistication (LS) DBR Stage 4 > Stage 3 > Stage 2 > Stage 1 Null hypotheses accepted (P < 0.05)	• Microsoft Excel • https://www.languagedata.net/editor/(汉语阅读分级指南针) • SPSS 26 • Advanced word rate: LS = Number of advanced word tokens / Number of word tokens $\times 100\%$
2c. How do lexical errors in essay artifacts produced vary across the four learning stages?	Descriptive statistics Mean, SD • Mean Lexical error rate (LE) Inferential statistics Lexical error rate $\rightarrow$ Lexical errors (LE) DBR Stage 4 < Stage 3 < Stage 2 < Stage 1 Null hypotheses accepted (P < 0.05)	• Microsoft Excel • https://www.languagedata.net/editor/(汉语阅读分级指南针) • SPSS 26 • Lexical error rate: LE = Number of error words / Total number of word tokens $\times 100\%$

3. What are learners' experiences, perceptions, and improvements in vocabulary learning through the utilisation of SCVL?	Descriptive statistics Mean, Frequency, Percentage • Mean post SCVLQ Inferential statistics T-test Null hypotheses accepted (P <0.05)	• Microsoft Excel • Powered by www.wjx.cn • Questionnaires • SPSS 26
3a. What are learners' experiences in the utilisation of SCVL?	Questions of SCVLQ (A) of 8 items	• Microsoft Excel • Powered by www.wjx.cn • Questionnaires • SPSS 26
3b. What are learners' perceptions of DingTalk platform use in an SCVL environment?	Questions of SCVLQ (B) of 12 items	• Microsoft Excel • Powered by www.wjx.cn • Questionnaires • SPSS 26
3c. To what extent do learners perceive that SCVL has improved their vocabulary learning of Chinese writing?	Questions of SCVLQ (C) of 10 items	• Microsoft Excel • Powered by www.wjx.cn • Questionnaires • SPSS 26

After the written texts of artifacts and essays from the CFL learners have been collected, these collected data were gathered in an electronic corpus. The corpus was processed according to the following steps.

Chinese word segmentation: Chinese word segmentation system (<http://corpus.zhonghuayuwen.org/CpsWParser.aspx>) was used to segment words in each writing text, manually proofread them, and then saved in plain text format. After collecting the written text of artifacts and essays from respondents, the collected data were gathered into an electronic corpus one by one, and several sub-corpus were built based on essay titles, learners' names, genders, ages and other information.

Manual review of segmentation: to ensure the accuracy of word segmentation, a manual review was conducted to ensure the accuracy of the raw data.

Lexical classification of vocabulary: Excel was used to compare the collected vocabulary data with of the "National Graded Vocabulary List" (2010) and HSK 2.0 Word List. There are 2,245 common vocabulary, 3,211 intermediate vocabulary, 4,175 advanced vocabulary and 1,461 advanced appendix vocabulary in the "National Graded Vocabulary List" (2010) while there are 150 HSK Level 1 vocabulary, 300 HSK Level 2 vocabulary, 600 HSK Level 3 vocabulary, 1,200 HSK Level 4 vocabulary, 2,500 HSK Level 5 vocabulary and 5,000 HSK Level 6 vocabulary in the HSK 2.0 Word List.

Measurements on Chinese vocabulary growth and lexical richness: The data was imported into Excel and SPSS 26 for further analysis to obtain the research results. This was the most important step in this

research. Hence, a combination of descriptive and inferential statistics was employed to comprehensively examine the outcomes of this research. Additionally, various tools for measuring vocabulary proficiency have been utilised, including but not limited to Type-Token Ratio (TTR) and Lexical Frequency Profile (LFP). These tools play a pivotal role in assessing the usefulness of the SCVL approach in enhancing learners' vocabulary growth and lexical richness (Table 12).

Table 12 Measurements on Chinese Vocabulary Growth and Lexical Richness in Writing

Stage	1	2	3	4	Tools	Types of Artifact	Supported References
Vocabulary growth measurement							
Indicator 1 Type-Token Ratio (TTR)	TTR1	TTR2	TTR3	TTR4	• Microsoft Excel • Chinese HSK 2.0 Word List: http://hsk.blcu.edu.cn/ • Chinese word segmentation system: http://corpus.zhonghuayuwen.org/CpsWParser.aspx $TTR = \frac{\text{Number of word types} \times 100}{\text{Total number of word tokens}}$ • SPSS 26	All artifacts	Cao & Tian (2020); Wang, S. & Wang, H. Z. (2021)
Indicator 2 Adapted Chinese Lexical Frequency Profile (LFP)	LFP1	LFP2	LFP3	LFP4	• Microsoft Excel • Chinese HSK 2.0 Word List • Chinese word segmentation system: http://corpus.zhonghuayuwen.org/CpsWParser.aspx • https://www.languagedata.net/editor/ (汉语阅读分级指南) • SPSS 26	Essay artifacts	Wong et al. (2016); Wu (2016)
Lexical richness measurement							
Indicator 1: Lexical diversity (Uber index)	U1	U2	U3	U4	• Microsoft Excel • Chinese word segmentation system: http://corpus.zhonghuayuwen.org/CpsWParser.aspx • SPSS 26 • Uber index = $(\log_{\text{Tokens}})^2 / (\log_{\text{Tokens}} - \log_{\text{Types}})$	All artifacts	Cao & Tian (2020); Zhang (2019)

Indicator 2 Lexical sophistication: Advanced word rate (LS)	LS1	LS2	LS3	LS4	• Microsoft Excel • Chinese word segmentation system: http://corpus.zhonghuayuwen.org/CpsWParser.aspx • SPSS 26 • https://www.languagedata.net/editor/(汉语阅读分级指南针) LS = Number of advanced word tokens/ Number of word tokens ×100%	Essay artifacts	Cao & Tian (2020); Zhang (2019)
Stage	1	2	3	4	Tools	Types of Artifact	Supported References
Lexical richness measurement							
Indicator 3 Lexical error rate (LE)	LE1	LE2	LE3	LE4	• Microsoft Excel • Chinese word segmentation system: http://corpus.zhonghuayuwen.org/CpsWParser.aspx • SPSS 26 • Lexical error rate: LE= Number of error words/ Total number of word tokens ×100%	Essay artifacts	Cao & Tian (2020); Zhang (2019)

The artifacts mentioned above focused on sentences, paragraphs, and essays. Hence, the improvement of vocabulary learned in each stage must be the result of the comparison between the findings in relation to sentence to sentence, paragraph to paragraph, and essay to essay as the number of words obtained the by sentences, paragraphs, and essays respectively will affect the TTR values.

It is worth noting that in order to examine the learners' experiences and perceptions of the SCVL, section V of the research questionnaire was utilised after the study that employed a five-point Likert scale to elicit quantitative data. A one-sample t-test was also employed in the analysis of the data.

For qualitative data analysis, thematic analysis was employed in this research. As Braun and Clarke (2006) stated, thematic analysis is widely used "for identifying, analysing, and reporting patterns (themes) within data" as they found it to be a useful and flexible method for qualitative research in and beyond psychology. Furthermore, according to Clarke and Braun (2013), thematic analysis emerged as a method of recognising and categorising patterns based on qualitative data, followed by the process of constructing themes based on the data. Moreover, thematic analysis is an appropriate method for analysing qualitative data from a variety of CFL learners (Archibald et al., 2015; Maguire & Delahunt

2017; Zhang et al., 2021). In the context of diverse learner demographic with low-medium-high academic performance groups, as well as learners presenting a variety of learning goals, thematic analysis seemed an appropriate choice.

Based on this, Braun and Clarke (2006) proposed a step-by-step yet flexible guide which contains six phases (Figure 3.8) that begins from data preparation to reporting findings.

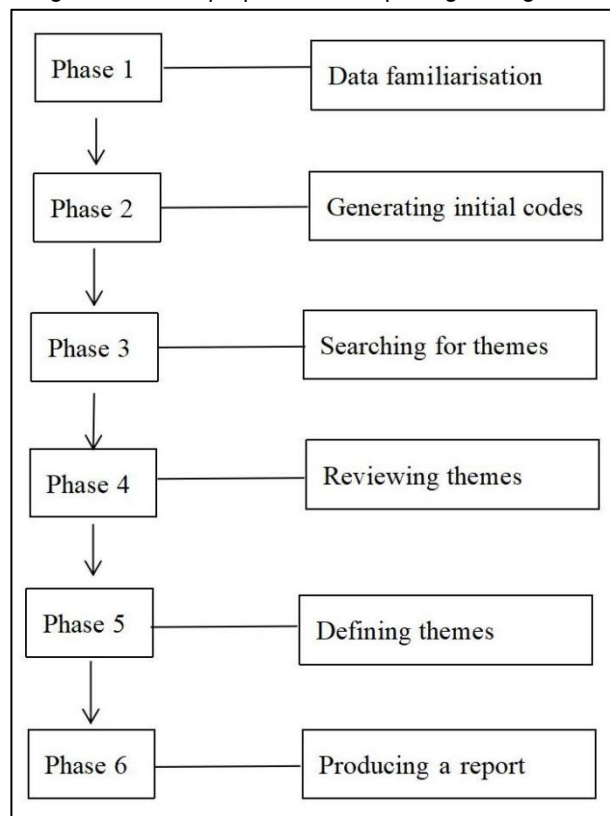


Figure 9 Six Phases of Thematic Analysis (Braun and Clarke, 2006)

Phase 1 included data transcription, reading, and rereading to immerse oneself as much as possible in the data. This was also done to jot down initial ideas. Although it is believed that it is tedious and time consuming, it is an excellent way for a researcher to become acquainted with the data.

In Phase 2, the researcher generates codes or a list of interesting ideas from collected data. Coding also entails categorising data into meaningful groups.

Phase 3 involves labelling previously discovered codes into broader themes and categorising all relevant coded data extracts under the identified themes. Unwanted codes may also be removed during this phase.

Phase 4 is concerned with the refinement of devised themes, where the coded extracts were reviewed to ensure that they fit into their respective themes. Also, the relationship between the themes and relevant codes were double-checked to ensure that it accurately reflected the meaning of the data. As a result, some themes were merged, while others were divided into additional themes.

Phase 5 concerned with defining and refining the themes to determine the essence of each theme and precisely what it is about, then determining the type of data each theme should capture.

Finally, Phase 6 entailed producing a report that tells the story of the data in an engaging and coherent manner.

Hence, the qualitative analysis of this research adhered to the six steps given above. This procedure was useful since it allowed for the shift from partially uncontrolled to carefully controlled data sources, covering the spectrum from general themes to possibly beneficial ones. This enabled the researcher to move from the general to the specific, providing a strong emphasis for the presentation of the findings (Braun & Clarke, 2006). Initially, there were a lot of different ideas, and the direction and outcome were not as clear as there were new concepts identified through the learners' comments. There were also codes that were unrelated to the RQs, or which were duplicates. After analysing, coding, and re-coding the data, reanalysing, collapsing the merging categories, amalgamating them, making changes to categorical labels, cross-checking, and reviewing, the data become more coherent. The central ideas also began to mature gradually by that point.

Furthermore, to address RQ 3, NVivo 12 Plus software was employed to analyse and discover insights in the qualitative data. By combining NVivo 12 Plus and the analysis method, thematic analysis was used to identify themes and place the data into a correlation of collected views to aid the understanding of the principal findings (Jon et al., 2014; Ramalingam et al., 2021). In the coding process using NVivo 12 Plus, each new thematic code was given a new index card with a reference, and then grouped together to form a thematic summary of frequently raised issues and perspectives (Armellini et al., 2021; Bielaczyc & Collins, 2007). This facilitated the descriptive analysis of the data themes, identification of connections and links, and underpinned any similarities or differences among the learners. The CFL learners' responses were juxtaposed and compared to ascertain any contradiction or agreement with regards to the perspectives on the use of SCVL (Table 13).

Table 13 Qualitative Data Analysis of the Research

Tools for Data Collection	Types of Data Collection	Methods of Data Analysis	Analysis Tool
Interviews	• Audio-based data, video-based data, etc	• Thematic analysis	NVivo 12 Plus
Open-ended questionnaires	• Textual data	• Thematic analysis	NVivo 12 Plus
Feedback	• Textual data	• Thematic analysis	NVivo 12 Plus

As stated in Table 13, in the interviews, data collection were audio-based data and video-based data. All audio-based and video-based data were transcribed and analysed manually. Besides that, thematic analysis was used to examine emerging themes.

Comments from open-ended questions of the questionnaire were textual data and were translated (if they write in Mandarin) and analysed manually. Also, thematic analysis was used to examine the themes that emerged.

Learners' feedback data were textual data and were analysed manually. Also, thematic analysis was used to examine the emerging themes.

2.9 Pilot Study

Prior to commencing the actual research, a pilot test was conducted to evaluate the research procedures, specifically focusing on the pilot testing of Research Questions 1 and 2 in the research study.

The pilot study took place during the July-September semester of 2021 in Chinese Mainland and analysed the vocabulary growth and lexical diversity of 138 artifacts that were produced by eight CFL learners who experienced SCVL. The learners made sentence artifacts and posted them every week on the DingTalk platform for eight weeks. During the pilot study, when the data were collected, the statistics of overall and stage-by-stage vocabulary use, TTR, as well as the Uber index were carried out to examine vocabulary growth and lexical diversity. One-way ANOVA was conducted to inspect whether there were significant differences in the relevant measures (TTR, Uber index) before conducting the pilot test across the two stages under the seamless learning environment. From the analysis carried out on the productive vocabulary data of the artifacts, the learners demonstrated that vocabulary growth and lexical diversity significantly improved. To note, following the pilot study, interviews were conducted to investigate the estimated time required by learners to create artifacts. The pilot findings revealed that crafting artifacts consisting of 1-2 sentences took approximately 20-30 minutes. Subsequent to the pilot study, the feedback obtained from the participants was meticulously analysed. Learners expressed their enthusiasm for seamless learning as an engaging approach to Chinese vocabulary learning. Their input played a pivotal role in identifying areas warranting further enhancement. Consequently, specific modifications were implemented to address these concerns. For example, the interview questions were refined for greater precision and comprehensibility, offered additional guidance to participants to

streamline the artifact creation process, and fine-tuned the seamless learning approach based on their valuable suggestions.

In summary, the conducted pilot study served multiple purposes: 1) it appraised the learners of their role in the seamless learning design; 2) it scrutinised the research instruments; 3) it collected feedback regarding artifact creation and the seamless learning approach; and 4) it offered the opportunity for reflective revision of the research procedures, methods, and instruments (Thomas, 2017).

2.10 Validity, Reliability and Trustworthiness

The questionnaires were employed to support the quantitative findings, therefore, establishing the validity and reliability of the questionnaire was important. The questionnaire underwent validation processes by three CFL experts from three universities in Chinese Mainland, which are Wuhan University, Xiamen University and Sichuan University of Media and Communications. After the pilot test, all three experts, namely a senior CFL lecturer and two associate professors in linguistics with an in-depth understanding of the present research granted the research questionnaires with a very positive and encouraging validation report, with no corrections needed to be made. Their comments were as follows:

Comments from an Associate Professor of Wuhan University:

This seamless Chinese vocabulary learning questionnaire is detailed, reasonably designed, interesting and logical, which can help researchers to comprehensively understand the learning process and findings of HSK Level 4 vocabulary through seamless learning framework and social media DingTalk. In general, the questionnaire content is extensive, comprehensive and useful!

Comments from an Associate Professor of Xiamen University:

The questionnaire is very informative and comprehensive, covering many aspects of your doctoral research. The questionnaires can be implemented.

Seamless learning is a relatively new area, and your questionnaire design is very meaningful. The content of seamless learning questionnaires has a reasonable arrangement for the investigation of learners' Chinese vocabulary learning, vocabulary growth and lexical richness.

Comments from a Senior lecturer at Sichuan University of Media and Communications:

There are many items in the questionnaires, which can comprehensively investigate learners' Chinese learning status and Chinese vocabulary learning condition, as well as the support and help of seamless learning to learners' Chinese vocabulary, and finally help learners to achieve vocabulary growth and lexical richness in writing.

With regards to the reliability of questionnaires, the questionnaires were piloted and the reliability result attained a Cronbach's alpha value of 0.826 (i.e., acceptable). Furthermore, as there were many mathematical formulas used to obtain the numerical value that examines vocabulary growth and lexical richness, their validity must be informed and supported in this research. Subsequently, references for the validity of the formulas are listed in Table 14, together with the references for the recent adoption of the formulas in academic research.

Table 14 References for the Validity of the Formulas

Formulas	Validity	Supported References
Type-Token Ratio (TTR) $TTR = \frac{\text{Number of word types} \times 100}{\text{Total number of word tokens}}$	Huang & Qian (2003); Laufer & Nation, 1995; Vermeer (2000); Wang, S. & Wang, H. Z., 2021	Wang, S. & Wang, H. Z. (2021) Wong et al. (2016)
Adapted Chinese Lexical Frequency Profile (LFP)	Laufer & Nation (1995); Meara (2005); Mo (2017); Wu (2016)	Wong et al. (2016); Aw et al. (2016)
Uber index $U = (\log \text{Token})^2 / (\log \text{Tokens} - \log \text{Types})$	Jarvis (2002); Treffers-Dalleret et al. (2018); Vermeer (2000); Wu & Hu (2021); Zhang et al. (2021)	Cao & Tian (2020); Wu & Hu (2021)
Advanced word rate $LS = \frac{\text{number of advanced word tokens}}{\text{number of word tokens}} \times 100\%$	Duan (2018); Huang & Qian (2003); Li (2013)	Cao & Tian (2020); Zhang J. J. (2019)
Lexical error rate $LE = \frac{\text{Number of error words}}{\text{Total number of word tokens}} \times 100\%$	Duan (2018); Engber (1995); Huang & Qian (2003); Read (2000); Schmitt (2014)	Cao & Tian (2020); Zhang, H. (2021)

With regards to the use of the DBR approach, due to the intricacies involved, critics often questioned both the credibility and generalisability of DBR. However, some scholars argue that an important aspect of DBR lies in both its ecological validity and its usefulness (e.g., Barab & Squire, 2004; Becker, 2019; Co & Lim, 2021; Victor & Ha, 2021). As stated by Becker (2019), DBR takes place in authentic and complex real-world settings, which means that the findings can increase credibility and ecological validity.

For qualitative analysis, this academic project was limited in terms of the number of researchers and CFL learners involved. Only one researcher conducted the research for the award of a PhD degree and there was no funding available to recruit another researcher for the data analysis. Based on this, to ensure the trustworthiness of the results obtained from qualitative research, a thematic analysis approach entailing step-by-step analysis was outlined. The themes that were derived from the learners' quotations after the coding process through thematic analysis are highlighted in Chapter 5. This approach not only holds the potential to enhance the reliability of the research but also increases its transparency and reproducibility for future evaluation purposes. For the limited number of learners, this limitation may impact the generalisability of the findings, as the results may not be representative of a larger population. However, qualitative analysis has its strengths, such as the ability to provide rich and

in-depth insights into complex phenomena. Additionally, triangulation of data from multiple sources can also enhance the robustness of the findings.

Furthermore, another useful procedure to address the credibility and trustworthiness of the research is the triangulation of information “to enhance the internal validity in mix-method studies” (Dawadi et al., p. 28). Therefore, in this research, the respondents were recruited from three universities and were divided into three cohorts based on their academic performance in Chinese: high, medium, and low. The collection of perceptions from various CFL learners allowed for the triangulation of data sources (Moon, 2019; Natow, 2020). In addition, the use of interviews and open-ended questionnaires resulted in multi-method triangulation (Natow, 2020). Furthermore, in this research, to validate the data obtained from CFL learners, “time triangulation” should be highlighted and described (Zohrabi, 2013 p. 256). According to Fraenkel et al. (2012), consistency over time with regards to what researchers are seeing or hearing is a strong indicator of reliability.

In the context of this research, the study extended over a duration of 16 weeks, during which tracking interviews were employed to substantiate ongoing progress. This approach significantly bolsters the internal validity of the findings.

Notably, within the framework of thematic analysis applied in this research study, a specialised software tool, NVivo 12 Plus, played a pivotal role in facilitating the systematic identification and organisation of themes. The incorporation of such software offers the distinct advantage of reducing potential researcher bias, thereby enhancing the overall reliability of the theme development process (Jon et al., 2014; Ramalingam et al., 2021).

Furthermore, to further fortify the reliability of the identified themes and their corresponding definitions, a meticulous peer review process was undertaken. One seasoned qualitative researcher, with expertise specifically in the field of Chinese as a foreign language, was enlisted for this purpose. Her feedback is provided below.

Comments from an Associate Professor of WH University:

In this research study, a thematic analysis was employed as the chosen method to analyse qualitative data sources, encompassing interviews, learner feedback, and open-ended questionnaires. The purpose of this analytical approach was to unveil, explore, and elucidate the underlying patterns and insights inherent within the dataset.

Following a comprehensive review of the coded references, themes, and sub-themes, a total of seven overarching themes and sixteen sub-themes emerged from the in-depth examination of interviews, open-ended questionnaires, and feedback datasets. These themes are not only intriguing but also provide a comprehensive reflection of learners' experiences, challenges, and their attitudes and opinions concerning the utilisation of the DingTalk platform.

Furthermore, it is evident that the validation of these themes was conducted rigorously by incorporating direct quotations sourced directly from Chinese

as a Foreign Language (CFL) learners. In conclusion, the thematic analysis employed in this study demonstrates both reliability and trustworthiness in capturing the nuanced insights derived from the participants.

The feedback and insights provided by her, which were integral to the peer review process, were found to be instrumental in refining and validating the identified themes, thereby ensuring a faithful representation of the intricacies within the dataset. As a result of this comprehensive approach to theme development, which involved the combination of software-assisted analysis with expert peer review, a reaffirmation of our unwavering commitment to upholding the highest standards of rigor and reliability in this research was achieved.

2.11 Summary

In this chapter, the methodological processes involved in the research have been outlined and described. The research objectives and research questions were carefully addressed. Meanwhile, the primary purposes of the research were explained clearly and a single group design with intra-group comparison repeated measurements was adopted. Notably, the results of pilot study were discussed, and the outcomes were positive and supportive.

The research methodology of this study is a mixed-method research design. DBR was used as one of the qualitative methods in this research to guide, design, and support learners' SCVL process. In other words, a combination of quantitative and qualitative data were collected and analysed. In terms of quantitative data, all sentences, paragraphs and essay artifacts were collected and copied to a Microsoft Excel file for further analysis. Moreover, the 16-week seamless learning period was divided into four stages for comparative analysis, with four weeks allocated for each stage. This enabled the researcher to measure learners' progress in artifact creation across time. Then, the productive vocabulary use in these artifacts was analysed to measure the various indicators for vocabulary growth and lexical richness of CFL learners across the four DBR stages. This research was also supplemented by qualitative data to understand the problems encountered during seamless learning implementation as part of the DBR. The findings and analysis are presented in subsequent sections.

3. Findings

This chapter aims to provide a comprehensive quantitative and qualitative analysis of the research study, blending both objective and subjective interpretations of the data. The integration of these two methods ensures a more robust analysis of the data, enabling the researcher to draw more accurate and meaningful conclusions.

Section 3.1 of this book is dedicated to presenting the quantitative findings derived from the research study. In contrast, Section 3.2 of this book focuses on presenting the qualitative findings of the research study.

3.1 Quantitative Analysis and Findings

The quantitative findings from the data analysis correspond to the three research questions outlined in Chapter 1 of this research, which are as follows:

1. RQ 1: To what extent is SCVL able to enhance productive vocabulary growth of Chinese writing?
2. RQ 2: To what extent does SCVL enhance lexical richness of Chinese writing?
3. RQ 3: What are learners' experiences, perceptions, and improvements in vocabulary learning through the utilisation of SCVL?

The three research questions are answered in subsequent sections. Specifically, to examine the extent of SCVL's role in enhancing productive vocabulary growth and the lexical richness of Chinese writing, supporting evidence based on the learners' artifact-making in terms of the vocabulary used from learning stages 1 to 4 is presented in a variety of ways to support the research findings.

Notably, each learner is identified by an assigned number (Thomas, 2009), accompanied by specific abbreviations. In addition, learners with different Chinese performance levels were numbered sequentially from low to high based on the initials of their Chinese names (Learner 1-10 = Low performance, Learner 11-21 = Medium performance, e.g., L1, Low, Week 1). The abbreviations indicate the data sources through which the learners' perceptions were obtained. The abbreviations employed are as follows:

Learner 1 = L1, Interview = I, Post Interview = PI, Open-ended Questionnaire = OQ,
Learners' Feedback = F

To recap, 32 mixed-ability international students learning Chinese language with high to low academic performances based on HSK Level 3 scores and Chinese writing performance participated in this study. Each CFL learner used their smartphone to take photos in their daily lives, created artifacts with the Chinese vocabulary learned, and posted them onto the DingTalk learning platform for peer discussions. The researcher (who was also the Chinese language instructor of the class) took charge of and designed the lessons for the teaching and learning of the HSK Level 4 syllabus for this group of CFL learners.

As the previous chapter indicated, the learners' process of SCVL was guided by four DBR stages in a 16-week intervention. Thus, throughout the intervention, multiple types of data were collected. However, the quantitative findings were derived from the data collected via questionnaires from the 32 CFL learners and the 2,301 artifacts that they posted on the DingTalk platform over the four-month

intervention. Notably, during the process of quantitative analysis, the artifacts-making mentioned above focused on sentences, paragraphs, and essays.

Overall, this chapter investigated the productive vocabulary growth and lexical richness of 1,921 sentence artifacts, 252 paragraph artifacts, and 128 essay artifacts for a total of 2,301 artifacts. This chapter does not analyse the comments on artifacts given by the CFL learners for peer interactions because an in-depth analysis of the CFL learners' interactions is beyond the scope of this research. This research mainly focuses on how CFL learners have improved in using Chinese vocabulary in the artifact creation.

As this was a longitudinal intervention that emphasised on the CFL learners' self-directed artifact creation over time and provides an intra-group comparison to reveal learners' vocabulary growth and lexical richness in different learning groups, it was not feasible to find a control class to make comparison. Thereafter, SPSS version 26 was adopted to analyse the quantitative data. All the findings are discussed in subsequent sections.

3.1.1 Findings of the Pre-research Questionnaire

In this section, the findings of the pre-research questionnaire are reported. The pre-research questionnaire consists of four sections and was administered before the research began. It was completed by the 32 CFL learners in the first induction week and was administered before the research started.

3.1.1.1 Demographic Profile

The purpose of this section is to provide valuable insights into the demographic profile of the CFL learners. Although they were recruited by purpose-based sampling, it is important to understand the nature and characteristics of the sample population (Salkind 2010).

Table 15 Demographic Data

Demographic	Values	Frequency	Percentage
Age	≥ 23	11	34.37%
	21 ≤ age ≤ 22	18	56.25%
	18 ≤ age ≤ 20	3	9.38%
Gender	Female	22	68.74%
	Male	10	31.26%
Nationality	Cambodia	8	25%
	Tanzania	3	9.38%
	Sudan	1	3.12%
	Egypt	7	21.88%
	Yemen	1	3.12%

	Pakistan	2	6.25%
	Indonesia	2	6.25%
	Vietnam	2	6.25%
	Thailand	6	18.75%
Duration of learning Chinese	< 2 years	3	9.38%
	2 ≤ years < 4	8	25%
	4 ≤ years < 5	12	37.5%
	years ≥ 5	9	28.12%
HSK Level 3 scores	180-220 points	10	31.26%
	221-260 points	11	34.37%
	261-300 points	11	34.37%

Hence, a total of 32 CFL learners in Chinese Mainland completed the survey. Five aspects of demographic information were gathered which are age, gender, nationality, duration of learning Chinese, and HSK Level 3 scores. The demographic information of the samples is shown in Table 15.

In terms of age, 56.25% of the participating learners were between 21-22 years old. This age range is common for universities and colleges in Chinese Mainland. Although the number of males is fewer than females in this research (1:2.2), according to DataMart (Data source: School of International Education of 3 Universities, 2021) information for 2019/2020 gathered from the internal systems of the three universities, the male to female ratio is about 1:2.2 among the three universities, respectively. The distribution of the learners according to gender is shown in Table 4 (Chapter 2). There was no gender bias as the sample ratios were in accordance with the population ratio as a whole.

All the participating international students were HSK Level 4 learners and they were from the Belt and Road Initiative countries, including Thailand, Laos, Cambodia, Indonesia, Tanzania, and other countries. They were pursuing their degree education at the universities in Chinese Mainland. Concerning the duration of learning Chinese (before and after coming to China), 37.5% of the learners had studied Chinese language within 4-5 years and 28.12% of the learners had studied Chinese for 5 years and above. In terms of HSK Level 3 scores, all the learners had passed HSK Level 3 with 34.37% of the learners achieving 261-300 points, and 34.37% and 31.26% of the learners achieving 221-260 points and 180-220 points, respectively.

3.1.1.2 Categorising Learners into Three Performance Groups

In conducting the research, the learners were classified into three groups based on their proficiency level in Chinese (HSK Level 3, which corresponds to CEFR level B1) and their Chinese writing grade, as determined by placement exams administered by the three universities. To clarify, CEFR is the standard for language proficiency assessments used globally (Common European Framework of Reference for Languages, 2023). The B1 level of CEFR indicates the understanding of familiar matters regularly encountered at work, school, leisure, etc. and ability to produce simple connected text on topics that are familiar or of personal interest (Common European Framework of Reference for Languages, 2023). HSK

(Hanyu Shuiping Kaoshi) is a standardised test for Mandarin Chinese proficiency that consists of six levels (Chinese Testing International, 2009). HSK Level 3 is the intermediate level of proficiency for Mandarin Chinese, where learners can communicate on familiar topics and have a good command of basic grammar and vocabulary. A placement exam or placement test in a university is an assessment designed to evaluate someone's pre-existing knowledge of a subject to determine the most suitable level for the person to begin coursework for that subject (Placement exam, 2023). This type of assessment was used by three universities to evaluate their learners' proficiency levels in the Chinese language. It was used to place them in HSK Level 4 programs that matched their knowledge and skills. The placement exam included various formats such as sentence making, essays, and others and was administered in person (Zhang, H., 2021; Zhang, M. J., 2022). The results reasonably reflect the performance of learners who took the placement tests. Next, the information of these three performance groups is shown in Table 16 below.

Table 16 Categorisation of 32 Learners into Three Performance Groups

Group	HSK Level 3 Scorer Ranking	N	%	Chinese Writing Performance	N	%
Low	180-220 points	10	31.26%	Grade C - B ⁻	11	34.37%
Medium	221-260 points	11	34.37%	Grade B - B ⁺	12	37.50%
High	261-300 points	11	34.37%	Grade A ⁻ - A ⁺	9	28.13%

Note:

1. The HSK Level 3 passing score is 180-300 points.
2. Passing HSK Level 3 is equivalent to CEFR Level B1.
3. Chinese writing performance level are D, C, C+, B-, B, B+, A-, A, A+.

Note 1. N = number of learners Note 2. % = Percentage

It should be noted that the CFL proficiency levels of the 32 learners were verified using HSK Level 3 examination results, and all passed the exam. The passing score for HSK Level 3, as determined by the Chinese Testing International (2009), is 180 out of a possible 300. To pass the exam, candidates must demonstrate an intermediate level of proficiency in Mandarin Chinese, which includes the ability to comprehend and utilise basic Chinese phrases and sentences on familiar topics, along with a solid grasp of basic grammar and vocabulary (Chinese Testing International, 2009).

To enhance the reliability of this research, three Chinese lecturers from three different universities were involved in the grouping process. As per the information provided by the three universities, Chinese writing performance is typically evaluated on a grading scale ranging from D to A, with D representing the lowest and A representing the highest level of performance (Syllabus of Chinese Language Program for Foreign Learners in Colleges and Universities, 2002). This grading scale aligns with the standards established by the Ministry of Education in China and is frequently utilised in Chinese language education programs in universities (including the three universities mentioned) across the country. The outcome of the discussion revealed that the low performance group is determined if the HSK Level 3 score is between 180 and 220 points and the learners' Chinese writing grade is rated C to C+. If the HSK Level 3 score is between 221 and 260 points and the learners' Chinese writing grade is rated B to B-, the learners are classified as the medium performance group. Meanwhile, learners with a score

between 261 and 300 and Chinese writing grade rated B+ and above are classified under the high performance group.

Based on above criteria, a total of 32 CFL learners were classified into three performance groups based on their HSK Level 3 scores and Chinese writing performance in the placement test. Of these learners, 10 obtained scores lower than 220 of the HSK Level 3 test and were classified into the low performance group. To note, 11 learners received grades ranging from C to B- for their Chinese writing performance. However, one learner achieved a significantly higher HSK Level 3 score than the passing score of 180, measuring 248, and was therefore transferred to the medium performance group to reflect the learner's advanced proficiency level. Besides that, another 11 learners scored between 281 and 296 for the HSK Level 3 test including the placement test range and were categorised as the high performance group. The remaining learners had HSK Level 3 scores between 221 and 260, and initially, 11 learners were placed in the medium performance group. On the other hand, 12 learners received grades ranging from B to B+ for their Chinese writing performance in the placement test and should be classified as the medium performing group. Nonetheless, two learners achieved exceptional HSK Level 3 scores of 289 and 290, respectively, and were moved to the high performance group based on their scores, leaving 10 learners in the medium performance group. Importantly, one learner from the low performance group with an HSK Level 3 score of 248 was transferred to the medium performance group. Ultimately, based on their HSK Level 3 scores and Chinese writing performance of the placement test, the learners were classified into Low (10), Medium (11), and High (11) performance groups.

As a result, this research included 10, 11, and 11 CFL learners with low to high academic performances from three universities. They were organised into a cohesive group of 32 people of varying abilities to participate in the seamless Chinese HSK Level 4 course over the four-month intervention. To note, the 32 learners were enrolled in the same course, which was the HSK Level 4 course with the same curriculum to cover the HSK Level 4 syllabus. Moreover, the learners who were pursuing their degree education in Chinese Mainland had a relatively consistent educational background.

3.1.1.3 Learners' Perceptions and Opinions on CFL Learning

The purpose of the pre-research questionnaire was to gather the learner's demographic information, Chinese learning background, and the triangulate learners' perceptions on the use of seamless learning to support their CFL learning, particularly Chinese vocabulary. An analysis of the responses has revealed the following key findings:

- i. All 32 intermediate level learners passed HSK Level 3 and thus were eligible to participate in this research with academic performances ranging from low-medium-high. With the HSK Level 3's Chinese proficiency, the learners had the ability to make comments or engage in discussions on social media platforms and perform related writing tasks in the Chinese language.
- ii. 87.50% of the learners reported that they think "teacher-centric" pedagogy is good because the teacher or educator will guide them with everything related to Chinese learning.
- iii. 68.75% of the learners looked forward to a class with reasonable learning activities to meet the learning requirements, such as vocabulary games, group interaction, oral presentation, etc.

- iv. Learning through “Definitions” was deemed by 81.25% of learners as the most widely used method in learning Chinese vocabulary, while 31.25% reported that “Scenarios” is one of the teaching methods for Chinese vocabulary.
- v. 90.63% of the learners reported that they think mobile devices and social media platforms can assist them in learning Chinese vocabulary anytime and anywhere.
- vi. 90.63% of the learners indicated that they think mobile devices and social media platforms can assist them in learning Chinese vocabulary outside the classroom.
- vii. 84.38% of the learners reported that they want to reduce the errors of vocabulary usage, followed by 78.13% of learners who want to increase the number of vocabulary or phrases.
- viii. 68.75% of the learners reported that they wanted to achieve the goal of using vocabulary flexibly in spoken and written Chinese, mostly through the use of mobile device and social media platforms.
- ix. 81.25% of the learners reported that apart from in-class formal learning, they like to learn Chinese vocabulary whenever and wherever they are curious to learn.

Next, the findings of the four parts pre-research questionnaire will provide the source of the above key findings, and these are presented below.

a) Chinese Learning Condition

Section ii of the pre-research questionnaire consists of seven items that elicited the learners’ background information and their Chinese learning condition. Based on the findings of learners’ Chinese performance, differences were noted in their points of HSK Level 3; all intermediate level learners with academic performances ranging from low-medium-high were eligible to participate in this research.

Reflecting on the Chinese learning condition, seven aspects were identified. The first question aimed to examine the learners’ motivation to learn Chinese language. As shown in Figure 10, the majority of those who responded to this item felt that “To find a good job” motivated them to learn Chinese language at 65.63%. Following this, 62.5% of the learners reported being interested in Chinese culture, and “Having a special interest in language studies” was ranked third (56.25%).

Almost two-thirds of the learners (65.63%) indicated that they have explicit job-seeking instrumental motivation. Intrinsic motivation comes second. In addition, 40.63% of the learners reported that they wanted “To secure a better life in the future.” These learners had more instrumental motivation than intrinsic motivation. Notably, “Others” accounted for 6.3%, including for scholarships and making a lot of money, which illustrates the extrinsic motivation for them to learn Chinese language.

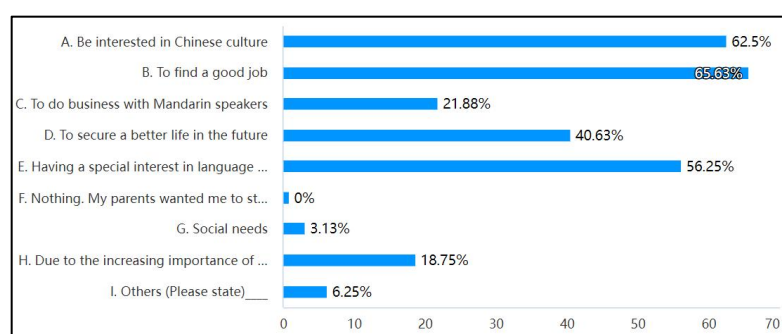


Figure 10 Learners' Motivation to Learn Chinese Language

Next, learners' career plan after graduation was investigated. As shown in Figure 11 below, a minority of learners (12.5%) indicated that they will go back to their home country to do business but will have products supplied from China after graduation. Additionally, "Be an interpreter" and "Do business in China" accounted for 18.75%, respectively. Surprisingly, 31.25% of the learners informed that they would continue to do a Master's degree after graduation. It is presumed that having a Master's degree could help them find a good job than a Bachelor's degree (Byrne, 2022). After being affected by the COVID-19 pandemic in the past three years, and with the economic downturn caused by the adjustment of the economic structure, the number of fresh university graduates and previous unemployed graduates was huge, resulting in an unprecedented increase in the current employment pressure (Rosik et al., 2022). Therefore, it is also a useful way to delay employment pressure through graduate school (Liu, 2022; Wang et al., 2022).

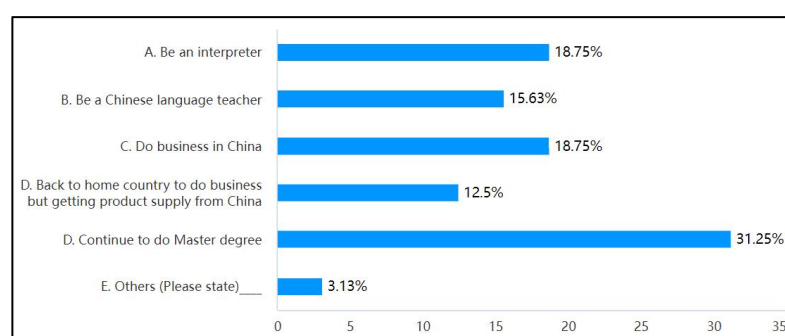


Figure 11 Learners' Career Plans after Graduation

Next, regarding the total hours the learners spent learning Chinese apart from in-class formal learning, Figure 12 shows an overview of the time learners spend on Chinese informal learning during the day. A total of 43.75% of learners spent 2-3 hours learning Chinese during informal learning settings while 25% of them spent 1-2 hours learning Chinese.

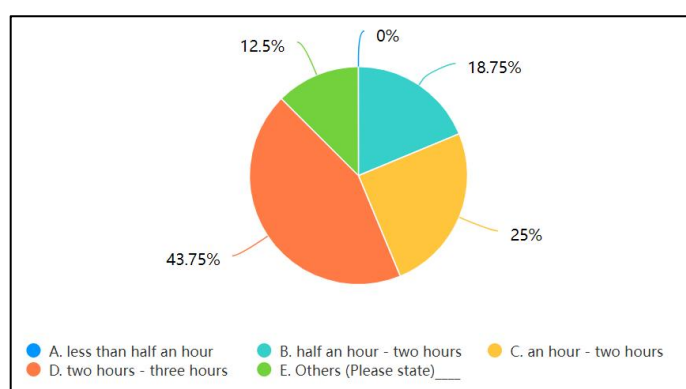


Figure 12 Time Spent on Learning Chinese

Subsequently, learners were asked to comment on “teacher-centric” Chinese classes. Figure 13 shows that 87.5% of the learners deemed that it is good because the teacher or educator will guide them on everything related to Chinese learning.

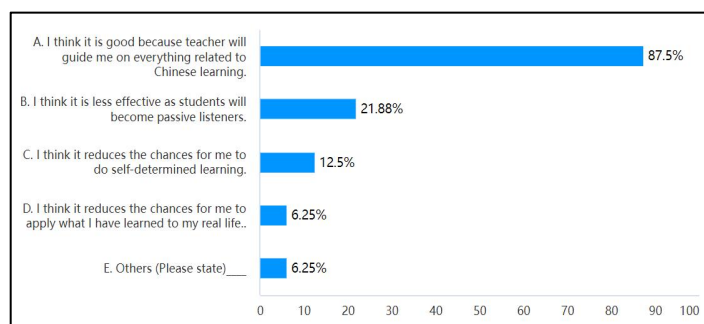


Figure13 Learners' Comments on “Teacher-Centric” Chinese Classes

When asked about the extent to which they prefer a “teacher-centric” Chinese class, 46.88%, 25%, and 3.13% of the learners “Prefer”, “Strongly prefer”, and “Very strongly prefer” (Figure 14) a “teacher-centric” Chinese class, respectively. In other words, the teacher-centric method is perceived as an efficient method of delivering a new lesson (Cui, 2003; Lu, 2012), especially in a formal teaching setting with limited contact hours.

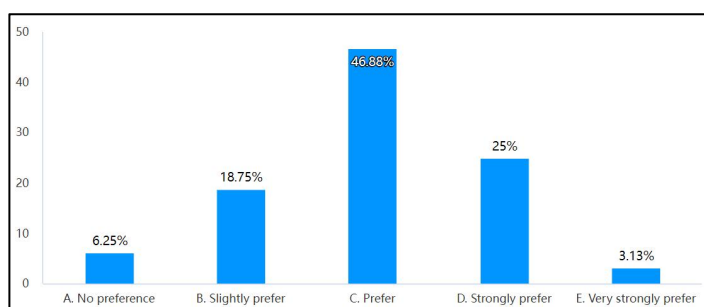


Figure 14 Learners' Preference of “Teacher-Centric” Chinese Classes

In terms of investigating the kind of Chinese class learners are looking forward to, the findings show that 68.75% (Figure 15) of the learners looked forward to a class with reasonable learning activities to meet the learning requirements, such as vocabulary games, group interaction, oral presentation, etc. From the findings of the responses, these learners would like to learn Chinese language proactively.

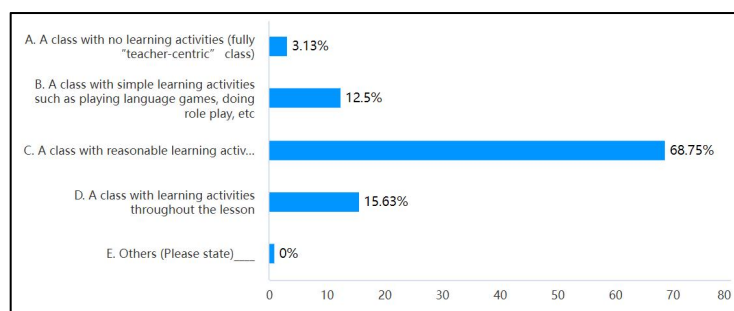


Figure 15 Learners' Expected Chinese Class

When asked about their preferred Chinese learning styles, there were a variety of responses. From Figure 16 the most popular Chinese learning style was to discuss with teachers and classmates (71.88%). "Watch video" (68.75%) was seen as the second most preferred Chinese learning style. This research may posit that these learners prefer an interactive classroom learning. This is because the language learning of learners develops interactively in the process of input and output (Corder, 1967; Fu, 2020). Besides that, "Learn from teacher's PPT" and "Read Chinese textbook" accounted for 59.38% respectively. It is evident that these learners have consciousness of autonomous learning. Notably, 50% of the learners preferred to use an online platform for self-study, while 40.63% of the learners would rather use a mobile device and social media platform to learn the Chinese language. This can be explained by the increased popularity of smartphones, the rapid growth of mobile-based educational tools, and their increased application to support foreign language learning (e.g., Hiew et al., 2018; Jiang & Li, 2018; Xiao et al., 2021; Yin, 2022).

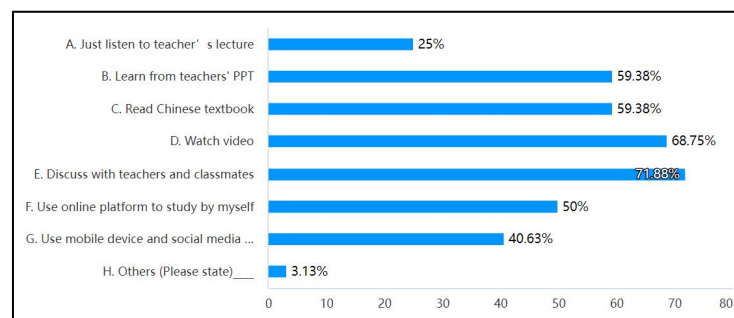


Figure 16 Learners' Preferred Chinese Learning Styles

b) Learners' Aim for Chinese Vocabulary Learning

Section iii of the pre-research questionnaire consists of five items designed to gather learners' aim for learning Chinese vocabulary. With regards to the method of teaching new vocabulary in the formal classroom, various vocabulary teaching methods identified are presented in Figure 17. The most widely used method was to learn from "Definitions" (81.25%). Next, is the use of "Synonyms" (75%) and "English translations" (75%) in the formal classroom to teach new vocabulary. Only 31.25% of the learners who answered this question reported "Scenarios" as another teaching method.

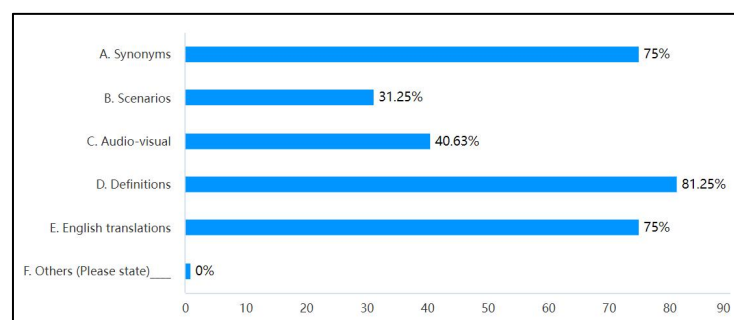


Figure 17 Chinese Vocabulary Teaching Methods

When asked about the aspects of Chinese vocabulary knowledge learners want to improve on, Figure 18 shows that 84.38% of the learners wanted to reduce the errors of vocabulary usage, followed by 78.13% of the learners who wanted to increase the mastery of the number of vocabulary or phrases in Chinese learning. “To identify the characteristics of vocabulary” and “To integrate the previous and new vocabulary” accounted for 68.75% and 50%, respectively. This data provides a foundation for the research’s assertion that learners would like to improve their vocabulary knowledge in the aspects of the correct use of vocabulary, increasing vocabulary or phrases, identifying characteristics of vocabulary, and the integration of previous and new vocabulary among others.

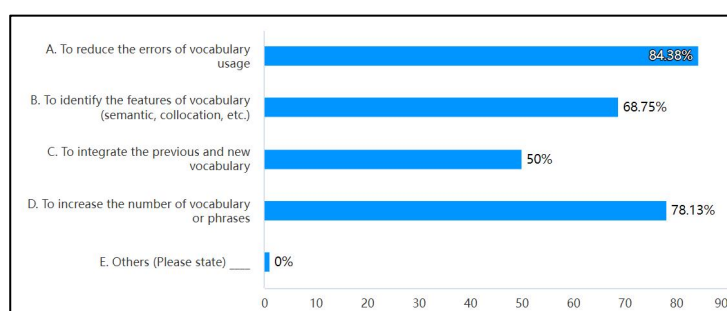


Figure 18 Improvement in Chinese Vocabulary Knowledge

Next, Figure 19 below shows that “Be able to understand and know Chinese film and TV works” (78.13%), “Be able to use vocabulary accurately to write a good paragraph in Chinese” (75%), and “Be able to use accurate vocabulary to write correct Chinese sentences” (71.88%) were the learners’ Chinese vocabulary learning goals. The principle of “learning for practice” is generally acknowledged by the learners.

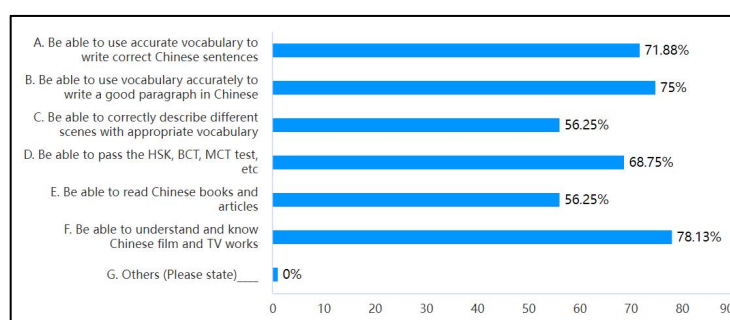


Figure 19 Learners’ Chinese Vocabulary Learning Goals

In terms of utilising a mobile device and social media platform to enhance Chinese vocabulary learning, Figure 20 shows that 90.63% of the learners believed that they can use mobile devices and social media platforms to help them learn Chinese vocabulary anytime and anywhere. Also, encouragingly, 90.63% of the learners indicated that they think mobile devices and social media platforms can assist them in learning Chinese vocabulary outside of the classroom.

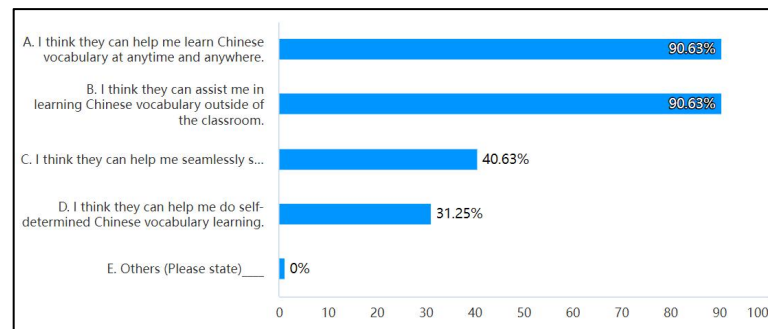


Figure 20 Learners' Opinions on Utilising Mobile Device and Social Media Platform

The above findings concerning the utilisation of mobile device and social media platform to enhance Chinese vocabulary learning were encouraging. Thereafter, to further delve into Chinese vocabulary learning goals through the use of mobile devices and social media platforms, more than two thirds of the learners reported that they wanted to achieve the goal of using vocabulary flexibly in spoken and written Chinese (Figure 21). Following this, 28.13% of the learners informed that they wanted to identify specific meanings of vocabulary in different contexts. Therefore, the incorporation of mobile devices and social media platforms into a learning programme is imperative to the design-base of the lesson and activities (Wong et al., 2016).

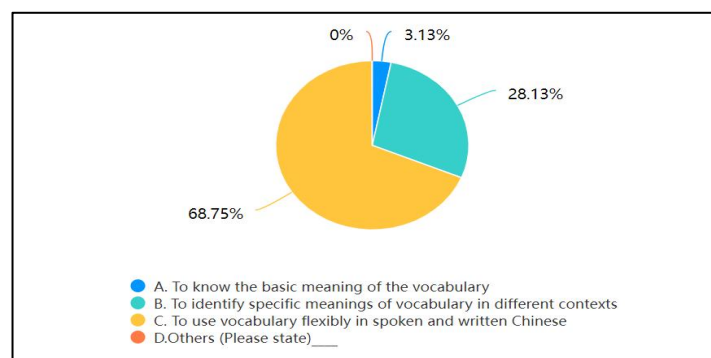


Figure 21 Learners' Vocabulary Learning Goals

c) Perceptions on Chinese Vocabulary Learning

One of the objectives of this research is to explore learners' perceptions in Chinese vocabulary learning. Section iv (10 items) sought to identify the learners' perceptions of Chinese vocabulary learning. The first four items reflected learners' perceptions towards Chinese vocabulary learning in Table 17.

Table 17 Learners' Perceptions on Chinese Vocabulary Learning

Items	Strongly disagree		Disagree		Somewhat agree		Agree		Strongly agree		Mean
	F	%	F	%	F	%	F	%	F	%	
1. It is important for me to master Chinese vocabulary	1	3.31%	3	9.38%	2	6.25%	14	43.75%	12	37.5%	4.03

for my Chinese course.											
2. It is important for me to master written Chinese.	1	3.13%	2	6.25%	18	75%	14	43.75%	9	28.13%	3.88
3. I believe I can do well in vocabulary learning in Chinese class.	0	0%	2	6.25%	4	12.5%	15	46.88%	11	34.88%	4.09
4. I like the traditional methods of “teacher-centric” Chinese vocabulary learning in university.	1	3.13%	3	9.38%	11	34.38%	15	46.88%	2	6.25%	3.44

Note. F=Frequency

The findings, as shown in Table 17, indicate that the learners' motivation (intrinsic motivation and self-efficacy) and their perceptions towards the mastery of Chinese vocabulary, written Chinese, and to do well in Chinese class, were generally positive. This clearly indicates that the majority of learners have positive attitudes towards Chinese vocabulary learning.

To note, learners least preferred traditional methods of teacher-centric Chinese vocabulary learning in their university (Mean=3.44 in Table 17). More than half of learners like the traditional methods of teacher-centric Chinese vocabulary learning in their university (53.13%). These findings suggest that the "teacher-centric" method is still popular in formal classroom learning. Hence, this consideration is crucial for the intervention by educators in a formal learning context and to implement the learning activities in this research. However, a certain extent of self-directed learning is also important as proposed and guided by the SCVL in this research.

Next, the findings on learners' perceptions, affectivity, and motivation towards informal Chinese vocabulary learning are reported in the remaining six items of Section iv (Table 18).

Table 18 Participating Learners' Perceptions, Affectivity and Motivation Towards Informal Chinese Vocabulary Learning

Items	Strongly disagree		Disagree		Somewhat agree		Agree		Strongly agree		Mean
	F	%	F	%	F	%	F	%	F	%	
1. I like the informal Chinese vocabulary learning in real and authentic situations.	2	6.25%	0	0%	7	21.88%	17	53.13%	6	18.75%	3.78

2. I am interested in Chinese vocabulary learning outside of the classroom (at home, on campus, and other places, etc.).	0	0%	1	3.13%	7	21.88%	14	43.75%	10	31.25%	4.03
3. I am happy to share content in Chinese about my daily life on social media platform.	0	0%	4	12.5%	13	40.63%	9	28.13%	6	18.75%	3.53
4. I am interested in posting Chinese content on social medial platform with vocabulary that I have learned in formal classroom.	0	0%	4	12.5%	7	21.88%	16	50%	5	15.63%	3.69
5. Apart from in-class formal learning, I like to learn Chinese vocabulary whenever and wherever I am curious.	0	0%	4	12.5%	9	28.13%	14	43.75%	5	15.63%	3.81
6. I am happy with the help of mobile devices and social media platforms to improve my informal Chinese vocabulary learning.	1	3.13%	1	3.13%	5	15.63%	11	34.38%	14	43.75%	4.13

Note. F= Frequency

As shown in Table 18, the findings clearly illustrate that the majority of learners have better perceptions, affectivity, and motivation towards informal Chinese vocabulary learning. Three main findings are shown below:

1. Over two-thirds of learners indicated that they like the informal Chinese vocabulary learning in real and authentic situations (71.88%); they are interested in Chinese vocabulary learning outside of the classroom (at home, on campus, and other places, etc.) (75%).
2. 65.63% of the learners were interested in posting Chinese content on social media platforms with vocabulary that they have learned in the formal classroom.
3. 81.25% of the learners reported that apart from in-class formal learning, they like to learn Chinese vocabulary whenever and wherever they are curious to learn.

In particular, learners' affectivity towards the help of mobile devices and social media platforms to improve their informal Chinese vocabulary learning is high (Mean = 4.13). Fundamentally, mobile

devices can no longer be viewed as a device that wastes time (Wong et al., 2021; Xiao et al., 2021). Unexpectedly, only 46.88% of the learners reported that they were happy to share content in Chinese about their daily life on social media platforms (Table 4.4). The reason behind this was investigated in the main research.

The findings above from the pre-research questionnaire formed the basis of the principal research study. They were used to guide the design of the learning process to integrate formal and informal Chinese language learning, which would enhance learners' vocabulary learning and exploit their perceptions towards the seamless learning of this research process.

3.1.2 Quantitative Finding of RQ 1

To address RQ 1, which was "To what extent is SCVL able to enhance productive vocabulary growth of Chinese writing?", there are two refined sub-research questions along with the corresponding null and alternative hypotheses. Productive vocabulary growth of Chinese writing is measured by the number of vocabulary used for artifact-making in terms of TTR sentence/TTR paragraph/TTR essay and the HSK Level 4 vocabulary distribution in essay artifacts.

The null and alternative hypotheses were investigated. The hypotheses tested statistically significant differences of productive vocabulary growth of Chinese writing across the learning stages using two-way ANOVA. To note, two-way ANOVA was used to compare the mean of two or more groups across two independent variables to determine whether there is a significant difference between the groups and if the effect of one independent variable depends on the other (Nibrad, 2019). Specifically, the "Time main effect", "Group main effect", and "Interaction effect" were employed to identify vocabulary growth in terms of TTR values and LFP rates. The "Time main effect" refers to the impact of one independent variable (i.e., Time) on the dependent variable (e.g., TTR sentence) while disregarding the other independent variable (i.e., Group), which in this case is time. The "Group main effect", on the other hand, pertains to the effect of one independent variable (i.e., Group) on the dependent variable (e.g., TTR sentence), while disregarding the other independent variable (i.e., Time), which in this case is the group. Finally, the "Interaction effect" is used to determine whether the effect of one independent variable (e.g., time) on the dependent variable (e.g., TTR sentence) differs depending on the level of another independent variable (e.g., group) (Nibrad, 2019). Specifically, if the interaction effect is significant, a post-hoc test will be required separately in different stages. The post-hoc test, also known as multiple comparison test (MCT) is used to compare the mean of multiple groups after an ANOVA has determined that there is a significant difference between at least two of the groups (Lee, S., & Lee, D. K., 2018; Mishra et al., 2019; Nibrad, 2019). Furthermore, the alpha level of significance was set at 0.05. The sample size is 32. For the region of rejection, this research rejected the null hypotheses if $p < 0.05$. Based on this, the findings of RQ 1a and RQ 1b are discussed accordingly (Section 3.1.2.1 and Section 3.1.2.2).

3.1.2.1 Findings of RQ 1a

RQ 1a: Do seamless learning activities enhance the number of vocabulary used for sentence/paragraph/essay artifact-making across the four learning stages?

The corresponding null and alternative hypotheses are presented as follows:

1. H01: Seamless learning activities do not enhance the number of vocabulary used for sentence artifact-making.
2. Ha1: Seamless learning activities significantly enhance the number of vocabulary used for sentence artifact-making.
3. H02: Seamless learning activities do not enhance the number of vocabulary used for paragraph artifact-making.
4. Ha2: Seamless learning activities significantly enhance the number of vocabulary used for paragraph artifact-making.
5. H03: Seamless learning activities do not enhance the number of vocabulary used for essay artifact-making.
6. Ha3: Seamless learning activities significantly enhance the number of vocabulary used for essay artifact-making.

The number of vocabulary used for sentence/paragraph/essay artifacts is referred to as the TTR value. The differences in performance were examined in accordance with the three groups of the learners across the four stages. Based on this, the indicators of “TTR sentence”, “TTR Paragraph”, and “TTR essay” were employed to investigate the extent of the number of vocabulary used in sentences, paragraphs, and essays. The calculations of these indices were explained in Section 2.13. Simultaneously, it is shown below.

Type-Token Ratio (TTR) = (Number of types×100/ Number of tokens) (Laufer & Nation, 1995, p. 31)

An example of the calculation of “TTR sentence” is provided below. In presenting the artifact authentically, no revisions were made on the written text.

Example 1 with word segmentation: 买/花/给/她/, 不仅/表示/你/很/浪漫/, 还/表示/你/很/真心/爱/她/的/。
(L22, High, Stage 1)

Pinyin: Mǎi huā gěi tā, bùjǐn biǎoshì nǐ hěn làngmàn, hái biǎoshì nǐ hěn zhēnxīn ài tā de。

English translation: Buying flowers for her not only means that you are very romantic, but also means that you really love her.

Number of types: 13

Number of tokens: 17

TTR= Number of types×100/ Number of tokens = 13×100/17= 76.47

Since the number of words of sentences, paragraphs, and essays affect the TTR value, the improvement of stage-by-stage vocabulary learning must be evaluated by comparing the findings from sentence to sentence, paragraph to paragraph, and essay to essay. If the values of TTR for sentences,

paragraphs, and essays are different across the four stages, this could indicate differences in the vocabulary growth of the text at different levels of analysis (Wong et al., 2016; Fu, 2020). Also, this comparison is sufficient to present the improvement throughout the four stages of SCVL. Next, the findings of TTR sentence, TTR paragraph, and TTR essay are reported below.

a) Findings of TTR Sentence

Referring to “TTR sentence”, the calculations of 1,921 sentence artifacts were similar to the above example. Table 19 displays the outcomes of a two-way ANOVA on TTR sentence across the four stages and within three performance groups.

Table 4.5 TTR Sentence for Three Performance Groups across Four Stages

Indicator (<i>M</i> ± <i>SD</i>)	Group	Stage 1	Stage 2	Stage 3	Stage 4	Group Main Effect (<i>F/p</i>)	Time Main Effect (<i>F/p</i>)	Interaction Effect (<i>F/p</i>)
TTR Sentence	Low	71.98±1.63	76.45±1.68	81.15±1.78	84.73±1.95			
	Medium	73.61±2.38	78.00±2.15	83.21±1.96	87.89±1.21	64.839***	481.782***	0.002/
	High	74.96±1.70	82.55±2.24	87.27±1.56	91.74±0.76	<0.001	<0.001	0.211
	Total	73.57±2.24	79.08±3.29	83.97±3.09	88.23±3.18			

Note. M=mean, SD=standard deviation

Firstly, the time main effect is significant. In terms of TTR sentence, which indicates the number of vocabulary used by learners in their sentences, there was a positive improvement in overall vocabulary growth as the stages were compared. The TTR sentence values increased from 73.57 to 88.23 ($F=481.782$, $p<0.001$), indicating a substantial increase in learners’ productive vocabulary growth in terms of sentence artifacts over time.

Similarly, the group main effect was found to be significant when comparing the three performance groups of learners based on their high, medium, and low levels of performance. Specifically, it was observed that the TTR sentence of the high performance group was significantly higher than that of the medium performance group, and the TTR sentence of the medium performance group was significantly higher than that of the low performance group ($F=64.839$, $p<0.001$).

One significant discovery regarding sentence artifacts was that the high performance group had the highest TTR sentence values, while the learners in the low and medium performance groups demonstrated positive improvement (Figure 22).

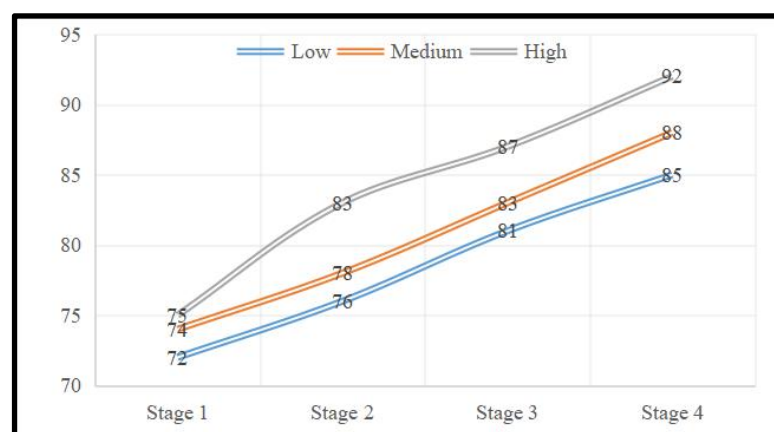


Figure 22 TTR Sentence for All Three Performance Groups across Four Stages

However, it should be noted that the interaction effect was not significant ($p > 0.05$), which indicates that the outcome of the intervention on TTR sentence was consistent across all performance groups (Mishra et al., 2019; Nibrad, 2019). Thus, regardless of whether learners are in the low or high performance group, the four stages of SCVL have a positive impact on them.

In order to assess the usefulness of SCVL in enhancing productive vocabulary growth in Chinese writing, the aforementioned results were reinforced by providing specific instances. The performance of a single learner in terms of her TTR sentence artifacts was tracked and analysed across four stages. Furthermore, by examining an individual's TTR sentence, it may be possible to monitor the learner's proficiency in CFL over a period of time. The following examples demonstrate sentence artifacts created by L12.

Example 2 with word segmentation: 我/不仅/喜欢/游泳/, 我/也/喜欢/散步/。(L12, Medium, Stage 1) Pinyin: Wǒ bùjǐn xǐhuan yóuyóǒng, wǒ yě xǐhuan sàn bù. English translation: Not only do I like swimming, but I also like to go for a walk. Number of types: 6 Number of tokens: 8 $TTR = \text{Number of types} \times 100 / \text{Number of tokens} = 6 \times 100 / 8 = 75$
Example 3 with word segmentation: 回到/宿舍/看到/了/其他/人/的/鞋子/, 太/讨厌/了/, 是/谁/放/在/这里/的/! (L12, Medium, Stage 2) Pinyin: Huídào sùshè kàndào le qítā rén de xiézi, tài tǎoyàn le, shéi fàng zài zhèlǐ de! English translation: When I went back to the dormitory, I saw other people's shoes, it was so annoying, who put them here! Number of types: 14 Number of tokens: 17 $TTR = \text{Number of types} \times 100 / \text{Number of tokens} = 14 \times 100 / 17 = 82.35$
Example 4 with word segmentation: 这/房间/我/用/晚上/特别/睡觉/的/时候/使用/, 来/中国/学习/以后/, 我/的/阅读/能力/提高/了/。(L12, Medium, Stage 3)

Pinyin: Zhè fángjiān wǒ yòng wǎnshàng tèbié shuìjiào de shíhòu shǐyòng, lái zhōngguó xuéxí yǐhòu, wǒ de yuèdú nénglì tígāo le。

English translation: I use this room especially when I sleep at night. After studying in China, my reading ability has improved.

Number of types: 18

Number of tokens: 20

$TTR = \text{Number of types} \times 100 / \text{Number of tokens} = 18 \times 100 / 20 = 90$

Example 5 with word segmentation: 虽然/上海人/也/会/讲/普通话/, 可是/仔细/听/, 还是/有/上海/ 味儿/呢/, 哈哈/。(L12, Medium, Stage 4)

Pinyin: Suīrán shànghǎi rén yě huì jiǎng pǔtōnghuà, kěshì zǐxì tīng, háishì yǒu shànghǎi wèier ne, hāhā。

English translation: Although Shanghainese can speak Mandarin, but listen carefully, it still has a Shanghai dialect, haha.

Number of types: 15

Number of tokens: 15

$TTR = \text{Number of types} \times 100 / \text{Number of tokens} = 15 \times 100 / 15 = 100$

The TTR values of these sentence artifacts from stages 1 to 4 increased at 75, 82.35, 90, and 100, respectively.

b) Findings of TTR Paragraph

Referring to the TTR paragraph, the calculations of 252 written artifacts for all stages were similar to the above examples. Table 20 depicts the outcomes of two-way ANOVA on TTR paragraph for three performance groups across the four stages.

Table 20 TTR Paragraph for Three Performance Groups across Four Stages

Indicator ($M \pm SD$)	Group	Stage 1	Stage 2	Stage 3	Stage 4	Group Main Effect (F/p)	Time Main Effect (F/p)	Interaction Effect (F/p)
TTR Paragraph	Low	63.02 $\pm$ 2.64	66.89 $\pm$ 3.38	71.60 $\pm$ 4.34	72.56 $\pm$ 11.70	<0.001	<0.001	0.812/0.564
	Medium	67.50 $\pm$ 3.00	68.89 $\pm$ 4.28	72.29 $\pm$ 4.31	78.69 $\pm$ 1.55			
	High	72.88 $\pm$ 3.44	77.15 $\pm$ 4.00	79.02 $\pm$ 4.47	84.18 $\pm$ 3.16			
	Total	67.96 $\pm$ 5.08	71.18 $\pm$ 5.93	74.45 $\pm$ 5.46	78.66 $\pm$ 8.29			

Note. M–mean, SD–standard deviation

The results presented in Table 4.7 reveal that the time main effect is statistically significant. The TTR paragraph, which serves as an indicator of the number of vocabulary used in a paragraph, shows a significant improvement in vocabulary growth across the four stages of the study. Specifically, the TTR paragraph increased from 67.95 to 78.49 ($F=28.690$, $p<0.001$), which indicates a noteworthy enhancement in learners' productive vocabulary growth in terms of paragraph artifacts over time. In addition, the group main effect was also significant. The TTR paragraph for the high performance group was considerably higher than that of the medium performance group, and the TTR paragraph for the medium performance group was significantly higher than that of the low performance group ($F=42.813$, $p<0.001$). Hence, the TTR of paragraphs presents a positive growth pattern over time in different performance groups (Figure 23).

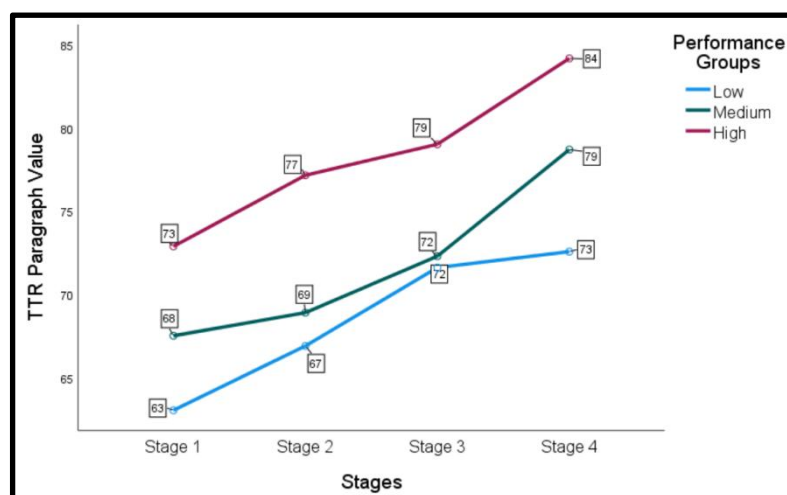


Figure 23 TTR Paragraph for All Three Performance Groups across Four Stages

However, the interaction effect between time and group is not significant ($p>0.05$), which indicates that the outcome of the intervention on the TTR paragraph was consistent across all performance groups (Mishra et al., 2019; Nibrad, 2019). To clarify, irrespective of the learners' performance level (i.e., low or high), the implementation of the four stages of SCVL demonstrated a favourable impact on their learning outcomes.

Next, to investigate the positive outcomes of SCVL in enhancing the productive vocabulary growth of Chinese writing in terms of paragraph artifacts, concrete examples of TTR paragraph are provided. By tracking and examining a learner's performance in TTR paragraph from stages 1 to 4, instructors may develop individualised learning plans to support the learner's language development. At the same time, to present the authenticity of paragraph artifacts, the written texts were not revised. For instance, some paragraph artifacts from L6 across different learning stages (i.e., stages 1, 3, 4) are shown below.

Example 9 with word segmentation: 爱情/和/结婚/有/密切/关系/。爱情/很/重要/，为了/是/继续/结婚/。如果/你/爱/一/个/人/，你/希望/跟/他/结婚/和/生活/。你/爱/他/的/优点/和/缺点/。我/认为/没有/爱/的/结婚/会/失败/。有的/人/结婚/，但是/他们/不/爱/互相/。所以/他们/面临/很/大/的/困难/，因为/他们/之间/没有/了解/。他们/可能/互相/分开/和/离婚/。(L6, Low, Stage 1)

English translation: Love and marriage are closely related. Love is very important in order to continue to get married. If you love someone, you want to marry and live with him. You love him with his strengths and weaknesses. I think a marriage without love will fail. So they face great difficulty because there is no understanding between them. they may separate and divorce each other.

Number of types: 44

Number of tokens: 67

$TTR = \text{Number of types} \times 100 / \text{Number of tokens} = 44 \times 100 / 67 = 65.67$

Example 10 with word segmentation: 说到/幸福/上/，人们/会/有/自己/的/想法/。在/我/心里/，幸福/就是/需要/有钱/含有/浪漫/的/爱情/。第一/的/原因/就是/钱/可以/让/你/买/东西/，过/好好/的/生活/。如果/你/有/比较/多/的/钱/，你/也/不用/工作/得/太/努力/，还是/加班/到/午夜/。第二/的/原因/，浪漫/的/爱情/会/让/你/很/开心/。例如/你/跟/你/的/情人/会/一起/做/你们/想要/的/事情/，买/很/多/的/东西/，去/很/多/的/地方/。(L6, Low, Stage 3)

English translation: When it comes to happiness, people have their own ideas. In my heart, happiness requires money and romantic love. The first reason is that money allows you to buy things and live a good life. If you have more money, you don't have to work too hard, you still work overtime until midnight. The second reason why romantic love makes you happy. For example, you and your lover will do what you want together, buy a lot of things, and go to many places.

Number of types: 57

Number of tokens: 84

$TTR = \text{Number of types} \times 100 / \text{Number of tokens} = 57 \times 100 / 84 = 67.86$

Example 11 with word segmentation: 我/热爱/亚洲/文化/，尤其/是/中国/文化/。我/最/爱/听/韩红/的/歌/。中国/回顾/了/更/有/5000/年/历史/的/故事/。五百年/前/，当/中国/已经/有/了/繁荣/的/高等/文化/时/，

今天的/阿拉伯/地区/的/情况/如何/? 不但/中国/的/生活/成本/要/低/得/多/ 而且/外国/菜/是/我/见过/的/最/贵/的/国家/之一/。在/麦当劳/吃/一/顿/简单/的/早餐/要/花/你/20/美元/。但/在/中国/你/可以/买/几/天/的/饭菜/。不但/不/中国/的/ 医疗/ 保健/ 很/ 棒/反而/认识/从/外国/来/中国/治病/的/人/很多/。中国/的/中医/很/神奇/希望/毕业/以后/ 能/再/回来/。感受/中国/最/真的/文化/。(L6, Low, Stage 4)

English translation: I love Asian culture, especially Chinese culture. China recalls an even older 5,000-year-old story. What was the situation in the Arabian region five hundred years ago, when China already had a prosperous high culture? Not only is the cost of living in China much lower, but foreign cuisine is one of the most expensive I have ever seen. Not only is the medical care in China great, but I know many people who come to China from foreign countries for medical treatment. I hope to come back after graduation. Experience the most genuine Chinese culture.

Number of types: 84

Number of tokens: 122

TTR = Number of types×100/ Number of tokens = 84×100/192 = 68.85

c) Findings of TTR Essay

TTR essay was obtained based on the 128 written essay artifacts collected from all four stages. Table 21 presents an overview of learner TTR essay among the different performance groups and across the four stages.

Table 21 TTR Essay for Three Performance Groups across Four Stages

Indicator (<i>M±SD</i>)	Group	Stage 1	Stage 2	Stage 3	Stage 4	Group Main Effect (<i>F/p</i>)	Time Main Effect (<i>F/p</i>)	Interaction Effect (<i>F/p</i>)
TTR Essay	Low	53.04±3.10	52.93±6.24	54.45±3.18	61.64±6.63			
	Medium	58.78±4.46	58.84±5.41	61.78±4.03	63.27±5.26	18.250***	9.351***	1.792/
	High	64.08±5.15	63.54±5.77	65.20±5.38	65.61±5.28	<0.001	<0.001	0.110
	Total	58.81±6.19	58.61±7.11	60.66±6.14	63.57±5.78			

Note. M=mean, SD=standard deviation

The results of two-way ANOVA indicate that both the time main effect and group main effect were statistically significant. In terms of the time main effect, the TTR essay, which serves as an indicator of learners' vocabulary usage in essays, showed a significant improvement in overall vocabulary growth from stages 1 to 4. Specifically, the TTR essay increased from 58.81 to 63.57 ($F=9.351$, $p<0.001$).

Likewise, the group main effect was found to be significant, with the TTR essay for the high performance group being significantly higher than that of the medium performance group, and the TTR essay for the medium performance group being significantly higher than that of the low performance group ($F=18.250$, $p<0.001$). Overall, the TTR of essays presents a positive growth trend over time in different performance groups (Figure 24)

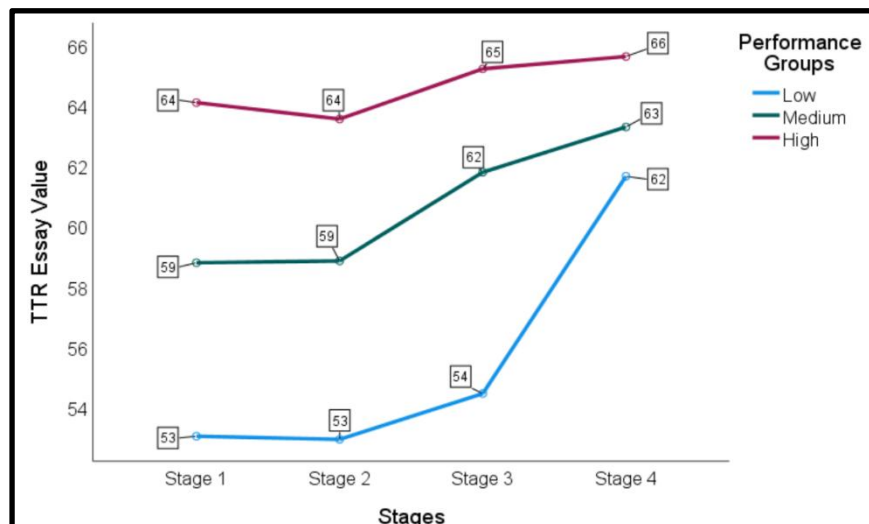


Figure 24 TTR Essay for All Three Performance Groups across Four Stages

However, the interaction effect was found to be not significant ($F=1.792$, $p>0.05$), which indicates that the outcome of the intervention on TTR essay was consistent across all performance groups (Mishra et al., 2019; Nibrad, 2019). To clarify, the positive impact of the four stages of SCVL was evident for learners irrespective of their placement in either the low or high performance group.

Next, in order to facilitate personalised learning and monitor learners' writing proficiency development over a period of time, additional evidence was presented to corroborate the enhancement of learners' productive vocabulary growth in essay writing, as observed in stages 1 to 4 of a learner of medium performance level.

Example 12 with word segmentation: 我/理想/的/城市/不仅/是/一/个/大/的, 而且/还是/非常/现代/的/地方/。因为/觉得/大/的/城市/好玩儿/、有趣/。每天/你/可以/参观/不同/的/地方/, 例如/博物馆/。公园/, 多种/饭馆/, 酒吧/, 名胜古迹/等/等/。小/的/时候/, 我们/居住/在/一/个/小/乡村/。这/个/乡村/没有/电影院/和/咖啡馆/什么/的/, 只有/一/个/游泳池/, 大约/有/五/个/饭馆/, 一/个/公园/还有/三/个/学校/, 所以/我/觉得/小/的/乡村/和/小/的/没/意思/。记得/有/一/次/, 我/的/家庭/来/中国/旅行/看/我/, 和/爸/妈/爷/奶/一起/旅行/在/很/多/城市/。我们/去/过/北京/, 桂林/, 西安/, 成都/还有/上海/:都/是/很/漂亮/的/城市/, 但是/我/最/喜欢/的/地方/是/上海/。我/觉得/上海/是/我/的/理想/的/城市/。上海/是/很/热闹/, 即/现代/又/漂亮/。帅哥/多/, 时尚/, 潮流/等/。我/特别/喜欢/它/。如果/选择/居所/, 我/一定/选择/上海/。(L11, Medium, Stage 1)

English translation (Summarised): When we were young, we lived in a small village. My ideal city is not only a big one, but also a very modern place. Because I think big cities are fun and interesting. I've been to Beijing, Guilin, Xi'an, Chengdu and Shanghai. If I choose to live, I will definitely choose Shanghai.

Number of types: 91

Number of tokens: 143

$TTR = \text{Number of types} \times 100 / \text{Number of tokens} = 63.64$

Example 13 with word segmentation: 记得/第一/次/来/中国/南京/学习/中文/是/20/岁/的/时候/。当时/十分/激动/。因为/初次/到达/，很/好奇/。礼拜天/，我/就/和/朋友/坐/公共汽车/去/夫子庙/观光/。我们/还/不/适应/这里/，所以/也/是/我们/第一/次/吃/中国/菜/。我/听说/了/中餐/很/辣/。而且/经常/用/筷子/。我/觉得/吃/别的/国家/饭菜/很/奇怪/还有/了/不起/。但是/我们/都/喜欢/吃饭/了/以后/我们/去/新街口/，晚上/去/看看/城市/。南京/的/晚上/景色/太/美丽/了/。跟/我/的/国家/的/城市/不/一样/，很/多/人/骑/自行车/和/摩托车/，在/商店/里/买/东西/比/我/的/国家/便宜/。之后/的/一/个/假期/，我们/决定/去/看看/别的/城市/，所以/我们/打算/去/北京/。在/北京/我们/去/看/过/天安门/。真/漂亮/和/宏伟/。我们/没/去/过/里面/因为/票/有点/贵/。但是/我/想/下一次/去/看/里面/。然后/我们/去/了/颐和园/。在/那里/很/漂亮/和/安静/。然后/在/王府井/逛街/，三里屯/，雅宝路/，秀水街/。下次/我/打算/旅行/去/上海/，广州/，了解/中国/的/少数民族/、品尝/小吃/还有/四川/火锅/、大/熊猫/等/等/。但是/现在/新冠病毒/，老师/告诉/我们/必须/在/宿舍/，不/可以/去/危险/的/地方/。哎呀/，当时/的/旅行/太/难忘/了/，很/多/人/，也/没有/COVID/。(L11, Medium, Stage 4)

English translation (Summarised): My friends took me to see Tiananmen Square in Beijing and went shopping in Wangfujing, Sanlitun, Yabao Road, Xiushui Street. Next time I plan to travel to Sichuan, to learn about the ethnic minorities in China, to taste snacks, hot pot and giant pandas. On Sunday, I took a bus with my friends to visit the Confucius Temple. I've heard that Chinese food is very spicy. The trip was so memorable, lots of people, and no COVID.

Number of types: 133

Number of tokens: 202

TTR = Number of types×100/ Number of tokens = 65.84

3.1.2.2 Findings of RQ 1b

RQ 1b: How does the HSK Level 4 vocabulary distribution in essay artifacts vary across the four learning stages?

The corresponding null and alternative hypotheses are presented as follows:

1. H04: There is no statistically significant difference in HSK Level 4 vocabulary distribution of essay artifacts across the four learning stages.
2. Ha4: There is a statistically significant difference in HSK Level 4 vocabulary distribution of essay artifacts across the four learning stages.

The distribution of HSK Level 4 vocabulary in essay artifacts was measured using the adapted Chinese LFP and expressed as a percentage. The performance of learners across the four learning stages was analysed based on three designated performance groups. The calculation of the LFP for HSK Level 4 is presented below.

$$\text{LFP} = \text{Number of HSK Level 4 word tokens} / \text{Total number of word tokens} \times 100\%$$

Note. LFP refers to the HSK Level 4 vocabulary distribution rate

To note, there were no revisions to the written texts when presenting the authentic essay artifact. Take L14's essay artifact from Stage 4 as an example:

Example 14 with word segmentation: 我/记得/新冠病毒/发生/前/的/一/个/寒假/旅行/，我/和/两/个/朋友/去/北京/。本来/要/坐/飞机/，后来/因为/下雨/就/坐/了/火车/选项/。因为/我们/坐/夜/火车/去/北京/，所以/很/早/到/了/。我们/先/去/找/宾馆/，然后/去/天安门/广场/和/故宫/。我们/都/觉得/非常/漂亮/！第二/天/和/导游/去/颐和园/、圆明园/和/北京大学/，人/特别/少/，可是/很/冷/，由于/冬天/去/。晚上/我们/去/了/看/奥林匹克/游泳池/和/鸟巢/。第三/天/我们/去/过/长城/和/王府井/大街/吃/传统/地道/的/小吃/。长城/的/景色/很/美丽/，我们/也/激动/极了/。我们/拍/很/多/照片/.....因为/第七/天/离开/，结束/旅行/。这/次/旅行/真得/很/好/，心情/愉快/极了/，没有/压力/，十分/难忘/。(L14, Medium, Stage 4)

English translation (Summarised): I remember a winter vacation trip before the outbreak of the COVID 19. I went to Beijing with two friends. The scenery of the Great Wall is very beautiful, and we are very excited. This trip was really good, very enjoyable, and very memorable.

To facilitate a more comprehensive analysis of L14's LFP, the number of HSK Level 4 word tokens was ascertained using the LanguageData tool (Jin et al., 2018), and the resulting LFP is presented in Table 22.

Table 22 The L14's LFP of Essay Artifact

HSK 2.0 Word List	Number of Word Tokens	Number of Word Types
HSK Level 1	80	24
HSK Level 2	19	16
HSK Level 3	19	12
HSK Level 4	30	25
HSK Level 5	3	1
HSK Level 6	0	0
Super class words	58	54
In total	209	132
LFP = Number of HSK Level 4 word tokens/ Total number of word tokens ×100%		
LFP = 30/ 209 ×100% = 14.35%		

To examine the statistical significance of the adapted Chinese LFP, a two-way ANOVA was conducted on 128 written texts across all stages. The results of the two-way ANOVA examination are presented in Table 23. To note, in order to not overwhelm readers with too much statistical detail, only the comparisons of the percentages of HSK Level 4 words are presented as one of the main purposes of the research is to encourage the learners to be more inclined to present their thoughts and experiences using the target vocabulary learned (i.e., HSK Level 4 words).

Table 23 LFP for Three Performance Groups across Four Stages

Indicator (<i>M</i> ± <i>SD</i>)	Group	Stage 1	Stage 2	Stage 3	Stage 4	Group Main Effect (<i>F</i> / <i>p</i>)	Time Main Effect (<i>F</i> / <i>p</i>)	Interaction Effect (<i>F</i> / <i>p</i>)
LFP	Low	5.87%±2.17%	8.28%±2.46%	10.10%±2.92%	12.51%±2.48%	7.634 **/ 0.002	141.818 ***/ <0.001	1.144/ 0.345
	Medium	9.63%±2.63%	11.41%±2.80%	13.13%±3.01%	15.88%±2.91%			
	High	10.24%±2.42%	11.99%±3.73%	14.38%±3.42%	18.05%±3.90%			
	Total	8.67%±3.07%	10.63%±3.38%	12.61%±3.52%	15.57%±3.83%			

Note. M–mean, SD–standard deviation

As shown in Table 23, the findings indicated that both the time main effect and group main effect were significant. The time main effect revealed a significant improvement in learners' HSK Level 4 vocabulary distribution across the four stages. Specifically, the LFP increased significantly from 8.67% to 15.57% ($F=141.818$, $p<0.001$).

The group main effect was also significant when comparing the three different performance groups. The LFP for the high performance group was significantly higher than that for the medium performance group, and the LFP for the medium performance group was significantly higher than that for the low performance group ($F=7.634$, $p<0.01$). Overall, the learners' LFP presents a consistent trend over time in different performance groups (Figure 25).

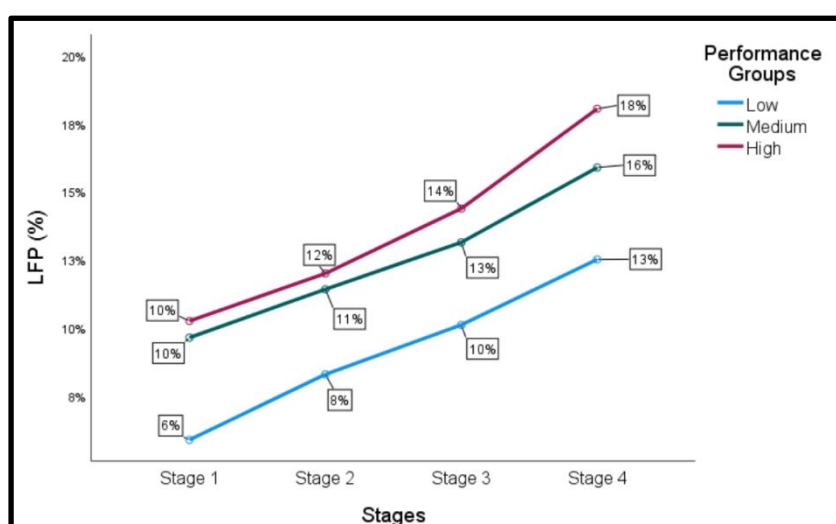


Figure 25 LFP for All Three Performance Groups across Four Stages

However, the interaction effect was not significant ($F=1.144$, $p>0.05$), which indicates that the outcome of the intervention on LFP was consistent across all performance groups (Mishra et al., 2019;

Nibrad,2019). Thus, whether learners are in the low or high performance groups, the four stages of SCVL benefitted them.

Next, to investigate the impact of SCVL on productive vocabulary growth in Chinese writing using HSK Level 4 vocabulary distribution, the aforementioned findings were supported by specific examples. Specifically, the performance of six learners in terms of LFP from stages 1 to 4 was tracked and analysed to gain a deeper understanding of their CFL writing progress.

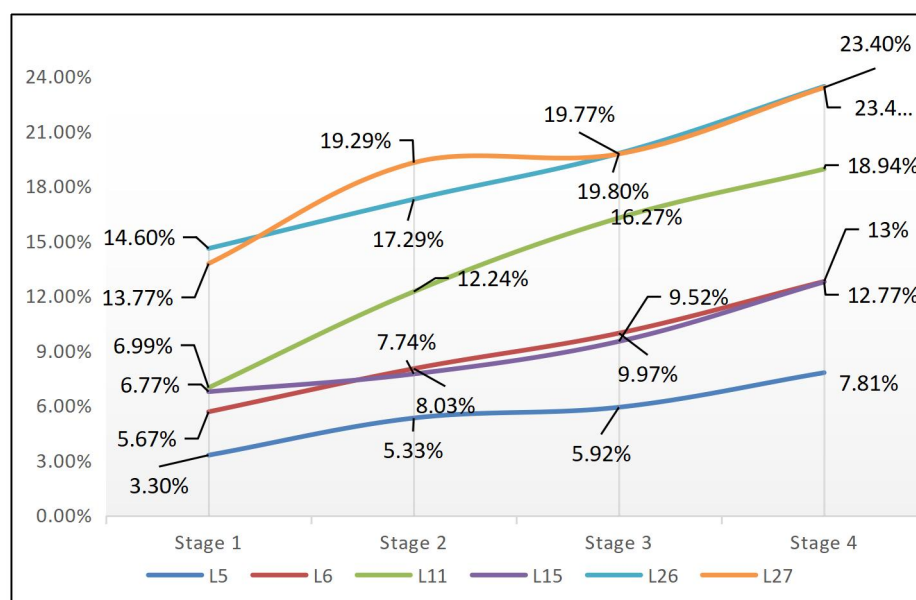


Figure 26 Six Tracked Learners' LFP from Stages 1 to 4

Figure 26 presents the learning performance of six tracked learners in terms of LFP results across stages 1 to 4. The results depicted in Figure 26 provide strong evidence of the positive impact of SCVL on individual learners' productive vocabulary growth in terms of LFP over time.

3.1.3 Quantitative Findings of RQ 2

RQ 2 of "To what extent does SCVL enhance lexical richness of Chinese writing?" investigated the enhancement of lexical richness in Chinese writing by CFL learners with high to low academic performances across the four learning stages. Lexical richness of Chinese writing was measured by lexical diversity (Uber index) (e.g., Cao & Tian, 2020; Wu, 2016; Zhang, J. J., 2019), lexical sophistication (LS) (e.g., Cao & Tian, 2020; Wu, 2016; Zhang, J. J., 2019), and lexical errors (LE) (e.g., Cao & Tian, 2020; Wu, 2016; Zhang, J. J., 2019). Subsequently, two-way ANOVA was conducted to investigate whether there were significant differences across the four stages. Two-way ANOVA is used to compare the mean of two or more groups across two independent variables to determine whether there is a significant difference between the groups and if the effect of one independent variable depends on the other (Nibrad, 2019). To note, the "Time main effect", "Group main effect", and "Interaction effect" were employed to identify lexical diversity in terms of U sentence. "Time main effect" refers to the impact of one independent variable (i.e., Time) on the dependent variable (i.e., U sentence), while disregarding the other independent variable (i.e., Group), which in this case is time. The "Group main

effect”, on the other hand, pertains to the effect of one independent variable (i.e., Group) on the dependent variable (i.e., U sentence), while disregarding the other independent variable (i.e., Time), which in this case is the group. Finally, the “Interaction effect” is used to determine whether the effect of one independent variable (e.g., time) on the dependent variable (e.g., U sentence) differs depending on the level of another independent variable (e.g., group) (Nibrad, 2019). Specifically, if the interaction effect is significant, a post-hoc test will be required separately in different stages. The post-hoc test, also known as MCT, is used to compare the mean of multiple groups after an ANOVA has determined that there is a significant difference between at least two of the groups (Lee, S., & Lee, D. K., 2018; Mishra et al., 2019; Nibrad, 2019).

Thereafter, the following subsections will present the findings of lexical diversity (Section 4.1.3.1), lexical sophistication (Section 4.1.3.2), and lexical errors (Section 4.1.3.3) accordingly.

3.1.3.1 Findings of Lexical Diversity

To address RQ 2a of “How does lexical diversity in sentence/paragraph/essay artifacts produced vary across the four learning stages?”, the corresponding null and alternative hypotheses are presented as follows:

1. H05: The diversity of vocabulary use in sentence artifacts produced does not increase across the four learning stages.
2. Ha5: The diversity of vocabulary use in sentence artifacts produced significantly increase across the four learning stages.
3. H06: The diversity of vocabulary use in paragraph artifacts produced does not increase across the four learning stages.
4. Ha6: The diversity of vocabulary use in paragraph artifacts produced significantly increase across the four learning stages.
5. H07: The diversity of vocabulary use in essay artifacts produced does not increase across the four learning stages.
6. Ha7: The diversity of vocabulary use in essay artifacts produced significantly increase across the four learning stages.

The measure of the diversity of vocabulary usage in sentences, paragraphs, and essays is known as the Uber index (U) value. In order to examine the differences in performance among the three performance groups of learners, this index was calculated using the following formula:

$$\text{Uber index value: } U = (\log_{\text{Tokens}})^2 / (\log_{\text{Tokens}} - \log_{\text{Types}}) \text{ (Jarvis, 2002, p. 59)}$$

Academic research has shown that a higher number of types compared to tokens indicates greater lexical diversity in a text (Jarvis, 2002; Treffers-Daller et al., 2018; Wu & Hu, 2021; Zhang et al., 2021). The Uber index is a validated and reliable measure of lexical diversity. However, it is important to note that the accuracy and validity of the index is highest when texts of the same length are compared (Wu, 2016; Zhang et al., 2021).

Therefore, to examine the improvement in lexical diversity across each DBR stage, comparisons were made between sentence to sentence, paragraph to paragraph, and essay to essay. To this end, the

indicators of “U sentence”, “U paragraph”, and “U essay” were employed to investigate the extent of learners’ lexical diversity in these different text units. It is important to note that the written texts were not revised to present an authentic essay artifact. An example of “U sentence” is presented below.

Example 15 with word segmentation: 我/哥哥/他/对/法律/有/一/个/兴趣/, 所以/他/学习/法律/, 他/想/当/一/个/有名/的/律师/。(L3, Low, Stage 1)

Pinyin: Wǒ gēge tā duì fǎlǚ yǒu yīgè xìngqù, suǒyǐ tā xuéxí fǎlǚ, tā xiǎng dāng yīgè yǒumíng de lǚshī.

English translation: My brother is interested in law, so he studies it, and he wants to be a famous lawyer.

Number of types: 16

Number of tokens: 21

Uber index = $(\log_{\text{Tokens}})^2 / (\log_{\text{Tokens}} - \log_{\text{Types}}) = 14.80$

Hence, the findings of U sentence are presented as follows.

a) Findings of U Sentence

In reference to the “U sentence” measure, the aforementioned formula was used to calculate 1,921 sentence artifacts. Table 24 presented below depicts the summary statistics of U sentence for the three performance groups and across four stages.

Table 24 U Sentence for Three Performance Groups across Four Stages

Indicator (<i>M</i> ± <i>SD</i>)	Group	Stage 1	Stage 2	Stage 3	Stage 4	Group Main Effect (<i>F</i> / <i>p</i>)	Time Main Effect (<i>F</i> / <i>p</i>)	Interaction Effect (<i>F</i> / <i>p</i>)
Uber Sentence	Low	15.38±2.03 ^{ab}	20.49±2.23 ^{ab}	25.31±3.34 ^a	32.75±4.48 ^{ab}			
	Medium	17.39±1.27 ^a	22.62±2.85 ^a	28.29±3.17 ^a	42.61±4.76 ^a	79.610***/ <0.001	366.875***/ <0.001	16.001***/ <0.001
	High	19.78±2.71	28.12±3.60	37.01±3.83	55.63±6.50			
	Total	17.58±2.71	23.85±4.35	30.35±6.05	44.00±10.78			

Note 1. M–mean, SD–standard deviation

Note 2. ^a for comparison with high performance group, $p < 0.05$; ^b for comparison with medium performance group, $p < 0.05$

The presented table reveals a significant time main effect, indicating a considerable improvement in the learners’ diversity of vocabulary use in sentence artifacts across the four stages. The U sentence increased significantly from 17.58 to 44.00 ($F=366.875$, $p < 0.001$), reflecting an increase in the lexical diversity of writing texts over time. Moreover, the group main effect was also significant, with the high performance group demonstrating a significantly higher U sentence than the medium performance group, and the medium performance group showing significantly higher U sentences than the low performance group ($F=79.610$, $p < 0.001$). Overall, the learners’ U sentence presents a consistent trend over time in different performance groups (Figure 27)

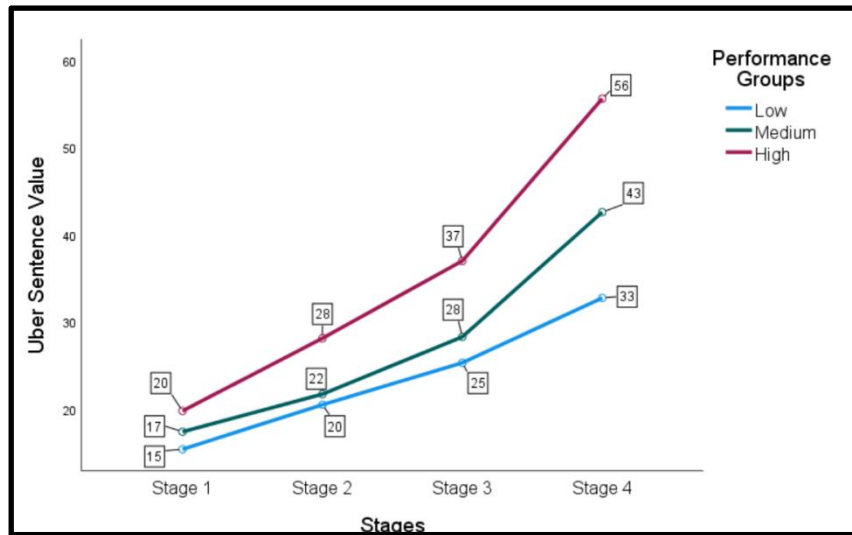


Figure 27 U Sentence for All Three Performance Groups across Four Stages

To note, the interaction effect was significant ($p < 0.001$), necessitating post-hoc test to be conducted separately for each stage (as shown in Table 25).

Table 25 Post-hoc Test for Different Stages

Time	Group 1	Group 2	<i>p</i>
Stage 1	Low	Medium	0.036*
	Low	High	<0.001**
	Medium	High	0.012*
Stage 2	Low	Medium	0.292
	Low	High	<0.001**
	Medium	High	<0.001**
Stage 3	Low	Medium	0.058
	Low	High	<0.001**
	Medium	High	<0.001**
Stage 4	Low	Medium	<0.001**
	Low	High	<0.001**
	Medium	High	<0.001**

Note. ** More significant

The results in Table 25 show the post-hoc test for U sentence at different stages among the three performance groups. The overall trend observed in Table 25 is that the U sentences for the high performance group were consistently and significantly higher than those of the medium and low performance groups across all four stages (Stage 1, Stage 2, Stage 3, And Stage 4). Additionally, the U sentences for the medium performance group were significantly higher than those of the low

performance group at all stages except for Stage 1, where the difference between these two groups was marginally significant.

However, there are two deviations from the main trend at stages 2 and 3, where there was no significant difference between the U sentence values of the medium and low performance groups ($p>0.05$), while at all other stages, the difference between these two groups was statistically significant.

Next, in order to investigate the usefulness of SCVL in improving the lexical diversity of Chinese writing, the aforementioned results were supplemented with concrete examples. Specifically, the performance of one learner in terms of U sentence artifacts was tracked and analysed across stages 1 to 4. This individual analysis allowed for the assessment of CFL writing progress over time based on the U sentence. The sentence artifacts created by L14 at each stage were examined as follows.

Example 16 with word segmentation: 我/朋友/不仅/是/努力/的/人/, 他/的/性格/也/不错/. 我/已经/认识/他/关于/十年/了/. 他/对/运动/印象/很/深/. 他/不仅/努力/的/人/还是/一/个/活力/的/. (L14, Medium, Stage 1)

Pinyin: Wǒ péngyou bùjǐn shì nǔlì de rén, tā de xìnggé yě bùcuò. Wǒ yǐjīng rènshí tā guānyú shínián le. Tā duì yùndòng yìnxiàng hěn shēn. Tā bùjǐn nǔlì de rén, háishì yī gè huólì de.

English translation: Not only is my friend a hard worker, but he also has a good personality. I have known him for about ten years. He was very impressed with the sport. He is not only a hardworking person but also a dynamic person.

Number of types: 25

Number of tokens: 35

Uber index= $(\log_{\text{Tokens}})^2 / (\log_{\text{Tokens}} - \log_{\text{Types}}) = 16.31$

Example 17 with word segmentation: 今天/的/汉语/阅读/考试/很/顺利/, 我/觉得/很/多/都/回答/对/了/, 于是/我/和/朋友/偷偷/跑/出去/吃/火锅/庆祝/一下/, 我/要/坐/公交车/去/市/里/吃/吃/火锅/去/. (L14, Medium, Stage 2)

Pinyin: Jīntiān de hànyǔ yuèdú kǎoshì hěn shùnlì, wǒ juéde hěnduō dōu huídá duìle, yúshì wǒ hé péngyou tōutōu pǎo chūqù chī huǒguō qìngzhù yíxià, wǒ yào zuò gōngjiāochē qù shì lǐ chī chī huǒguō qù.

English translation: Today's Chinese reading test went well, and I think many of the answers were correct, so my friend and I sneaked out to eat hot pot to celebrate, and I'm going to take the bus to the city to eat hot pot.

Number of types: 30

Number of tokens: 38

Uber index= $(\log_{\text{Tokens}})^2 / (\log_{\text{Tokens}} - \log_{\text{Types}}) = 24.3$

Example 18 with word segmentation: 和/朋友/报/了/一/个/旅游/团体/去/旅游/, 车上/人/少/有点/, 而且/大巴/师傅/很/热情/, 很/阳光/, 这是/一/个/愉快/的/旅行/, 我/要/放松/了/. (L14, Medium, Stage 3)

Pinyin: Hé péngyou bàole yī gè lǚyóu tuántǐ qù lǚyóu, chēshàng rén shǎo yǒudiǎn, érqiě dàbā shīfù h

ěn rèqíng, hěn yángguāng, zhè shì yīgè yúkuài de lǚxíng, wǒ yào fàngsōng le.

English translation: I signed up for a tour group with my friends to go on a trip. There were few people on the bus, and the bus driver was very enthusiastic and sunny. It was a pleasant trip, and I felt relaxed.

Number of types: 26

Number of tokens: 31

Uber index = $(\log_{\text{Tokens}})^2 / (\log_{\text{Tokens}} - \log_{\text{Types}}) = 29.12$

Example 19 with word segmentation: 同屋/ 买/了/两/包/干脆面/！ 好/羡慕/，但是/按照/我们/之间/的/规定/他/需要/给/我/一/包/的/！ (L14, Medium, Stage 4)

Pinyin: Tóngwū mǎile liǎng bāo gāncuìmiàn! Hǎo xiànmù, dànshì ànzhào wǒmen zhījiān de guīdìng tā xūyào gěi wǒ yī bāo de.

English translation: My roommate bought two packs of crispy noodles! I'm so envious, but according to the agreement between us, he needs to give me a pack.

Number of types: 19

Number of tokens: 21

Uber index = $(\log_{\text{Tokens}})^2 / (\log_{\text{Tokens}} - \log_{\text{Types}}) = 40.22$

The U values of the sentence artifacts from stages 1 to 4 increased at 16.31, 24.3, 29.12, and 40.22, respectively.

Next, to foster a better understanding of the writing performance of learners and to provide motivation for learners to see their progress relative to their peers, an analysis of the U sentence of high, medium, and low performance learners was conducted. Due to word limits, three specific examples from Stage 1 are provided below.

Example 20 with word segmentation: 我/哥哥/他/对/ 法律/有/一/个/兴趣/，所以/他/学习/法律/，他/想/当/一/个/有名/的/律师/。 (L3, Low, Stage 1)

Pinyin: Wǒ gēge tā duì fǎlǚ yǒu yīgè xìngqù, suǒyǐ tā xuéxí fǎlǚ, tā xiǎng dāng yīgè yǒumíng de lǚshī.

English translation: My brother is interested in law, so he studies it, and he wants to be a famous lawyer.

Number of types: 16

Number of tokens: 21

Uber index = $(\log_{\text{Tokens}})^2 / (\log_{\text{Tokens}} - \log_{\text{Types}}) = 14.8$

Example 21 with word segmentation: 我/哥哥/的/专业/是/法律/，我/对/他/印象/很/深/，所以/我们/熟悉/了/。他/不仅/有/很/好/的/工作/，也/有/很/好/的/性格/。 (L16, Medium, Stage 1)

Pinyin: Wǒ gēge de zhuānyè shì fǎlǚ, wǒ duì tā yìnxiàng hěn shēn, suǒyǐ wǒmen shúxile. Tā bùjǐn yǒu hěn hǎo de gōngzuò, yěyǒu hěn hǎo de xìnggé.

English translation: My brother's major is law, and I have a deep impression on him, so we got acquainted. Not only does he have a great job, he has a great character too.

Number of types: 21

Number of tokens: 29

Uber index = $(\log_{\text{Tokens}})^2 / (\log_{\text{Tokens}} - \log_{\text{Types}}) = 15.27$

Example 22 with word segmentation: 我/好/朋友/学习/了/法律/, 他/对/法律/印象/深/熟悉/, 我/觉得/这/个/工作/为/他/很/舒服/, 不仅/很/聪明/性格/很/刚/。(L32, High, Stage 1)

Pinyin: Wǒ hǎo péngyou xuéxí le fǎlǜ, tā duì fǎlǜ yìnxiàng shēn shúxī, wǒ juéde zhè ge gōngzuò wèi tā hěn shūfú, bùjǐn hěn cōngmíng xìnggé hěn gāng.

English translation: My good friend studied law, he is very familiar with the law, I think this job is very comfortable for him, he is not only very smart but also tough.

Number of types: 22

Number of tokens: 27

Uber index = $(\log_{\text{Tokens}})^2 / (\log_{\text{Tokens}} - \log_{\text{Types}}) = 23.03$

b) Findings of U Paragraph

With reference to the U paragraph, a total of 252 written texts were analysed for all stages in a similar manner to the examples provided above. This analysis aimed to examine the lexical diversity of paragraphs created by the three performance groups across the four learning stages. The results are presented in Table 26.

Table 26 U Paragraph for Three Performance Groups across Four Stages

Indicator (M±SD)	Group	Stage 1	Stage 2	Stage 3	Stage 4	Group Main Effect (F/p)	Time Main Effect (F/p)	Interaction Effect (F/p)
Uber Paragraph	Low	19.51±0.63 ^{ab}	20.28±0.90 ^{ab}	23.12±1.46 ^{ab}	25.99±0.68 ^{ab}			
	Medium	22.80±1.33 ^a	24.84±1.38 ^a	27.18±1.76 ^a	32.16±1.84 ^a	76.207***	177.660***	8.570***
	High	27.77±2.71	31.16±4.38	34.36±5.44	42.19±4.02	<0.001	<0.001	<0.001
	Total	23.48±3.80	25.61±5.15	28.38±5.67	33.40±7.12			

Note 1. M=mean, SD=standard deviation

Note 2. ^a for comparison with high performance group, $p<0.05$; ^b for comparison with medium performance group, $p<0.05$

Table 26 displays the results of the U paragraph analysis for written texts of three performance groups across four learning stages. The table demonstrates that both the time main effect and group main effect were significant. The time main effect indicates that the overall lexical diversity has improved significantly over time, as demonstrated by the growth of U paragraph values from 23.48 to 33.40

($F=177.660$, $p<0.001$), which is a strong indicator of learners' improvement in lexical diversity in paragraph artifacts over time. Moreover, the group main effect is significant, showing that the U paragraphs for the high performance group were significantly higher than those for the medium performance group, and the U paragraphs for the medium performance group were significantly higher than those for the low performance group ($F=76.207$, $p<0.001$). Overall, learners in different performance groups displayed a positive trend of improvement in the U paragraph over time (Figure 28)

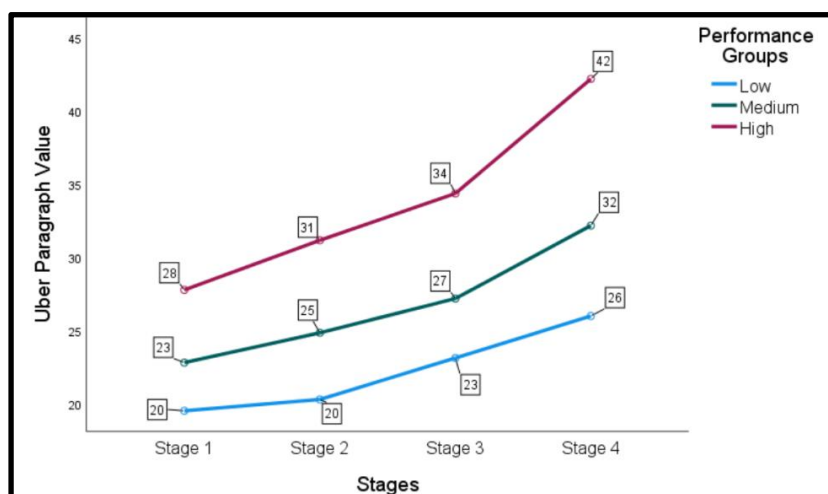


Figure 28 U Paragraph for All Three Performance Groups across Four Stages

Additionally, the interaction effect was significant ($p<0.001$), requiring post-hoc test to be conducted separately for different stages (Table 27).

Table 27 Post-hoc Test for Different Stages

Time	Group 1	Group 2	<i>p</i>
Stage 1	Low	Medium	<0.001**
	Low	High	<0.001**
	Medium	High	<0.001**
Stage 2	Low	Medium	<0.001**
	Low	High	<0.001**
	Medium	High	<0.001**
Stage 3	Low	Medium	0.01*
	Low	High	<0.001**
	Medium	High	<0.001**
Stage 4	Low	Medium	<0.001**
	Low	High	<0.001**
	Medium	High	<0.001**

Note. ** More significant

The overall trend observed in Table 4.17 was that the U paragraph scores increased across all performance groups as the learning stages progressed. Specifically, at each learning stage, the U paragraph scores for the high performance group were significantly higher than those of the medium and low performance groups, and the U paragraph scores for the medium performance group were significantly higher than those of the low performance group.

However, in Stage 3, the difference between the U paragraph scores for the medium and low performance groups was smaller compared to the previous stages, and the difference was only marginally significant ($p=0.01$). This is a deviation from the main trend where the difference between the medium and low performance groups was significant in all other stages with p -values <0.001 .

To note, in order to assess the impact of SCVL on enhancing the lexical diversity of Chinese writing for paragraph artifacts, this study provided concrete examples of the U paragraph. By tracking and analysing the performance of one learner, instructors may develop individualised learning plans to support the learner's CFL development. However, due to the constraints on word count, the evidence supporting learners' lexical diversity in paragraph artifacts from stages 1 to 4 was limited to L6's U paragraph. Figure 29 presents the trend in L6's lexical diversity development in paragraph artifacts.

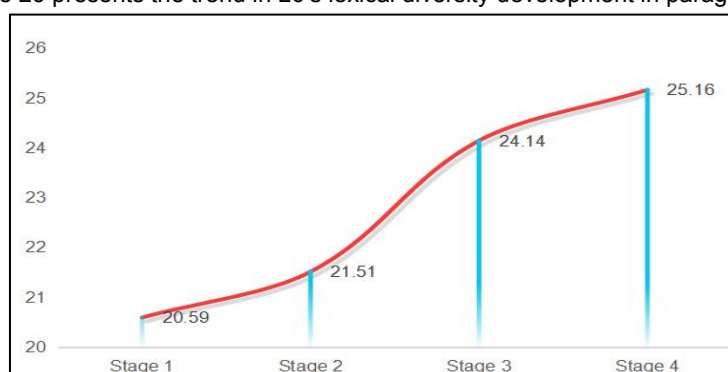


Figure 29 The Development Trend of U Paragraph for L6

Overall, there was evidence of growth in L6's lexical diversity in paragraph artifacts, as indicated by the increasing U values over time.

c) Findings of U Essay

The U essay was derived from 128 written essay artifacts obtained from all four learning stages. An overview of learners' U essay across four stages is presented in Table 28.

Table 28 U Essay for Three Performance Groups across Four Stages

Indicator ($M \pm SD$)	Group	Stage 1	Stage 2	Stage 3	Stage 4	Group Main Effect (F/p)	Time Main Effect (F/p)	Interaction Effect (F/p)
Uber Essay	Low	20.00 $\pm$ 1.30 ^{ab}	21.47 $\pm$ 1.23 ^{ab}	22.92 $\pm$ 1.57 ^{ab}	25.55 $\pm$ 1.78 ^{ab}	<0.001	<0.001	<0.001
	Medium	23.27 $\pm$ 0.67 ^a	24.34 $\pm$ 1.26 ^a	28.03 $\pm$ 4.05	29.82 $\pm$ 1.87 ^a			
	High	27.18 $\pm$ 3.30	28.57 $\pm$ 3.82	30.86 $\pm$ 3.91	38.28 $\pm$ 5.92			
	Total	23.59 $\pm$ 3.59	24.90 $\pm$ 3.79	27.41 $\pm$ 4.67	31.39 $\pm$ 6.49			

Note 1. M=mean, SD=standard deviation

Note 2. ^a for comparison with high performance group, $p < 0.05$; ^b for comparison with medium performance group, $p < 0.05$

A two-way ANOVA revealed significant effects for both the time main effect and group main effect on U essay, which is an indicator of learners' lexical diversity in essay. Specifically, the overall lexical diversity demonstrated a significant improvement over time as the U essay increased from 23.59 to 31.39, indicating an increase in the diversity and variety of lexical items used in the essays ($F=132.862$, $p < 0.001$).

For the group main effect, the high performance group exhibited significantly higher U essay than the medium performance group, and the medium performance group showed significantly higher values than the low performance group ($F=28.678$, $p < 0.001$). Overall, the U essay consistently displays a trend over time in different performance groups (Figure 30).

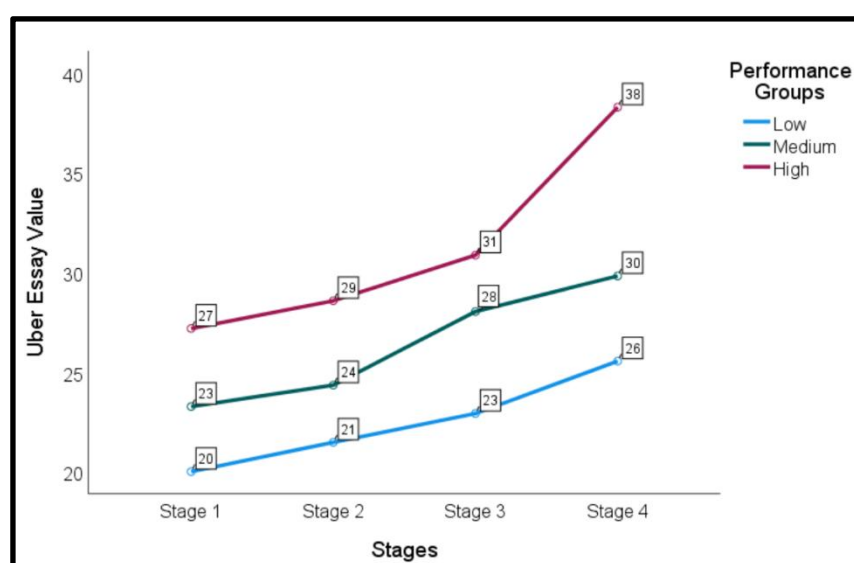


Figure 30 U Essay for All Three Performance Groups across Four Stages

Notably, the interaction effect was also found to be significant ($F=9.290$, $p < 0.001$). Consequently, a post-hoc test was conducted for each stage, which is presented in Table 29.

Table 29 Post-hoc Test for Different Stages

Time	Group 1	Group 2	<i>p</i>
Stage 1	Low	Medium	0.001**
	Low	High	<0.001**
	Medium	High	<0.001**
Stage 2	Low	Medium	0.012*
	Low	High	<0.001**
	Medium	High	0.001**
Stage 3	Low	Medium	0.002**
	Low	High	<0.001**

Time	Group 1	Group 2	<i>p</i>
Stage 4	Medium	High	0.062
	Low	Medium	0.015*
	Low	High	<0.001**
	Medium	High	<0.001**

Note. ** More significant

The findings from Table 29 demonstrate that the high performance group's U essay was consistently higher than those of the medium and low performance groups across all four learning stages. Moreover, across all four stages, the U essay for the medium performance group was consistently higher than those for the low performance group.

However, at Stage 3, the U essay for the high performance group was not significantly different from those for the medium performance group ($p>0.05$), despite both being significantly higher than those for the low performance group. This contrasts with the results at stages 1, 2, and 4, where the U essay for the high performance group was significantly higher than those for the medium and low performance groups.

Next, to provide empirical evidence for individualised learning and to track the writing performance progress of learners over time, supporting data based on six tracked learners' lexical diversity in essay artifacts from stages 1 to 4 are presented in Table 30.

Table 30 Six Tracked CFL Learners' Lexical Diversity in Essay Artifacts from Stages 1 to 4

Tracked Learners	Stage 1	Stage 2	Stage 3	Stage 4
L5	20.41	21.12	23.33	24.07
L6	19.70	20.80	22.60	26.45
L11	23.66	24.10	27.47	30.28
L15	22.89	22.01	27.39	31.29
L26	35.12	37.12	38.88	49.72
L27	27.51	32.51	34.63	40.33

3.1.3.2 Findings of Lexical Sophistication

The RQ 2b of "How does the lexical sophistication of essay artifacts vary across the four learning stages?" investigated the rates of advanced words used in essay artifacts of Chinese writings by CFL learners across four stages. The corresponding null and alternative hypotheses are as follows:

1. H08: The rates of advanced words use do not increase significantly across four learning stages.
2. Ha8: The rates of advanced words use significantly increase across four learning stages.

To investigate the research question, the study first examined the overall rates of advanced word usage in writing artifacts of the three performance groups. Subsequently, the rates of advanced word usage

were analysed among the three performance groups across the four stages. The rates of advanced word usage in essay artifacts referred to lexical sophistication (LS), which was calculated as follows:

$$LS = \text{Number of advanced word tokens} / \text{Number of word tokens} \times 100\%$$

Similarly, no modifications were applied to the written text while displaying the authentic paragraph artifact. Take L21's essay artifact made in Stage 2 as an example.

Example 23 with word segmentation: 从/来/中国/以后/，我/在/商店/里/很少/买/东西/特别/是/买/衣服/的/。原因/是/很/简单/。第一/，我/讨厌/跟/商人/议价/。在/中国/，有趣/的/差不多/不管/你/买/什么/东西/都/要/讨价还价/。我/去/旅行/的/时候/，我/常常/一/瓶/水/也/要/常/讨价还价/，这/真/可惜/的/啊/！第一/。.....但是/无论/我/怎么/说/，反正/他/就/不/答应/给/我/折扣/。我/就/觉得/要/讨价还价/得/更/厉害/，我/以/为/如果/出去/商店/的/话/，老板/就/随/我/喊/，他/到底/同意/给/我/想/买/靴子/的/价格/。她/马上/高高兴兴/的/买/了/我/能/穿/的/最后/一/双/。听到/这/件/消息/，我/就/感到/大失所望/。觉得/自己/傻/得/不得了/。下次/不会/那么/长/时间/和/商人/讨价/，只要/立刻/买。我/从来/再/没/找到/了/一样/的/靴子/。我/每次/进入/一/家/鞋店/，就/痛苦/的/梦想/以前/的/完美/靴/。(L21, Medium, Stage 2)

English translation (Summarised): Since coming to China, I have rarely purchased anything in stores, as I dislike bargaining with merchants. However, on my first attempt to buy shoes in China, I encountered an unfortunate situation. There were only a couple of salespeople inside the store. I came across a pair of stylish and attractive cowhide boots, but the price was too high for a college learner. I attempted to negotiate with the boss to lower the price. A Chinese friend advised that patience and compromise are key qualities required to reach an agreement. Despite waiting for a few hours and returning to the store, the boots had already been sold. I was disappointed and regretted not bargaining harder. Next time, I should consider purchasing the item immediately, as there may not be another chance to find the same boots again.

With the assistance of the LanguageData software developed by Jin et al. (2018), each word present in the National Graded Vocabulary List (2010) was categorised into its respective vocabulary grade. Furthermore, to analyse the advanced words in the essay artifacts of L21, LanguageData was used to calculate the number of advanced words, advanced appendix words, and super-class words, with the resulting LS displayed below (Table 31).

Table 31 The L21's LS of Essay Artifact

National Graded Vocabulary List (2010)	Number of Word Tokens	Number of Word Types
Universal words	311	142
Intermediate words	17	16
Advanced words	8	6

Advanced appendix words	13	2
Super class words	67	56
In total	416	222

LS = number of advanced word tokens/ Number of word tokens ×100%

LS = 88/ 416 ×100% = 21.15%

The present research proceeded to perform two-way ANOVA to examine whether there were significant differences in LS across the four stages. It was noted that if the interaction effect was significant, post-hoc multiple comparisons would be necessary to explore the differences in each stage. The results of this analysis are presented in Table 32.

Table 32 LS for Three Performance Groups across Four Stages

Indicator (<i>M</i> ± <i>SD</i>)	Group	Stage 1	Stage 2	Stage 3	Stage 4	Group Main Effect (<i>F</i> / <i>p</i>)	Time Main Effect (<i>F</i> / <i>p</i>)	Interaction Effect (<i>F</i> / <i>p</i>)
LS	Low	15.09%±1.99% ^{ab}	16.48%±2.38% ^{ab}	18.24%±2.02% ^{ab}	20.81%±3.40% ^{ab}	27.879** */ <0.001	134.647 ***/ <0.001	4.265/ 0.004
	Medium	17.46%±3.14%	18.72%±1.45% ^a	20.39%±1.92% ^a	23.64%±1.36% ^a			
	High	18.49%±2.57%	23.01%±1.39%	24.03%±1.45%	27.74%±1.57%			
	Total	17.07%±2.91%	19.49%±3.24%	20.97%±2.98%	24.16%±3.61%			

Note 1. M–mean, SD–standard deviation

Note 2. ^a for comparison with high performance group, $p < 0.05$; ^b for comparison with medium performance group, $p < 0.05$

The findings of the statistical analysis of LS are presented in Table 33. Two-way ANOVA was performed, which revealed that both the time main effect and group main effect were significant. Regarding the time main effect, the rates of advanced word used increased significantly across the four stages, with the LS indicator increasing from 17.07% in Stage 1 to 24.16% in Stage 4. Specifically, the rates of advanced words used accounted for 20.81%, 23.64%, and 27.74% among the low, medium, and high performance groups in Stage 4, respectively, while in Stage 1, the rates were 15.09%, 17.46%, and 18.49% among the low, medium, and high performance groups, respectively ($F = 134.647$, $p < 0.001$).

Moreover, the group main effect was significant, with the LS for the high performance group being significantly higher than that of the medium performance group, and the LS for the medium performance group was significantly higher than that of the low performance group ($F = 27.879$, $p < 0.001$). Overall, the LS exhibited an upward trend of positive improvement over time in different performance groups (Figure 31).

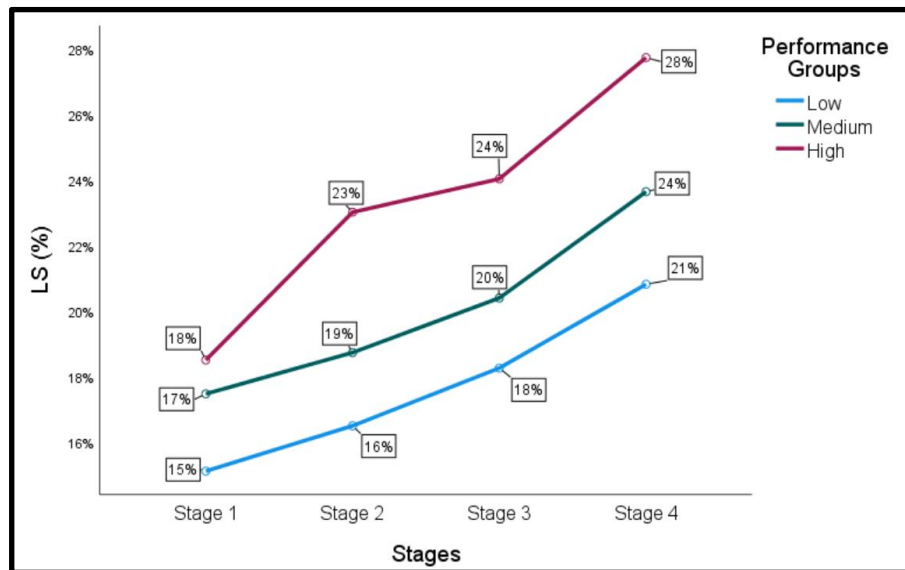


Figure 31 LS for All Three Performance Groups across Four Stages

Furthermore, the interaction effect was significant ($p < 0.05$), and a post-hoc test was conducted in different stages to explore the differences between groups (Table 33).

Table 33 Post-hoc Test for Different Stages

Time	Group 1	Group 2	<i>p</i>
Stage 1	Low	Medium	0.049*
	Low	High	0.006**
	Medium	High	0.364
Stage 2	Low	Medium	0.007**
	Low	High	<0.001**
	Medium	High	<0.001**
Stage 3	Low	Medium	0.011*
	Low	High	<0.001**
	Medium	High	<0.001**
Stage 4	Low	Medium	0.007**
	Low	High	<0.001**
	Medium	High	<0.001**

Note. ** More significant

As shown in Table 33, the overall trend in LS is that it increases as the level of performance rises. Specifically, the high performance group had the highest LS on a consistent basis, followed by the medium performance group and then the low performance group. However, the trend that differs from the overall trend where there was no significant difference in LS between the high and medium performance groups at Stage 1 ($p > 0.05$), but there was a significant difference between the medium and

low performance groups. In all other stages, the high performance group surpassed both the medium and low performance groups in terms of LS.

To note, the analysis of an individual's LS can aid in assessing their progress in CFL writing performance over time. Furthermore, the examination of six tracked CFL learners' learning performance in LS from stages 1 to 4 corroborates the findings on the main effect. Figure 32 portrays the LS results of the six tracked learners' learning performance from stages 1 to 4.

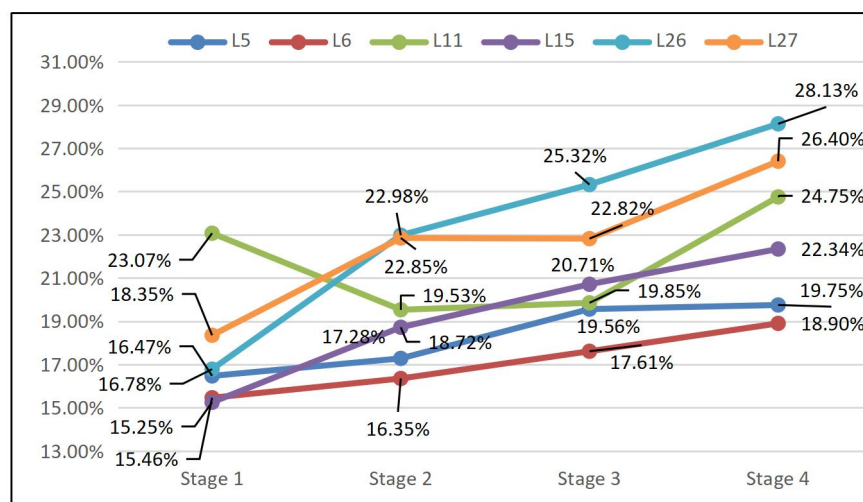


Figure 33 The Development Trend of LS for Six Tracked Learners

As shown in Figure 33, learners' advanced word use improved significantly in terms of LS through the use of SCVL over time.

3.1.3.3 Findings of Lexical Errors

To address RQ 2c of "How do lexical errors in essay artifacts produced vary across the four learning stages?", the corresponding null and alternative hypotheses are as follows:

1. H09: The rates of lexical errors in Chinese writing do not decrease across the four learning stages.
2. Ha9: The rates of lexical errors in Chinese writing significantly decrease across the four learning stages.

To address RQ 2c, various types of lexical errors were identified by thoroughly examining each essay artifact, and a comprehensive analysis of the overall lexical errors in CFL learners' written essay artifacts was conducted. As previously explained in Chapter 2, the categorisation of Chinese lexical errors was applied. The frequency of lexical errors presented in the essay artifacts is denoted as the Lexical Errors (LE) rate. Notably, recurring errors were only counted once to ensure accuracy. The calculation method for determining the LE (Cao & Tian, 2020; Zhang et al., 2021) is further elaborated below.

$$LE = \text{Number of error words} / \text{Total number of word tokens} \times 100\%$$

As a continuation, the researcher coded the errors noted for this study using the following categories (e.g., Fu., 2020; Nation, 2001; Mo, 2015; Tian, 2019; Zhang, H., 2021; Zhang, M. J., 2022):

- 1) Word Writing Errors
- 2) Word Collocation Errors
- 3) Word Redundancy Errors
- 4) Word Choice Errors
- 5) Word Omission Errors
- 6) Uncertain Lexical Errors

It should be noted that non-lexical errors were marked in both italics and bold fonts. Moreover, recurring errors were treated as a single instance during coding. A demonstration of this coding process is illustrated in Example 24. The frequency of lexical errors in CFL learners' essay artifacts was computed by tallying all types of lexical errors in each essay artifact, which is presented in the following section. For example, L5's essay artifact from Stage 1 was used.

Example 24: 我/喜欢/的/职业/是/当/银行/ (Error 1, word choice errors) 。因为/我/妈妈/在/银行/工作/。所以/我/收/ (受, Error 2, word writing errors) 了/妈妈/的/影响/。因此/ (因为, Error 3, word choice errors) 这个/理由/ , 我/想/在/银行/工作/。我/喜欢/这/个/职业/的/原因/首先/是/收钱/ (工资, Error 4, word choice errors) /高/。银行/是/做/和/钱/有/关系/的/工作/ (的, Error 5, word omission errors) , 所以/为了/防止/偷钱/ (给, Error 6, word omission errors) 员工/的/报酬/高/。第二/ , 工作/地/ (Error 7, word redundancy error)福利/很/好/。银行/让/ (为, Error 8, word choice errors) 职员/的/孩子/们/全部/付/孩子/们/的/ (Error 9, word redundancy error)教育费/。现在/我/妈妈/在/银行/工作/ , 所以/我/和/我/妹妹/的/教育费/是/免费/的/。因此/ (Error 10, word redundancy error)第三/个/理由/ (是, Error 11, word omission errors) 生活/稳定/。收钱/ (工资, Error 4, word choice errors) 高/和/收入/均衡/、所以/我们/的/生活/稳定/。反而/ (可是, Error 12, word choice errors) 在/银行/工作/的/不好/的/方面/也/有/。第一/工作/忙/、工作/幸/ (辛, Error 13, word writing errors) 苦/。每天/很多/人/来/银行/办/很多/事件/ (事情, Error 14, word choice errors) , 所以/工作/有点/幸/ (辛, Error 13, word writing errors) 苦/。第二/ , 工作/压力/ (力, Error 15, word writing errors) /大/。银行/是/跟/钱/有/关系/的/工作/。每/个/ (件, Error 16, word collocation errors) 事/一定/要/小心/。第三/ , 需要/往往/ (常常, Error 17, word choice errors) /加班/。每/个/工作/都/各/有/利弊/。银行/职员/是/从/小/时候/ , 我/的/理想/职业/。所以/我/回国/后/ , 准备/资格证/ (考试, Error 18, word omission errors) 。然后/我/要/去/银行/工作/。 (因此, Error 19, word omission errors) 从/现在/要/努力/学习/!加油/!

(L5, Low, Stage 1)

Number of error words: 19

Total number of words: 170

LE = Number of error words/ Total number of words *100% = 19/ 170 *100%=11.18%

Referring to the variables of "LE", the calculations of lexical errors were performed for all 128 essay artifacts following the aforementioned examples. The rates of lexical errors in CFL learners' writing were then investigated across the four stages and three performance groups. The results of this analysis are presented in Table 34.

Table 34 LE for Three Performance Groups across Four Stages

Indicator (<i>M</i> ± <i>SD</i>)	Group	Stage 1	Stage 2	Stage 3	Stage 4	Group Main Effect (<i>F/p</i>)	Time Main Effect (<i>F/p</i>)	Interaction Effect (<i>F/p</i>)
LE	Low	11.87%±1.15%	9.36%±1.27%	7.20%±1.14%	6.55%±0.90%			
	Medium	9.33%±0.83%	7.55%±0.72%	5.07%±0.79%	4.58%±0.94%	172.970***	152.337***	0.900/
	High	6.48%±1.80%	5.20%±1.02%	2.95%±0.73%	2.16%±0.65%	<0.001	<0.001	0.499
	Total	9.15%±2.56%	7.31%±1.98%	5.01%±1.95%	4.36%±1.99%			

Note. M–mean, SD–standard deviation

Table 34 shows that the main effect of time is significant across the four stages, indicating a positive decrease in the LE from 9.15% (Stage 1) to 4.36% (Stage 4) ($F=152.337$, $p<0.001$). In terms of the group main effect, the LE for the high performance group was significantly higher than the medium performance group, and the LE for the medium performance group was significantly higher than the low performance group ($F=172.970$, $p<0.001$). Overall, a substantial drop in lexical errors was indicated in the results from stages 1 to 4 among the three performance groups (Figure34).

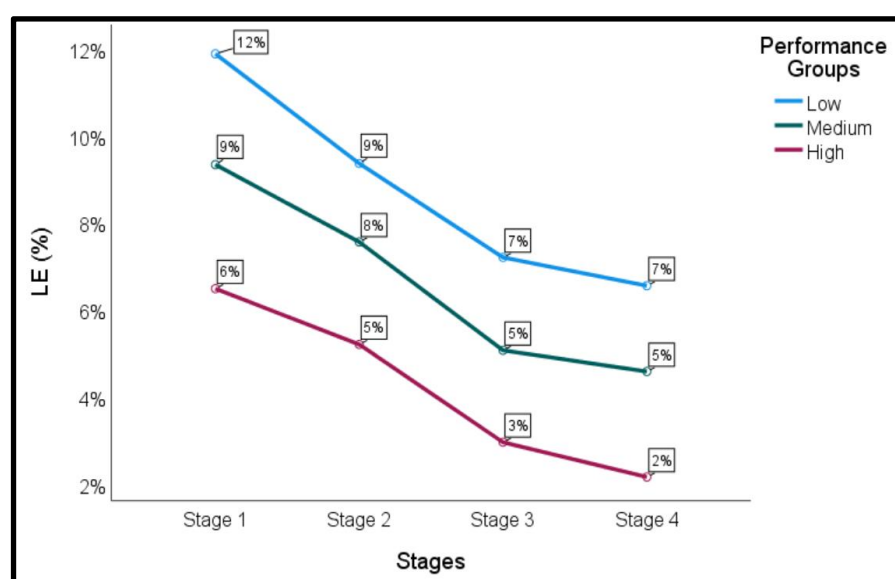


Figure 34 LE for All Three Performance Groups across Four Stages

However, the interaction effect was found to be non-significant ($p>0.05$), which indicated that the effect of the intervention on LE was consistent across all performance groups (Mishra et al., 2019; Nibrad, 2019). Thus, whether in the low or high performance group, learners experienced a positive impact from the four stages of SCVL.

Although the above findings have addressed RQ 2c, analysing the frequency of lexical errors based on error categories can help CFL learners identify specific areas for improvement. Such analysis can also indicate the areas in which language learners may need additional support or resources. The learners' overall number of lexical errors in this research is displayed in Table 35.

Table 35 The Overall Number of Lexical Errors across Four Stages

Categories of Lexical Errors	Stages				
	1	2	3	4	In total
Word Writing Errors	57	46	31	16	150
Word Collocation Errors	16	25	11	8	60
Word Redundancy Errors	46	54	50	38	188
Word Choice Errors	153	133	135	104	525
Word Omission Errors	82	80	61	48	271
Uncertain Errors	18	9	3	6	36
In total	372	347	291	220	1230

As shown in Table 35, it can be observed that the learners' lexical errors exhibited a significant decrease from stages 1 to 4. Notably, the category of Word Choice Errors accounted for the highest number of errors (N=525). Three instances of Word Choice Errors are provided below.

Example 25: 他真是一个有远眼的人。 (Example is taken from: *My ideal marriage*, Stage 1)

Lexical error: 远眼 (far eye)

Pinyin: Tā zhēnshi yīgè yǒu yuǎnyǎn de rén. ("yuǎnyǎn" gǎiwéi "yuǎnjiàn")

English translation: He is really a far eye person. ("far eye" change "visionary")

Example 26: 奥秘可溶太恐怕了。 (Example is taken from: *Difficulties encountered in China*, Stage 3)

Lexical error: 恐怕 (afraid)

Pinyin: Àomìkěróng tài kǒngpà le. ("kǒngpà" gǎi wéi "kěpà")

English translation: Omicron is too afraid. ("afraid" change "scary")

Example 27: 还有他们诈骗我们说这里的Wifi是免费的。 (Example is taken from: *An unforgettable trip*, Stage 4)

Lexical error: 诈骗 (defrauded)

Pinyin: Háiyǒu tāmen zhàpiàn wǒmen shuō zhèlǐ de Wifi shì miǎnfèi de. ("Zhàpiàn" gǎiwéi "piàn")

English translation: Also, they defrauded us by saying the WiFi was free. ("defrauded" change "lie to")

However, in consideration to the scope and objectives of this research, further investigations will be conducted in the future to address additional issues related to the classification of lexical errors.

3.1.4 Quantitative Findings of RQ 3

This section will present the quantitative findings on RQ 3 of “What are learners’ experiences, perceptions, and improvements in vocabulary learning through the utilisation of SCVL?” Section v (SCVLQ) of the research questionnaire was used to answer RQ 3. The SCVLQ consisted of SCVLQ (A), SCVLQ (B), and SCVLQ (C) using a five-point Likert scale to elicit the extent to which learners’ experiences with SCVL (8 items), perception towards SCVL platform (DingTalk) (12 items), and Chinese vocabulary growth and lexical richness (10 items) were positive or negative. After data collection, the reliability value for each SCVLQ was also calculated as follows (Table 36).

Table 36 Reliability of SCVLQ of Questionnaire

Sub-components	N	Cronbach’s Alpha
SCVLQ (A)	8	0.898
SCVLQ (B)	12	0.817
SCVLQ (C)	10	0.864

Next, data analysis was conducted using SPSS 26. A one-sample t-test was employed to determine the overall experiences and perceptions of learners towards SCVL, with an alpha level of significance set at 0.05. The mean score of each item and sub-component was calculated, with a minimum score of 1 and a maximum score of 5. A cut-off point of 3.5 (equivalent to 50%) was used, as suggested by scholars such as Finstad (2010), Oxford (1990), and Qiu (2020). If the mean score was above 3.5, it indicates a positive experience and a high perception of the utilisation of SCVL. The scores were based on a Likert scale starting from 1, with each point representing a distance of 20% (Oxford, 1990; Qiu, 2020).

Following that, the sample size was 32. For the region of rejection, this research rejected the null hypotheses if $p < 0.05$. Thereafter, there were three sub-research questions proposed, along with the corresponding null and alternative hypotheses. According to this, the findings will be discussed in the subsequent sections.

3.1.4.1 Findings of RQ 3a

To answer RQ 3a of “What are learners’ experiences in the utilisation of SCVL?”, the corresponding null and alternative hypotheses were as follows:

1. H010: The learners’ experiences with the SCVL are not favourable.
2. Ha10: The learners’ experiences with the SCVL are favourable.

Accordingly, descriptive and inferential analysis were adopted. To start, the detailed descriptive findings of the SCVLQ (A) are shown in Table 37.

Table 37 Learners' Experiences Towards the SCVL

Questions	Strongly disagree		Disagree		Somewhat agree		Agree		Strongly agree		Mean score
	F	%	F	%	F	%	F	%	F	%	
1. I am comfortable with Chinese HSK Level 4 vocabulary learning through my mobile device outside of the classroom (at home, on campus, and other places, etc.).	0	0%	0	0%	6	18.75%	16	50%	10	31.25%	4.13
2. I am able to learn Chinese HSK Level 4 vocabulary from in class formal learning to out-of-class informal learning through the use of mobile devices and social media platforms.	0	0%	1	3.13%	3	9.37%	22	68.75%	6	18.75%	4.03
3. Informal learning guided by teaching instructor in seamless Chinese HSK Level 4 vocabulary learning can support my formal classroom learning.	0	0%	0	0%	5	15.63%	14	43.75%	13	40.62%	4.25
4. Guided informal learning under seamless Chinese HSK Level 4 vocabulary learning after class hours is important to improve the mastery of Chinese vocabulary.	0	0%	2	6.25%	2	6.25%	16	50%	12	37.5%	4.19
5. It is interesting to learn Chinese HSK Level 4 vocabulary under seamless learning after class hours.	0	0%	2	6.25%	6	18.75%	16	50%	8	25%	3.94
6. I am happy to share content in Chinese about my daily life on social media platform.	0	0%	2	6.25%	5	15.62%	15	46.88%	10	31.25%	4.03
7. It is meaningful to connect my in-class learning to my out-of-class learning of Chinese.	0	0%	0	0%	3	9.37%	19	59.38%	10	31.25%	4.22

8. Guided seamless learning gives me confidence and motivation in learning Chinese vocabulary.	0	0%	0	0%	7	21.87%	13	40.63%	12	37.5%	4.16
In total											4.12
Note. F=Frequency											

As shown in Table 37, the learners' experiences towards the SCVL were generally positive and favourable (all mean scores were above 3.5). In particular, 90.63% of learners indicated that they thought it was meaningful to connect their in-class learning to out-of-class learning of Chinese through the use of SCVL. Likewise, 87.5% of the learners reported that guided informal learning under seamless Chinese HSK Level 4 vocabulary learning after class hours was important to improve the mastery of Chinese vocabulary. Furthermore, 81.25% of the learners informed that they were comfortable with Chinese HSK Level 4 vocabulary learning through their mobile devices outside of the classroom (at home, on campus, and other places, etc.) (Mean score = 4.13). Thus, learners had a positive experience using SCVL to learn Chinese vocabulary.

Next, the hypotheses were tested by using a one-sample t-test; the alpha level of significance was set at 0.05. The sample size was 32. For the region of rejection, this research rejects the null hypotheses if $p < 0.05$. The findings on SCVLQ (A) of the research questionnaire based on the one-sample t-test is shown in Table 38.

Table 38 Learners' Experiences Towards the SCVL by One Sample T-Test

SCVLQ	Mean±SD	t	df	Sig. (2-tailed)
A	4.12±0.43	14.13	29	0.000

As shown in Table 38, the mean score for the post-SCVLQ (A) was 4.12 with a standard deviation of 0.43. Since the P value was less than 0.05, H_0 was rejected. As a result, it was significantly greater than 3.5. Hence, it clearly indicates that the learners' experiences towards the SCVL was positive and favourable ($P < 0.001$).

3.1.4.2 Findings of RQ 3b

RQ 3b of "What are learners' perceptions of DingTalk platform use in a SCVL environment?" investigated learners' perceptions of the DingTalk platform use in a SCVL environment. To address RQ 3b, descriptive and inferential analysis were adopted. Firstly, the detailed descriptive findings of the SCVLQ (B) are depicted in Table 39.

The corresponding null and alternative hypotheses are as follows:

1. H011: The learners' perceptions of DingTalk platform use in an SCVL environment are not positive.
2. Ha11: The learners' perceptions of DingTalk platform use in a SCVL environment are positive.

As shown in Table 39 below, the mean scores for the majority of items were above 3.5. Thus, the findings clearly illustrate that the majority of learners had better perceptions, affectivity, and motivation (intrinsic motivation and self-efficacy) towards the use of DingTalk learning platform. Four main positive findings are shown below.

1. 93.74% of the learners enjoyed the comments and 'likes' given by the teacher/educator and learners.
2. Compared with the pre-research finding where 65.63% of learners were interested in posting Chinese content on social media platforms with vocabulary that they had learned in formal classrooms (refer to Figure 4.15), 87.5% of the learners were happy to post Chinese artifacts comprising of sentences made using target vocabulary on the DingTalk platform.
3. 81.24% of the learners reported that by posting Chinese artifacts comprised of sentences made using target vocabulary at anytime and anywhere on DingTalk platform, they were able to improve their Chinese faster as compared to before they joined seamless learning.
4. 78.13% of the learners indicated that the DingTalk learning platform was user-friendly for posting Chinese artifacts.

The results revealed that 18.75% of learners encountered difficulties when using DingTalk to post Chinese artifacts containing sentences utilising target vocabulary, as reflected by a mean score of 3.41.

Table 39 Learners' Perceptions on DingTalk Learning Platform

Questions	Strongly disagree		Disagree		Somewhat agree		Agree		Strongly agree		Mean scores
	F	%	F	%	F	%	F	%	F	%	
1. DingTalk learning platform is user friendly for posting Chinese artifacts comprised of sentences made using target vocabulary.	0	0%	0	0%	7	21.87%	13	40.63%	12	37.5%	4.16
2. I don't find any problem in using DingTalk to post Chinese artifacts comprised of sentences made using target vocabulary.	1	3.13%	5	15.62%	13	40.63%	6	18.75%	7	21.87%	3.41
3. I am able to take 2-3 photos of target vocabulary by myself to make sentences, paragraphs, or stories in my real-life contexts using mobile devices to illustrate the artifacts' meanings.	0	0%	0	0%	5	15.62%	19	59.38%	8	25%	4.09
4. I am able to seamlessly and rapidly switch between different situations to make Chinese sentences or paragraphs, like from classroom to campus, from campus to supermarket, etc.	0	0%	2	6.25%	7	21.87%	13	40.63%	10	31.25%	3.97
5. According to the situations given by instructors, I am able to use the target vocabulary to make paragraphs that best represent the situations on the DingTalk platform.	0	0%	0	0%	6	18.75%	17	53.13%	9	28.12%	4.09
6. By posting Chinese artifacts comprised of sentences made using target vocabulary at anytime and anywhere on DingTalk platform, I am able to improve my Chinese faster as compared to before I joined seamless learning.	0	0%	1	3.13%	5	15.63%	13	40.62%	13	40.62%	4.19
7. I am happy to post Chinese artifacts comprised of sentences made using target vocabulary on the DingTalk platform.	0	0%	0	0%	4	12.5%	15	46.88%	13	40.62%	4.28
8. I am able to comment on artifacts created by other learners on the DingTalk platform.	0	0%	3	9.37%	14	43.75%	9	28.13%	6	18.75%	3.56
9. I enjoy giving comments on other learners' posts on the DingTalk platform.	0	0%	10	31.25%	10	31.25%	6	18.75%	6	18.75%	3.25

10. I am able to learn more vocabulary in the process of commenting and discussing with classmates on the DingTalk platform.	0	0%	0	0%	14	43.75%	12	37.5%	6	18.75%	3.75
11. I enjoy about the comments and 'likes' given by teachers and learners.	0	0%	1	3.13%	1	3.13%	16	50%	14	43.74%	4.34
12. I enjoy about the informal Chinese vocabulary learning on DingTalk platform.	0	0%	2	6.25%	8	25%	12	37.5%	10	31.25%	3.94
In total											3.92

Note. F=Frequency

Following that, the hypotheses were tested using a one-sample t-test with an alpha level of significance of 0.05. The sample size was 32. This research rejected the null hypotheses in the region of rejection if $p < 0.05$. Table 40 shows the results of the one-sample t-test on the SCVLQ (B) of the research questionnaire.

Table 40 Learners' Perceptions on DingTalk, the Seamless Learning Platform by One Sample T-Test

SCVLQ	Mean $\pm$ SD	t	df	Sig. (2-tailed)
B	3.92 $\pm$ 0.60	8.39	29	0.000

With reference to Table 40, the results revealed that the learners significantly strongly agreed ($P < 0.001$). In other words, the participated CFL learners had a great perceptions towards DingTalk platform in the SCVL environment ($M = 3.92$).

3.1.4.3 Findings of RQ 3c

To address RQ 3c of "To what extent do learners perceive that SCVL has improved their vocabulary learning of Chinese writing?", the corresponding null and alternative hypotheses are as follows:

1. H012: The learners perceive that SCVL does not improve their vocabulary learning of Chinese writing.
2. Ha12: The learners perceive that SCVL significantly improve their vocabulary learning of Chinese writing.

Accordingly, descriptive and inferential analysis were used to answer RQ 3c. To begin, Table 41 displays the detailed descriptive findings of the SCVLQ (C).

Table 41 Learners Perception on SCVL in Improving Their Vocabulary Learning of Chinese Writing

Questions	Strongly disagree		Disagree		Somewhat agree		Agree		Strongly agree		Mean scores
	F	%	F	%	F	%	F	%	F	%	
1. Through seamless Chinese vocabulary learning, I have mastered more vocabulary than usual.	0	0%	0	0%	4	12.5%	18	56.25%	10	31.25%	4.19
2. Through seamless Chinese vocabulary learning, I am able to write longer sentences than before I joined seamless learning.	0	0%	0	0%	4	12.5%	18	56.25%	10	31.25%	4.19
3. Through seamless Chinese vocabulary learning, I am able to create short paragraphs using target vocabulary to present a situation provided by instructors.	0	0%	0	0%	7	21.87%	13	40.63%	12	37.5%	4.16
4. Through seamless Chinese vocabulary learning, I am able to find materials in real life and make Chinese artifacts comprised of sentences made using target vocabulary.	0	0%	0	0%	8	25%	16	50%	8	25%	4.0
5. Through seamless Chinese vocabulary learning, I am able to observe, imagine and create situations in life, and describe the situations with learned vocabulary.	0	0%	1	3.13%	5	15.62%	20	62.5%	6	18.75%	3.97
6. Through seamless Chinese vocabulary learning, I am able to blend in my real life to make Chinese artifacts comprised of sentences made using target vocabulary.	0	0%	0	0%	8	25%	19	59.38%	5	15.62%	3.90
7. Through seamless Chinese vocabulary learning, I am able to learn new vocabulary by reading classmates' posts and comments.	0	0%	2	6.25%	7	21.88%	16	50%	7	21.87%	3.87
8. Through seamless Chinese vocabulary learning, I have noticed that the use of HSK Level 4 vocabulary is increasing for myself in the formal and informal learning.	0	0%	0	0%	5	15.62%	15	46.88%	12	37.5%	4.22
9. Through seamless Chinese vocabulary learning, I have made fewer vocabulary mistakes (collocation errors, syntactic errors, meaning errors and	0	0%	4	12.5%	10	31.25%	15	46.88%	3	9.37%	3.53

Chinese characters errors.) in the formal and informal learning.

10. Through seamless Chinese vocabulary learning, I am able to help
classmates correct and revise their Chinese artifacts comprised of sentences
made using target vocabulary.

0	0%	2	6.25%	13	40.63%	10	31.25%	7	21.87%	3.70
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In total

3.97

Note. F=Frequency

The learners' perceptions of SCVL in improving their vocabulary learning of Chinese writing were relatively favourable, as demonstrated by Table 4.35 (all mean scores were above 3.5). The main findings are presented below.

- 87.5% of the learners indicated that through SCVL, they had mastered more vocabulary than usual and were able to write longer sentences than before they joined seamless learning.
- 84.38% of the learners reported that through SCVL, they noticed that the use of HSK Level 4 vocabulary increased for themselves in formal and informal learning.
- 81.25% of the learners indicated that through SCVL, they could observe, imagine, and create situations in their lives, and describe the situations with learned vocabulary.
- 78.13% of the learners informed that through SCVL, they were able to create short paragraphs using target vocabulary to present a situation provided by the instructors.
- 71.87% of the learners informed that through SCVL, they were able to learn new vocabulary by reading classmates' posts and comments.
- Over half of the learners (56.25%) indicated that through SCVL, they made fewer vocabulary mistakes (collocation errors, syntactic errors, meaning errors and Chinese characters errors) in formal and informal learning.

Next, the hypotheses were tested using a one-sample t-test with a level of significance of 0.05. The sample size was 32. The null hypotheses were rejected in the region of rejection if $p < 0.05$. The results of a one-sample t-test on the SCVLQ (C) of the research questionnaire are provided in Table 42.

Table 42 Learners' Perception on SCVL in Improving Their Vocabulary Learning of Chinese Writing by One Sample T-Test

SCVLQ	Mean±SD	t	df	Sig. (2-tailed)
C	3.97±0.56	9.57	29	0.000

Table 42 indicates that the mean score for the SCVLQ (C) was 3.97 with a standard deviation of 0.56, which was significantly greater than 3.5 ($P < 0.001$). Consequently, the finding proves that learners had a high perception of the effectiveness of SCVL in improving their vocabulary learning of Chinese writing.

Next, to enhance the depth and comprehensiveness of these findings, Section 3.2 will present the qualitative results concerning learners' viewpoints, feelings, perceptions, and experiences with SCVL, as well as the challenges encountered during their use of the DingTalk platform and vocabulary enhancement through SCVL.

3.2 Qualitative Analysis and Findings

This section presents the qualitative findings that address RQ 3, which aimed to capture the authentic voice, feelings, and perceptions of learners regarding their use of SCVL. Qualitative data analysis was a key component of this research, and interviews and learners' feedback guided the DBR approach (Ge et al., 2021; Yin, 2011), as described in Chapter 3. Additionally, the findings were triangulated with other data sources, such as open-ended questionnaires. Overall, there were three refined sub-research questions proposed.

RQ3: What are learners' experiences, perceptions, and improvements in vocabulary learning through the utilisation of SCVL?

RQ3a: What are learners' experiences in the utilisation of SCVL?

RQ3b: What are learners' perceptions of the DingTalk platform use in an SCVL environment?

RQ3c: To what extent do learners perceive that SCVL has improved their vocabulary learning of Chinese writing?

The study involved 32 CFL learners, all of whom actively participated in at least one semi-structured interview across the four DBR stages. In each stage, 4-5 questions were posed to these learners to elicit their insights regarding their learning experiences and perceptions of the use of SCVL. Furthermore, within the scope of this research, six out of the 32 international students who were actively monitored throughout the study underwent in-depth interviews (refer to Appendix B). These open interviews encompassed approximately 30 questions, and there were 28 questions for the semi-structured interviews. These interviews were conducted both before and after the research study. For reference within this section, these selected CFL learners are coded as L5T, L6T, L11T, L15T, L26T, and L27T. Additionally, a dataset comprising 70 pieces of feedback from CFL learners was collected throughout the four DBR stages within the SCVL environment. Notably, 29 out of the 32 open-ended questionnaires, each containing two items, which were distributed to learners upon course completion were returned, contributing to the overall dataset. This high response rate, at 90.63%, reflects the robustness of data collection efforts. It is important to note that since the interviews were conducted in Chinese, translations of learners' comments into English were required. Within the main text, these statements were summarized in English and cited indirectly.

The present study adopted a thematic analysis approach in alignment with past research (Braun & Clarke, 2006; Braun et al., 2019; Maguire & Delahunt, 2017; Zhang et al., 2021) to address RQ 3. The qualitative data was examined and insights were extracted using NVivo 12 Plus software. Through the integration of NVivo 12 Plus and the thematic analysis approach, themes were identified, and the data were organised to establish correlations among collected perspectives, facilitating a comprehensive understanding of the primary findings of qualitative data (Jon et al., 2014; Ramalingam et al., 2021). To note, the thematic analysis was driven by the data content (i.e., Interview, Feedback, and Open ended questionnaires), with the research question (i.e., RQ 3) serving as a guide (Braun et al., 2015). After a rigorous coding process (refer to Section 3.8) of the data obtained from semi-structured interviews, learners' feedback, and open-ended questionnaires, a total of seven themes and 16 sub-themes were identified. Table 43 presents examples of the themes and sub-themes identified in this research.

Table 43 Examples of the Themes and Sub-themes

No	Theme	Sub theme
1	Affective engagement	Ambivalent experience Positive experience
2	Issues and challenges	Formal learning Informal learning
3	Perceived Ding Talk's ease of use	Positive views on using DingTalk Negative views on using DingTalk
4	Perceived usefulness of DingTalk	Motivating and empowering Supported by DingTalk learning tools
5	Attitudes towards using DingTalk	Positive attitude

		Negative attitude
6	Cognitive development	Increasing awareness of identifying errors in an artifact Improving self-revising ability Enhancing writing performance
7	Affective enhancement	Inspiring to achieve learning goals Growing self-confidence in Chinese learning Enhancing self-directed learning

As shown in Table 43, these themes and sub-themes provided a comprehensive understanding of the learners' experiences, challenges, and perceptions towards SCVL, which were used to answer RQ 3. Next, as recommended by numerous scholars (Archibald et al., 2015; Braun & Clarke, 2006; Maguire & Delahunt, 2017), incorporating visual representations can be advantageous for presenting the research findings. For instance, to illustrate learners' learning experience using SCVL, a word cloud was used to display the hundred most frequent words, highlighting the most important themes (Archibald et al., 2015). Consequently, this study's findings regarding RQ 3 are presented through thematic analysis, which involved deriving themes and sub-themes from learners' quotations. This approach established a solid foundation for interpreting and applying the research results, ensuring the credibility and rigour of the findings. By incorporating exact quotations sourced from interviews, open-ended questionnaires, and feedback datasets, the identified themes and sub-themes were further reinforced and supported. For easy reference, the relevant quotations provided by learners can be found in Appendix F.

3.2.1 Findings on Learners' Experiences in the Utilisation of SCVL

In answering RQ 3a of "What are learners' learning experiences in the utilisation of SCVL?", the qualitative data garnered from three datasets, i.e., interviews, open-ended questionnaires, and learners' feedback that related to learners' experiences in the utilisation of SCVL were coded.

Next, two themes related to learning experiences were identified to answer RQ 3a, which were "Affective engagement" and "Issues and challenges" that were finalised after the code identification process. Following that, with reference to the learners' quotations, further elaboration of the findings on learners' experiences in the utilisation of SCVL is presented below.

3.2.1.1 Theme 1: Affective Engagement

"Affective engagement" refers to a learner's emotional connection to what they are learning (Alharbi & Alnoor, 2022; Houssein et al., 2022; Ramalingam et al., 2021). Specifically, positive experiences and affections have been recognised as motivating foreign language learners to be active in the learning process (Ramalingam et al., 2021). Du (2020) conducted a similar study demonstrating that learners' positive e-learning experiences significantly impacted their research and learning skills. Consequently, this study identified two sub-themes of "Affective Engagement", including "Ambivalent Experience" and "Positive Experience", which are reported below.

a) Sub-theme 1: Ambivalent Experience

When the learners were requested to share their experiences towards SCVL, not all expressed positive emotions when discussing their feelings. A total of 78.79% (F=130) of the views showed that the positive feelings of the learners were enjoyable, excited, interested, satisfactory, comfortable, helpful, fun, proud and others while 21.21% (F=35) of the views illustrated negative emotions such as nervous, tired, skeptical, unfamiliar, hurt, and stressed.

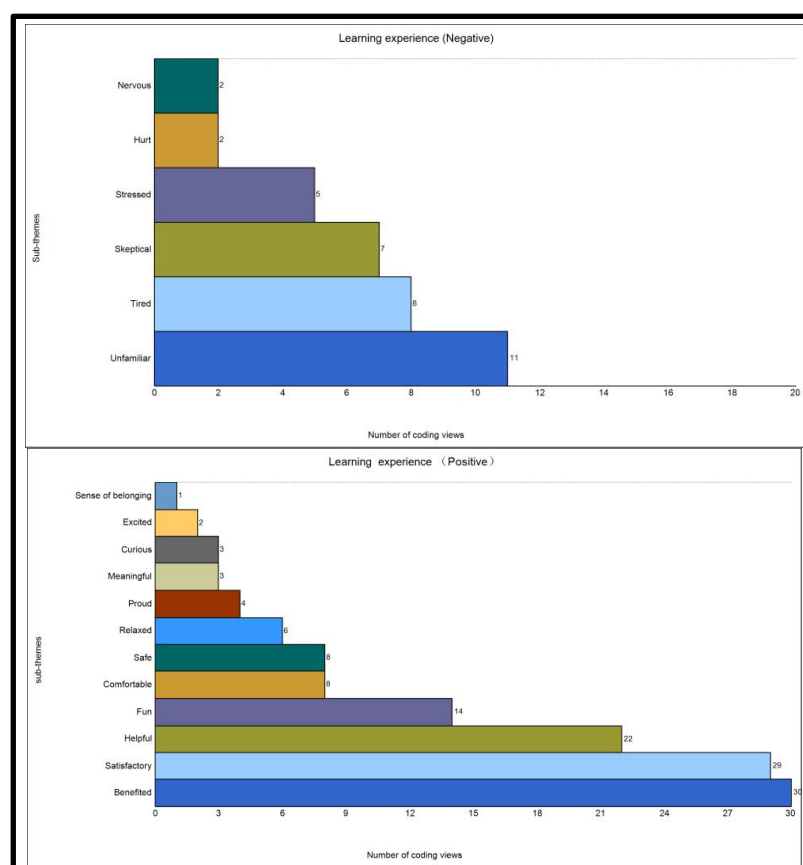


Figure 35 Number of Coding Views on Learning Experience of the Learners About SCVL

Figure 35 illustrates both the positive and negative learning feelings of the learners about SCVL from the interview, feedback, and open-ended questionnaire datasets. These identified sub-themes were mentioned by learners who experienced the four learning stages, hence, diverse and ambivalent experiences were presented to reflect the learners' learning experiences under the SCVL environment. Although the educator introduced and clarified the SCVL approach to learners prior to the research, many learners were suspicious about the usefulness of SCVL at the beginning. One learner (L32, High, OQ, Appendix F) stated that:

"I am very skeptical of this learning method because the formal learning mode is also online learning, I think it is similar to my university."

As shown in Figure 4.25, 4.24% (F=7) of the views were that the learners were skeptical. However, after experiencing 16 weeks of SCVL, one commented that:

"It has changed my perspective, I am becoming increasingly satisfied, and I have experienced a new way of writing, which has greatly enhanced my Chinese vocabulary learning." (L32, High, OQ, Appendix F)

This represented some of the learners' initial prejudice towards SCVL as being sceptical and feeling confused, but at a later stage, some of learners' paradoxical impression towards SCVL were positively changed.

Apart from the prejudice towards SCVL, the DingTalk platform also produced nervousness for a few learners as shown in this excerpt:

"I'm a bit nervous because this is my first time to learn Chinese with DingTalk." (L5T, Low, I, Week 2, Appendix F)

"When I was writing a composition within the one-hour time limit, I was very nervous." (L13, Medium, I, Week 4, Appendix F)

Another concern linked to the function of the DingTalk platform concerns posting artifacts in the HSK Level 4 Learning Circle. A total of 6.67% (F=11) of the views showed that the learners were unfamiliar with the platform, with one learner stating that:

"I am not used to using DingTalk platform to post Chinese because it is the first time I use it." (L7, Low, I, Week 2, Appendix F)

Also, the data from another learner derived from another data source (i.e., Feedback) confirmed that:

"This is my first time posting Chinese on the DingTalk platform, but I can't enter the HSK Level 4 Learning Circle because I don't have permission." (L11T, Medium, F, Week 2, Appendix F)

Furthermore, many learners felt stressed when doing essay artifacts at the beginning. In terms of the one-hour time limit in writing in DBR Stage 1, there was a sense of pressure amongst the interviewees, as represented in the quotation:

"I was very nervous and stressed when I was writing in one hour of limited time. I was worried that I would not be able to finish it, but in the end I did." (L6T, Low, I, Week 4, Appendix F)

A similar line of evidence came from the Feedback dataset, which stated that:

“When I was writing a composition within the one-hour time limit, I was very nervous. There was a feeling of starting an exam, which made me stressed.” (L13, Medium, I, Week 4, Appendix F)

Moreover, concerns were expressed about experiences of seamless learning activities during DBR Stage 2, as some learners felt hurt when doing the activity called “compare multiple sentences using one word (比较一词多句)”. A number of issues were identified below:

“I don’t like the fact that the teacher set up the activity which called ‘compare multiple sentences using one word’. The teacher asked us to compare our artifacts created using the same target vocabulary with each other. It hurts me very much because I am not good at Chinese writing. But, I’m fine with other activities.” (L5T, Low, I, Week 8, Appendix F)

Another learner emphasised the disadvantage of the “compare multiple sentences using one word (比较一词多句)” activity:

“To be honest, I didn’t like the activity, we are all learners from different countries, it’s embarrassing and hurts our self-esteem.” (L11T, Low, I, Week 8, Appendix F)

A similar line of evidence came from a learner who stated that:

“I don’t like to see my artifacts compared with other classmates’ artifacts because I think it make confusing people and everybody have their own idea and thoughts to create the artifacts. This is not a satisfactory activity.” (L19, Medium, F, Week 8, Appendix F)

These views surfaced mainly in relation to the “compare multiple sentences using one word” activity during Stage 2. As it was important for educator to examine different learners’ writing improvement (Aw et al., 2016; Wong et al., 2012), the educator designed the “compare multiple sentences using one word” activity, where the learners were required to create an artifact using the target vocabulary in the same scene, or create an artifact using the target vocabulary in different scenes. Their feedback shows that this activity did not work out well.

In Stage 3, 4.85% (F=8) of the views showed that the learners were tired. Issues related to cognitive load were particularly prominent in the interview dataset. Referring to the interview datasets, a common

emotion from the two interviewees was that they were tired of doing seamless learning activities. One learner stated that:

“There are so many seamless learning activities, I finished writing the sentence artifacts, then posted the paragraph artifacts, and then I have to write the essay, I am too tired. And I have a lot of exams and homework lately.” (L13, Medium, I, Week 12, Appendix F)

Likewise, another learner complained that:

“A lot of activities! Mr. Zhou should consider the fact that a learner is staying at dormitory to avoid illness or infection from happening. Also, learners have lots of assignments from their schools. Too many tasks kill us! Not because of the coronavirus that causes us to die.” (L7, Low, F, Week 11, Appendix F)

However, despite some learners’ initial concerns upon approaching SCVL, many were excited to start new ways of seamless learning. For instance, one learner stated that:

“This is my first time participating in seamless Chinese vocabulary learning, and I am so excited.” (L10, Low, F, Week 2, Appendix F)

Similarly, when L15 was interviewed at the beginning, he described his experience as:

“It’s a very innovative and new idea of learning.” (L15T, Medium, I, Week 2, Appendix F)

As the research progressed towards the final stage, numerous positive learning experiences were revealed. The sub-theme of “Positive Experience” is discussed in the next section.

b) Sub-theme 2: Positive Experience

Referring to Figure 35 many learners reported that SCVL offered them a satisfactory learning experience. The sub-theme of “Satisfactory” accounted for 17.58% (F=29). Referring to the open-ended questionnaires, one learner stated that:

“Seamless learning is a flexible and fast scaffolding approach for my Chinese writing... I am very happy with the method to learn Chinese.”
(L15T, Medium, OQ, Appendix F)

Similarly, the data garnered from this learner through another data source (i.e., Interview) confirmed that:

"I think seamless Chinese learning method is a perfect way to thrive our ability to write better, because we have to think and create how to make posts." (L15T, Medium, I, Week 8, Appendix F)

Specifically, the sub-theme of "Benefited" that recurred throughout the three datasets accounted for 18.18% (F=30), as illustrated by the following quotations:

"I gained a lot of knowledge, and by creating Chinese artifacts and posting them online." (L6T, Low, I, Week 16, Appendix F)

"I gained confidence to learn Chinese through the way of seamless learning." (L20, Medium, I, Week 16, Appendix F)

Furthermore, 13.33% (F=22) of the views illustrated that the learners' experiences of SCVL were helpful as demonstrated by the following quotations:

"Posting Chinese artifacts in Learning Circle is very fast and helpful." (L20, Medium, I, Week 2, Appendix F)

"It is very helpful to practise my learned vocabulary and do seamless learning activities." (L3, Low, I, Week 8, Appendix F)

"The seamless learning has been really helpful and has helped me learn something new and at the same time I have reduced errors in my Chinese writing." (L5T, Low, OQ, Appendix F)

Also, positive experiences with online peer discussion, posting Chinese artifacts, and searching for a scene to post Chinese artifacts were expressed as "Fun", "Relaxed", "Comfortable", "Curious", "Proud", "Excited", "Meaningful", and others. The CFL learners appreciated the flexibility of the DingTalk platform's Learning Circle, as it offered them a learning space to discuss freely, work at their own pace, and post Chinese artifacts at their convenience. The data gathered from one learner through the interview data source stated that:

"I feel very comfortable posting Chinese in the HSK Level 4 Learning Circle and interacting with my classmates. I really enjoy it." (L13, Medium, I, Week 8, Appendix F)

Likewise, another learner with medium performance in Chinese had a similar experience:

“At this stage, I feel much better. We can study by ourselves or discuss in the Learning Circle, which is very relaxed and casual.”
(L15T, Medium, F, Week 8, Appendix F)

Furthermore, the data garnered from one learner through another data source (i.e., Open-ended questionnaires) showed that the learner had a wonderful experience, as illustrated in the following quotation:

“Seamless learning is very supportive of my HSK Level 4 vocabulary learning! Every time I go outside with my phone to take pictures and find a scene to create artifacts, I feel like I'm on an adventure. I will think about how to create one interesting artifact that is very stimulating.” (L3, Low, OQ, Appendix F)

Moreover, after experiencing 16 weeks of SCVL and benefiting from the educator and classmates' comments, the learners felt proud and felt a sense of belonging, as displayed in the following quotation:

“The seamless Chinese vocabulary learning is incredible; I feel like I've improved my social skills, and I can learn Chinese in a variety of scenes, taking pictures, making sentences, and posting Chinese artifacts. Teachers and classmates often comment my artifacts and give me more likes. I am so proud of myself.” (L11T, Medium, PI, Appendix F)

Overall, the learners enjoyed the SCVL experience and they described their learning experiences as being more “Satisfactory”, “Comfortable”, “Helpful”, “Excited” and “Meaningful” among others. Furthermore, the open-ended questionnaire data reveals that learners expressed the usefulness of SCVL for their Chinese learning and artifact-making, as indicated by the word cloud in Figure 36.

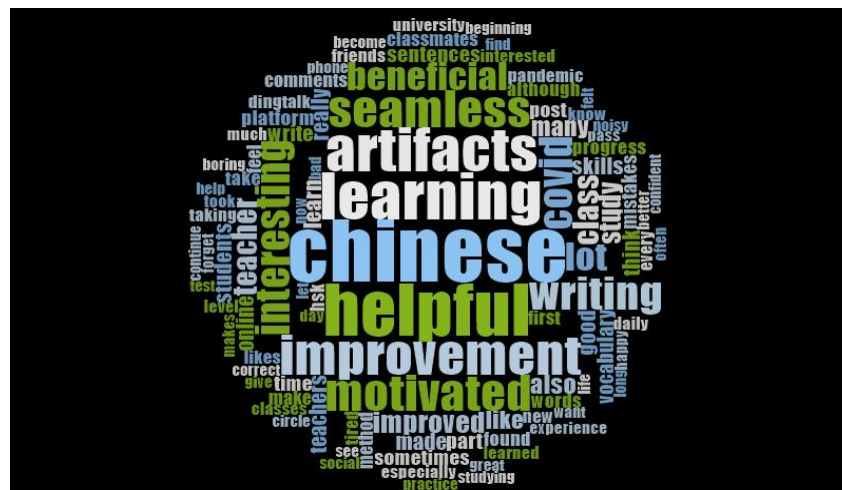


Figure 36 Word Cloud Created by NVivo 12 Plus (Data source: Open-ended questionnaires)

In summary, the findings from the “Affective Engagement” theme indicate that while some learners were initially hesitant about the new modes of learning, they eventually came to thoroughly enjoy the SCVL experience as the research progressed.

The next section reports the theme of “Issues and Challenges”.

3.2.1.2 Theme 2: Issues and Challenges

According to Ramalingam et al. (2022), the issues and challenges related to the technique that learners faced during their learning experience cannot be ignored. Additionally, Almaiah et al. (2020) and Yan (2021) provided evidence that potential challenges associated with adopting an e-learning system (i.e., Blackboard) and a technology-enhanced learning model (i.e., DingTalk) can impact learners’ learning experiences. Similarly, several potential issues and challenges were encountered in the SCVL environment across the four stages.

Many sub-themes were produced after the coding process, and these sub-themes, which emerged from the thematic analysis, were “Issues and Challenges” in terms of formal and informal learning as shown in Figure 37. These are the issues and challenges that the learners faced when experiencing the SCVL over the four stages. The theme “Issues and Challenges” has two main sub-themes of “Formal Learning” and “Informal Learning” as discussed below.

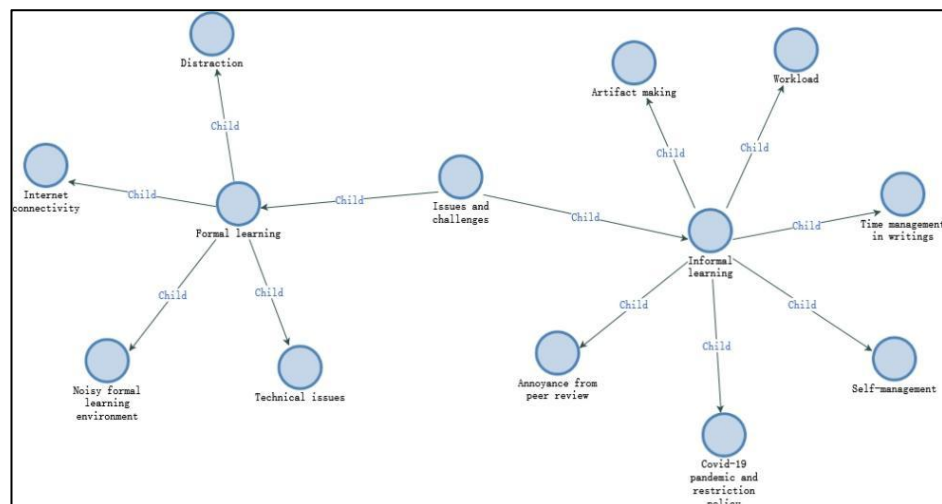


Figure 37 Sub-themes of Issues and Challenges

a) Sub-theme 1: Formal Learning

When the learners were asked to report their problems and challenges with the use of SCVL, 69 views were elicited from the learners across the four developmental phases of their engagement with SCVL (Figure 38). As shown in Figure 4.28, some learners reported challenges with noisy formal learning, internet connectivity, distraction, and technical issues in a formal learning environment.

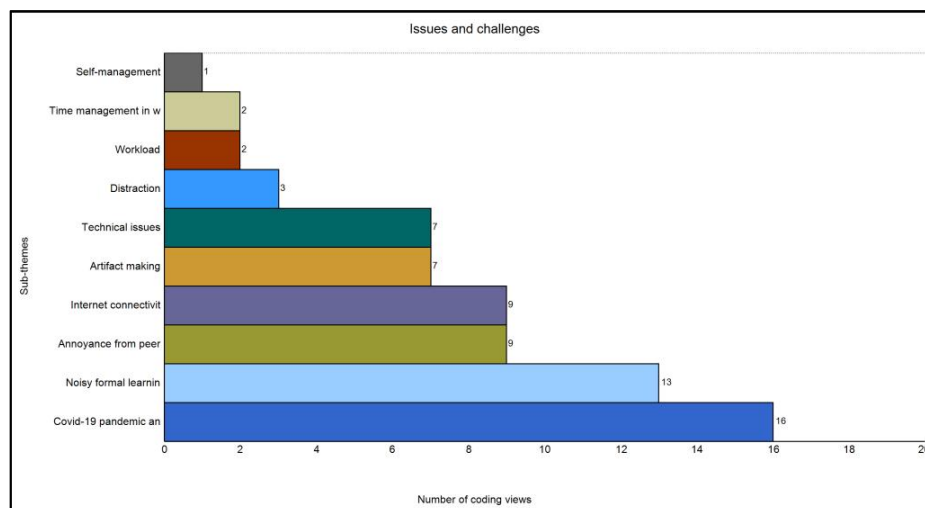


Figure 38 Number of Coding Views of Issues and Challenges Encountered in the SCVL Environment

Noisy formal learning environment: Many interviewees stated that the noisy formal learning environment was one of the challenging issues faced. As shown in Figure 4.28, 18.84% (F=13) of the views illustrated the learners' challenges with the noisy formal learning environment. One explanation is that the formal learning class consisted of 32 learners from three different universities. Nonetheless, it should be pointed out that this challenge appeared during the first stage, as demonstrated by some learners:

"The class is now quite noisy; 32 learners in one class is far too many." (L2,7..., I, Week 2, Appendix F)

Internet connectivity: Some learners confirmed that internet connectivity was one of the obstacles that they faced, as when there was an issue of accessing to the internet, it affected the whole implementation of SCVL in the formal learning setting (i.e., Activity 1: learning engagement). A total of 13.04% (F=9) of the views were related to the learners' challenges with internet connectivity, as stated below:

"I had poor internet connection." (L15T, Medium, I, Week 2, Appendix F)

"My internet constantly disconnect." (L24, High, I, Week 2, Appendix F)

Also, the data gathered from one learner through another data source (i.e., the open-ended questionnaires) confirmed that:

"My network is poor because four people in our dorm share one WiFi." (L30, High, I, Week 2, Appendix F)

Distraction: Some learners reported that it was hard for them to concentrate on formal learning, as illustrated by the following quotation:

"I'm constantly distracted by other things, such as eating, drinking, texting, or surfing the web for other purposes." (L6T, Low, I, Week 4, Appendix F)

Technical issues: Referring to interview data source, only 10.14% (F=7) of the views illustrated the learners' challenges with technical issues, as stated by the following quotations:

"I am sorry, I have a problem with my microphone." (L8, Low, I, Week 2, Appendix F)

"I'm not used to using DingTalk, last time I didn't know how to post and turn on my microphone." (L12, Medium, I, Week 2, Appendix F)

Next, the finding of learners' issues and challenges with the informal learning setting are shown in next section.

b) Sub-theme 2: Informal Learning

From Figure 38, it is evident that some learners reported challenges with the COVID-19 restriction policy, artifact-making, annoyance from peer review, time management in writings, workload, and self-management in an informal learning environment.

COVID-19 pandemic and restriction policy: Many learners stressed that the recurrent outbreak of COVID-19 in China was one of the biggest challenges to their informal learning experience. Accordingly, the Chinese government was very strict with the implementation of the COVID-19 restriction policy in any region of Chinese Mainland. A total of 23.19% (F=16) of the views illustrated the learners' challenges with the COVID-19 restriction policy, as stated by the following quotations:

"This restriction policy has a side where I don't like it, for example, because I can't go anywhere." (L2, Low, I, Week 8, Appendix F)

"The COVID-19 pandemic often prevents me from creating Chinese artifacts." (L11T, Medium, OQ, Appendix F)

"My university has been locked down for weeks due to the recurrent outbreak of COVID-19. I have to study at the dorm." (L26T, High, I, Week 12, Appendix F)

Artifact-making: Some learners reported that they faced problems in making artifacts when conducting SCVL. A total of 10.14% (F=7) of the views illustrated the learners' challenges in artifact-making.

Some learners found faced disadvantages in using the HSK Level 4 Learning Circle, where it was impossible to delete a post once it had been successfully posted. One feedback from a learner stated that:

“Why can’t I delete my posted artifacts from the Learning Circle of DingTalk platform? I have to delete it and redo one.”(L11T, Medium, F, Week 4, Appendix F)

Surprisingly, one learner reported that the cost of the internet was a problem for him. The learner stated that:

“ Creating Chinese artifacts costs me lots of data when I am searching for situations outside! It’s very pricey to spend money on the internet data plan. I’m a learner who gets minimal pocket money. That makes it hard for me to buy a data plan.”(L26T, High, F, Week 13, Appendix F)

Also, one learner stated that some words were abstract and it was hard to apply it into her daily life. Notably, one learner stated that:

“I find that some words, like ‘responsibility (责任),’ can be quite abstract, and it’s challenging to relate them to real-life situations. However, I do my best by searching for images on the Internet to create my artifacts.”(L30, High, I, Week 12, Appendix F)

Annoyance from peer review: From the codes in Figure 4.28, 13.04% (F=9) of the views illustrate the learners’ challenges of feeling annoyance from the peer reviews. For instance, some learners in their feedback informed that the comments from other learners were annoying and disturbing, as stated by one learner:

“ I was annoyed by some incorrect comments made by other classmates and refrained from posting Chinese artifacts because I believed it would disrupt my learning pace.” (L17, Medium, F, Week 10, Appendix F)

In the same vein, the data gathered from some learners through another dataset (i.e., Interview) stated that:

"It's very annoying that some learners comment haphazardly." (L5T, Low, I, Week 8, Appendix F)

Interestingly, there were also findings from the open-ended questionnaires:

"I don't believe learners' comments on each other's artifacts are reliable because they all have mistakes in their artifacts, and we're both learners, and classmates can't fully correct each other's mistakes. I think the teacher's comments are excellent." (L27T, High, OQ, Appendix F)

Time management in writing: Some learners felt that there was a challenge to finish an essay writing in the one-hour time limit in Stage 1, as stated below:

"I was fear of Chinese writing and can't manage to put words on the screen within the one-hour time limit." (L2, Low, I, Week 4, Appendix F)

"It's hard for me to manage the time to finish the essay and then post it in the 'Homework' function." (L6T, Low, I, Week 4, Appendix F)

Workload: Regarding the challenges with workload, some learners stated that they had too much homework from their universities, and they felt stressed to do seamless learning activities in Stage 3. As one learner stated:

"I have been assigned so much homework from my school that I have no time to work on seamless Chinese vocabulary learning as I can't manage my time better." (L9, Low, I, Week 12, Appendix F)

Self-management: Only one learner with low performance in Chinese stated that:

"Getting used to the new online seamless learning environment has been very stressful under the COVID-19 pandemic situation and strict restriction policy. I have difficulty with time management and I have difficulty staying motivated." (L6T, Low, I, Week 8, Appendix F)

3.2.2 Findings on Learners' Perceptions of DingTalk Platform Use in an SCVL Environment

In answering RQ 3b of “What are learners’ perceptions of DingTalk platform use in an SCVL environment? ”, the data garnered from three datasets, i.e., the interviews, the open-ended questionnaires, and the learners’ feedback related to the use of DingTalk by learners and their perceptions of SCVL by using DingTalk were coded. However, there were a lot of nodes in the three data sources that were created by NVivo 12 Plus. The hierarchy panel of NVivo 12 Plus was used to arrange the hierarchy and render the order to organise the learners’ perceptions. The node hierarchy refers to a function that can combine nodes and components together to create all kinds of images, texts, and interactive elements in a scene (Brooks, 2018; Gibbs, 2014). The purpose of the node hierarchy is to determine the highest number of nodes relating to the themes (Gibbs, 2014). The larger the size of the square, the greater the number of the nodes relating to the themes (Figure 39, Red box).

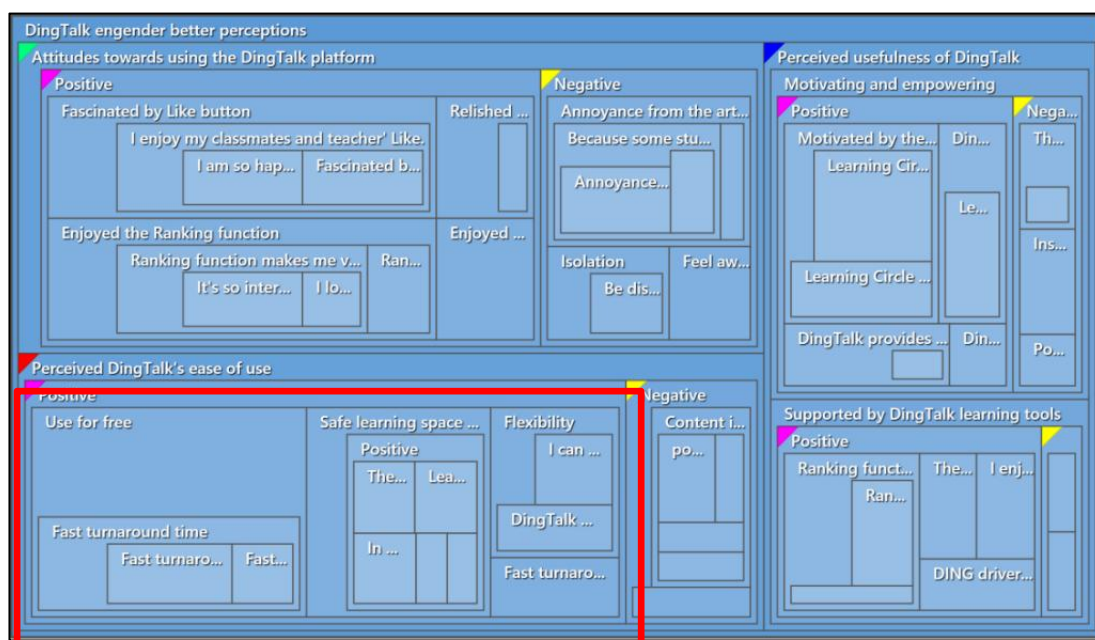


Figure 39 Node Hierarchy of Learners' Perceptions Generated by NVivo 12 Plus

As is shown in Figure 39, three themes of “perceived Ding Talk’s ease of use”, “perceived usefulness of DingTalk”, and “attitudes towards using the DingTalk platform” are presented and the theme “perceived DingTalk’s ease of use” was the largest, indicating that the theme has the most nodes. Thus, the majority of learners shared the same view.

Subsequently, further explication of the findings with regards to whether the DingTalk platform engenders better perceptions among learners towards SCVL is provided below.

3.2.2.1 Theme 1: Perceived Ding Talk’s Ease of Use

It is essential to note that perceived ease of use is the perception of how a platform or application is easy to use (Alfadda & Mahdi, 2020; Yu et al., 2022). The theme of “perceived DingTalk’s ease of use”

in this research is related to the perceived use of the DingTalk platform and motivation to use DingTalk. Figure 40 illustrates the learners' positive and negative perceptions of the use of DingTalk in their SCVL process.

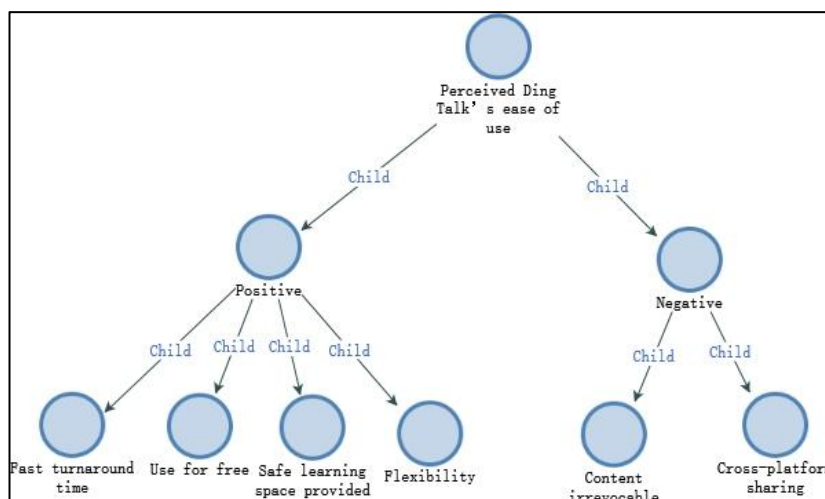


Figure 40 Learners' Positive and Negative Perceptions of the Use of DingTalk

Figure 41 shows the number of learners' positive and negative views as the sub-themes on the use of DingTalk. The perceptions of learners' views on DingTalk include "use for free" (F=25); "DingTalk linked ease of access to an appreciation of speed and fast turnaround" (F=16); "learners appreciated the flexibility of posting artifacts in DingTalk" (F=14); and "the learners deemed that DingTalk platform offered a safe learning space to learn Chinese" (F=13). On the other hand, it was found that "the posted artifacts were irrevocable" (F=12) and that "learners cannot share their artifacts to other social media applications" (F=9). A total of 89 views were identified to demonstrate learners' positive and negative perceptions of the use of DingTalk.

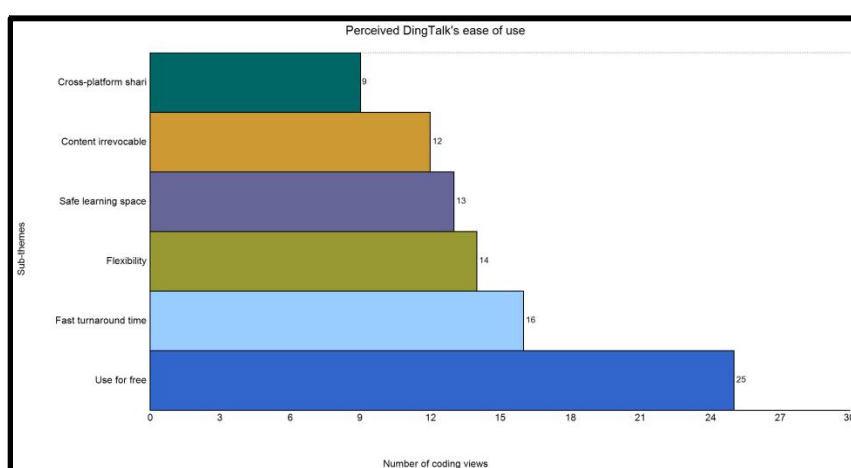


Figure 41 Number of Learners' Positive and Negative Views on DingTalk's Use

a) Sub-theme 1: Positive Views on Using DingTalk

Use for free: 28.09% (F=25) of the views showed that the learners appreciated that the DingTalk platform can be used for free. This was the biggest advantage of using the platform. The data garnered from some learners through the data sources demonstrated that:

"This is my first time using DingTalk..... and it's free of charge." (L3, Low, I, Week 2, Appendix F)

"DingTalk is the best free social media platform for me to learn Chinese, I really like it." (L15T, Medium, OQ, Appendix F)

Fast turnaround time: 17.97% (F=16) of the views related to ease of access, i.e., the appreciation of speed, and fast turnaround. The learners' comments stressed on the importance of speed in assisting learners in their learning. As one learner stated:

"It was so great that after learning Chinese, I can quickly enter the Learning Circle and post my Chinese artifacts." (L6T, Low, F, Week 2, Appendix F)

Also, the value of the time factor in the interview data source was also evident in the following quotations:

"It feels good to be able to do exercises immediately after studying." (L4, Low, I, Week 2, Appendix F)

"Wow! I find access to DingTalk platform was faster than access to Chaoxing. I like to use the platform." (L26T, High, I, Week 2, Appendix F)

Based on this, the learners seemed to have a time-sensitive emotional bond or curiosity associated with every piece of writing they created. For that curiosity to be sustained, learners need to realise that their educator and classmates has responded and commented on their posted writing texts.

Flexibility: 15.73% (F=14) of the views commented that the HSK Level 4 Learning Circle of the DingTalk platform allowed flexibility by granting them more autonomy to post their created artifacts freely at their own desired time and place, as they wished.

When the findings on flexibility in posting artifacts in DingTalk were analysed, the learners stated that "I can post Chinese artifacts at my convenience" (F=5) and "making Chinese learning easy for the learners" (F=7), where some of the views were as follows:

"It is very easy to post Chinese artifacts in the HSK Level 4 Learning Circle on the DingTalk platform." (L10, Low, I, Week 12, Appendix F)

"I like to study Chinese on the DingTalk platform, it allows me to work at my own pace to take photos, post artifacts anytime, anywhere." (L16, Medium, I, Week 2, Appendix F)

"Aha, it's so easy to post artifacts in the HSK Level 4 Learning Circle. Just click the 'plus sign', then type Chinese, upload the photo and you can post it easily." (L4, Low, I, Week 4, Appendix F)

Unparalleled flexibility can promote learners' tendency to apply their learned vocabulary into their daily lives more frequently to not forget the vocabulary that they had learned from the informal learning contexts, as reflected in this quotation:

"This platform is particularly convenient, and you can log in to practise the target vocabulary anytime, anywhere." (L18, Medium, OQ, Appendix F)

Similarly, the value of the learner autonomy in Feedback data source was also evident in this quotation:

"I can create artifacts and post it into DingTalk platform whenever I want or not. Everything is at my fingertips." (L31, High, F, Week 8, Appendix F)

It is clear that the advantage of the DingTalk platform is that it is user-friendly and can assist learners in performing more out-of-class learning activities to practice the target vocabulary. This made it possible for learners to apply what they have learned in class about writing in Chinese to real life anytime and anywhere they prefer.

Safe learning space provided: Regarding the safe learning space provided by the DingTalk platform, 14.61% (F=13) of the codes that showed the views of the learners on the safety of practising Chinese vocabulary and posting Chinese artifacts in the HSK Level 4 Learning Circle (Table 44).

Table 44 Data of Safe Learning Space Provided in Datasets (N=32)

Data Sources	Views	N
Interview	"The Learning Circle is very interesting and safe." (L2, Low, Week 2, Appendix F)	9
Open-ended questionnaires	"The HSK Level 4 Learning Circle is very protective and safe for my Chinese vocabulary learning." (L26T, High, Week 4, Appendix F)	3
Feedback	"Our Learning Circle is very safe, unlike Facebook, which is public, many people can browse it." (L10, Low, F, Appendix F)	1
In total		13 (40.63%)

As shown in Table 44, many learners found that the Learning Circle function was interesting and safe. One learner stated that:

“The HSK Level 4 Learning Circle is safe and transparent and it has a protective effect, I like it.” (L26T, High, OQ, Appendix F)

Likewise, the data from another learner derived from another data source (i.e., interview) confirmed that:

“The Learning Circle is great. I can post lots of artifacts, and I can also comment on others. In my opinion, the best part is the privacy, only my classmates and teachers can see it and comment on it; others can’t, so it has a protective effect.” (L30, High, I, Week 4, Appendix F)

Furthermore, a significant perceived benefit of the HSK Level 4 Learning Circle, according to the learners, was to protect privacy:

“From my point of view, the HSK Level 4 Learning Circle is limited to people in this circle who can comment. I think it’s safe to protect our privacy because the Chinese artifacts posted by some learners are not very good, and they do not want unknown people to review their mistakes.” (L11T, Medium, I, Week 4, Appendix F)

Moreover, the data garnered from another learner through another data source (i.e., feedback) confirmed the same perception of the safety of HSK Level 4 Learning Circle:

“The Learning Circle is safe and helpful, only people we know well can see and comment.” (L21, Medium, F, Week 4, Appendix F)

b) Sub-theme 2: Negative Views on Using DingTalk

On the other hand, 13.48% (F=12) of the views were negative where learners expressed that the posted artifacts were not able to be withdrawn and should be deleted or re-posted. Furthermore, 10.11% (F=9) of the views indicated that some learners reported that they could not share the artifacts on other social media platforms. Therefore, the following are some of the learners’ negative perceptions of this sub-theme based on the three datasets.

In the interviews, one of the learners talked about the problem in posting Chinese artifacts:

“Although the Learning Circle is safe, one problem is that once an artifact is posted, it cannot be withdrawn or modified. Similar to other social media platforms, the artifact must be deleted and re-posted in order to make changes.” (L21, Medium, I, Week 4, Appendix F)

There was also an interesting response from other two datasets about learners wanting to share her created artifacts on other social media platforms:

“When I want to share my Chinese artifacts posted in the HSK Level 4 Learning Circle to my friends, my friends can’ see and comment because they are not in this Learning Circle. I realised the Learning Circle is too sealed.” (L5T, Low, OQ, Appendix F)

“But, the artifacts cannot be shared on other social media platforms.”
(L21, Medium, F, Week 4, Appendix F)

3.2.2.2 Theme 2: Perceived Usefulness of DingTalk

“Perceived Usefulness of DingTalk” refers to the perceived utility and value of DingTalk as a learning platform. As evidenced by Yan (2021) and Han (2021), DingTalk is a techno-pedagogical model that actively integrates formal language learning in the classroom with language application and reflection processes in learners’ daily lives. It involves learners in the continuous creation of social media as an online platform (Yan, 2021; Han, 2021). For instance, the Learning Circle function serves as a seamless learning space to enable learners to carry out seamless learning activities. Other functions and tools, including Reminder, Ding Drive, and others were utilised to assist learners in SCVL.

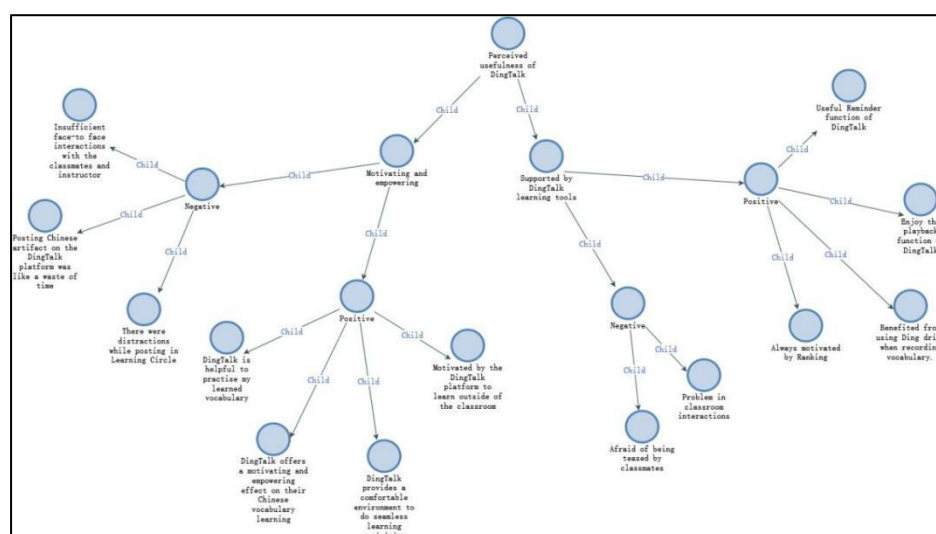


Figure 42 Learners' Positive and Negative Perceptions of Usefulness of DingTalk

Hence, as shown in Figure 42, there are two sub-themes of “Perceived Usefulness of DingTalk”, which are “Motivating and Empowering” and “Supported by DingTalk Learning Tools”. These are presented in two ways: positive and negative.

While presenting the findings, the examples from the sub-themes with the highest frequency were included to state the common opinion. The frequencies of the positive and negative views of the learners about the usefulness of DingTalk are depicted in Figure 43.

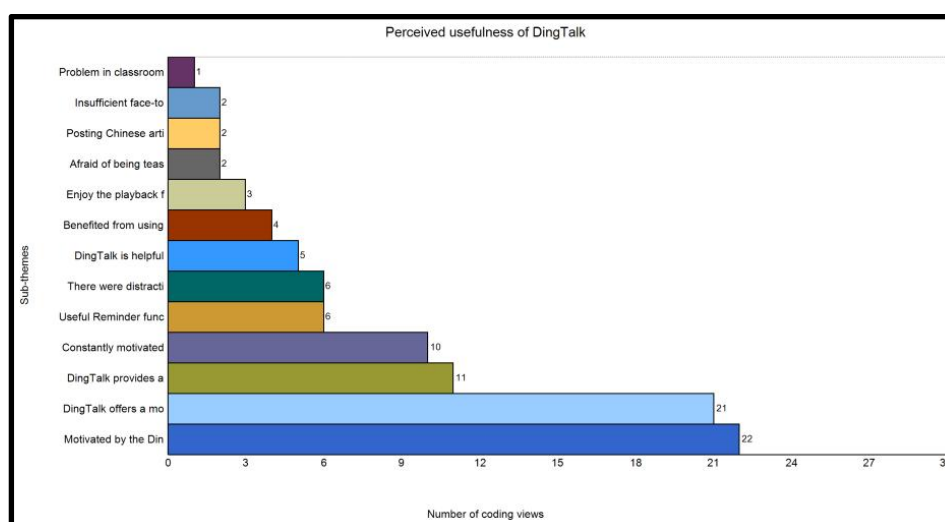


Figure 43 Number of Learners’ Positive and Negative Views on the Usefulness of DingTalk

Figure 43 shows that learners were motivated by the DingTalk platform to learn outside of the classroom (F=22); DingTalk offers learners a motivating and empowering effect on their Chinese vocabulary learning (F=21); DingTalk platform provided a comfortable environment (F=11); the learners ewre constantly motivated by the Ranking function (F=10); the Reminder function was useful (F=6); DingTalk was helpful to do seamless learning activities (F=5); the learners benefitted from using the Ding Drive when learning vocabulary (F=4); and the learners enjoyed the playback of DingTalk (F=3). On the other hand, it was found that there were distractions while posting artifacts in the Learning Circle (F=6); posting Chinese artifacts on the DingTalk platform was a waste of time (F=2); there was insufficient face-to-face interactions with the classmates and instructor (F=2); the learners were afraid of being teased by classmates (F=2); and there were problems in classroom interactions on the DingTalk platform (F=1). In total, 95 coded views were identified to demonstrate learners’ positive and negative views on the usefulness of DingTalk.

Subsequently, further explication of the findings with regards to learners’ perceived usefulness of DingTalk is provided below, with reference to the learners’ quotations.

a) Sub-theme 1: Motivating and Empowering

Motivation: 23.16% (F=22) of the views show that learners were motivated by the DingTalk platform to learn outside of the classroom. This may be because the platform is user-friendly and allows flexibility to learners. For instance, through the interview, some learners stated that:

“I was too lazy to learn Chinese, so I took this course with the attitude of giving it a try, but when I posted my Chinese artifacts in the HSK Level 4 Learning Circle for the first time, I quickly received ‘likes’ from my classmates, it was really interesting. I am very happy to study Chinese in DingTalk platform.” (L7, Low, I, Week 4, Appendix F)

“I am always motivated by the “ranking” feature of DingTalk, which encourages me to keep practicing and posting Chinese artifacts.” (L18, Medium, I, Week 4, Appendix F)

Also, four learners out of the 32 (12.5%) in the feedback data reported that the notifications from the DingTalk platform made them motivated, as illustrated in the following quotation:

“Make It Happen! I like this word. Every time I open my DingTalk platform, there are different words of encouragement that keep me motivated to learn.” (L12, Medium, F, Week 12, Appendix F)

Also, Plate 3 shows a screenshot of the encouraging word.



Plate 3 Screenshot of Encouraging Word: “Make It Happen” in DingTalk Platform

Furthermore, to confirm the positive view on the DingTalk platform in the open-ended questionnaire, 22.11% (F=21) of the views showed that consistency in writing practice in the DingTalk platform had a motivating and empowering effect on their SCVL. Consistency in writing practice, which referred to the ‘s

entence-paragraph-essay' artifact-making with clear and persistent procedures, was discussed below (L15T, Medium, Appendix F):

"As I need to create 'sentence-paragraph-essay' artifacts persistently, the DingTalk platform provides a seamless learning space named Learning Circle, which has made me more motivated than before."

Comfortable environment: 11.58% (F=11) of the views expressed that the learners perceived that the DingTalk platform provided them with a comfortable environment. Some of the views from interview dataset are presented as follows:

"It was the first time I posted Chinese artifacts on the platform yesterday. I feel very comfortable to post Chinese artifacts." (L14, Medium, Week 2, Appendix F)

"I am very used to posting Chinese in the Learning Circle; it is very comfortable. And I can also see other learners' posts, likes, and comments." (L32, High, I, Week 4, Appendix F)

However, some of the learners (i.e., Open-ended questionnaires) stated that they had insufficient face-to-face interactions with their classmates and instructor (F=2), as illustrated in this statement:

"Actually, I am not interested in peer discussion in the HSK Level 4 Learning Circle, I prefer face-to-face communication and discussion, so that it will be very helpful to improve my Chinese vocabulary learning." (L31, High, OQ, Appendix F)

In the same vein, one more learner gave her feedback to support face-to-face learning as shown in the comment below:

"In my opinion, it is important to interact with teachers and peers because these interactions can enhance our Chinese learning through immediate feedback. And during in-class learning, my Chinese teacher vividly presented Chinese materials in an engaging manner. Sometimes, I can go to his office as soon as I have any questions." (L32, High, F, Week 11, Appendix F)

b) Sub-theme 2: Supported by DingTalk Learning Tools

It should be noted that there are many functions and tools, including Ranking, Reminder, Ding Drive, and others that were utilised to assist learners in SCVL.

Ranking function: The Ranking function was popular among the learners. This function was used by the instructor to record learners' artifacts, resulting in diverse outcomes. This includes a weekly ranking, a monthly ranking, and a final ranking. Some learners were encouraged by the ranking function to post more artifacts on the DingTalk platform. As reflected from the three datasets of 10 learners (31.3%), out of the 32, the following excerpt shows that:

"If I saw my friend has a higher score than me, I think it would motivate me to compete with him and surpass him." (L19, F, Week 11, Appendix F)

Therefore, the creation of a competitive atmosphere with an increase in individuals' desire to prove themselves to others in the class can partly explain why some learners regarded DingTalk favourably. However, one low performance learner argued that:

"I do not like it, because some of learners are not good at Chinese writing and few artifacts posted, it can lead to upsetting their classmates and humiliating them." (L1, Low, I, Week 8, Appendix F)

Reminder function: For the Reminder tool, 6.32% (F=6) of the views expressed that it was very helpful. Take one learner's quotation as an example:

"I kind of like the fact that there is a 'Reminder' function of DingTalk platform often reminding me to do the seamless learning activities." (L9, Low, I Week 8, Appendix F)

Helpful Learning Circle function: 5.26% (F=5) of the views showed that the DingTalk Learning Circle was helpful to do seamless learning activities. Some learners reported that posting Chinese artifacts in the Learning Circle was helpful to practise their learned vocabulary (Data source: Interview). As stated by one learner:

"DingTalk is very user-friendly and it is very helpful to practise my learned vocabulary and do seamless learning activities at this platform." (L3, Low, I, Week 8, Appendix F)

Specifically, the Learning Circle function as a seamless learning space played an important role in learning Chinese vocabulary. The data garnered from two learners through another data source (i.e., Feedback) demonstrated that:

"The seamless Learning Circle is so interesting, a bit like Instagram, you can post photos, short videos....The most important thing is that it is very helpful for Chinese vocabulary learning." (L30, High, F, Week 4, Appendix F)

"HSK Level 4 Learning Circle is very supportive of my vocabulary learning and writing." (L7, Low, F, Week 4, Appendix F)

Ding Drive tool: Regarding the Ding Drive tool, 4.21% (F=4) of the views informed that learners benefited from using the Ding Drive when they learned vocabulary. One learner said:

"The Ding Drive is particularly useful and helps me to remember the Chinese vocabulary and sentences I have learnt" (L10, Low, F, Week 8, Appendix F)

Playback function: 3.16% (F=3) of the views illustrated that some learners enjoyed the playback of DingTalk. One learner stated that:

"When I miss a class, the teacher will send us the replay of the class, and I will watch the replay in the dormitory the next day." (L4, Low, F, Week 4, Appendix F)

Yet, other voices shared negative views for the sub-theme of "Supported by DingTalk learning tools". A total of 13.68% (F=13) negative views were identified. Some of the learners' negative views were as follows:

"I don't think it's interesting to post Chinese artifacts in the Learning Circle, because I can learn Chinese in normal Chinese classes, and I think I can improve my Chinese by not posting artifacts." (L32, High, I, Week 2, Appendix F)

"I already master them during in-class learning and then keep the vocabulary in mind. There is nothing that attracts me to practise them additionally. Except the HSK Level 4 test." (L11T, Medium, I, Week 10, Appendix F)

Also, the data garnered from another data source (i.e., Feedback) confirmed that:

“when I am posting Chinese artifacts via my mobile phone, both the Learning Circle and DingTalk chat box are open. I am typing there in Learning Circle, DingTalk pops up a lot of messages to distract me.”
(L3, Low, F, Week 11, Appendix F)

The learners' attitudes towards SCVL by using DingTalk are presented next.

3.2.2.3 Theme 3: Attitudes Towards Using DingTalk

Attitude towards the social media platform is one of the factors that has an impact on a person's L2 learning when using the platform (e.g., Lin et al., 2022; Opoku-Darko, 2023; Suo et al., 2022). Many scholars believe that attitude as an important factor can have certain roles and influences on L2 learners' learning process, increasing or decreasing the chance of success (e.g., Alharbi & Alnoor, 2022; Houssein et al., 2022; Mayordomo et al., 2022). In addition, in the study by Chuenyindee et al. (2022), attitude had a significant effect on one's behavioural perception, which suggests that individuals were more likely to use a learning platform if they felt positive about it. Based on this, the theme of “Attitudes Towards DingTalk Platform” was generated in this research. Figure 44 illustrates the learners' positive and negative attitudes towards the use of DingTalk in their SCVL.

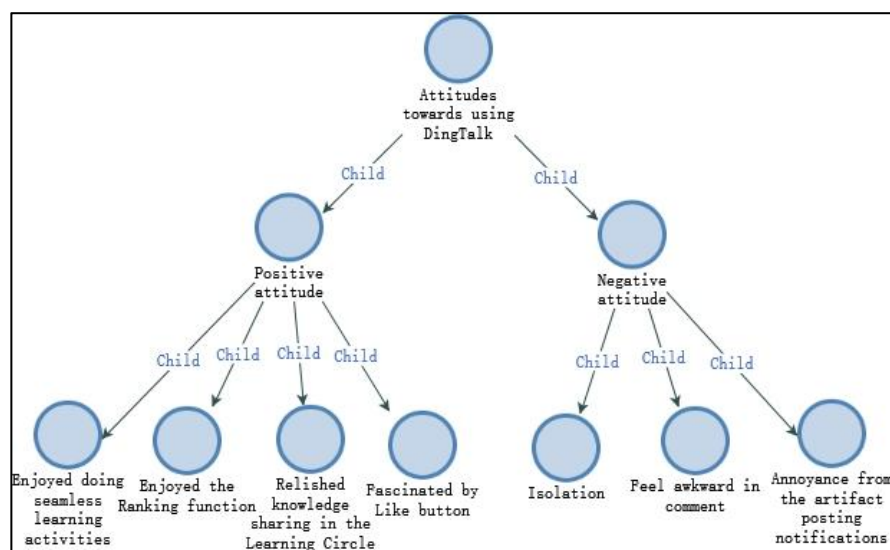


Figure 44 Learners' Positive and Negative Attitudes Towards Using DingTalk

The positive and negative attitudes of the learners on the use of DingTalk are shown in Figure 44. It was discovered that the learners were fascinated by the “Like” button ($F=15$); the learners enjoyed doing seamless learning activities on the DingTalk platform ($F=14$); the Ranking function was enjoyable ($F=11$); and learners relished knowledge sharing in the Learning Circle ($F=5$). On the other hand, it was found that the learners got annoyed by notifications ($F=8$); they felt awkward in comments ($F=4$); and they felt isolated ($F=3$). A total of 60 views were identified to illustrate the learners' positive and negative attitudes towards using the DingTalk platform.

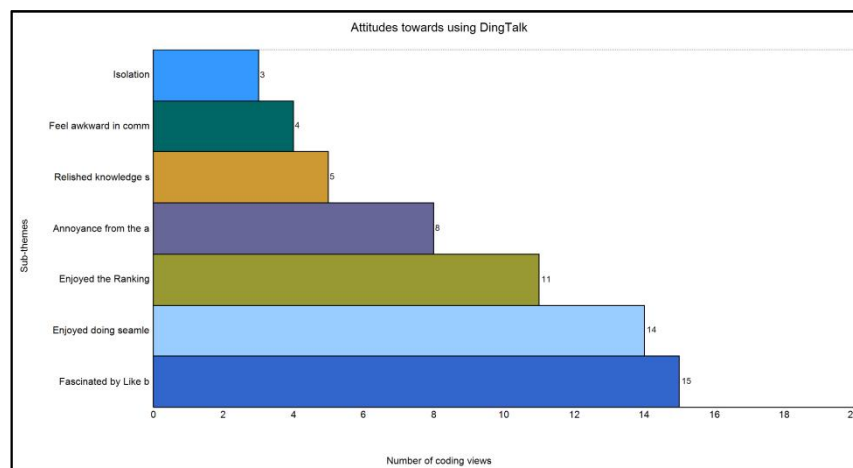


Figure 44 Number of Learners' Positive and Negative Attitudes Towards Using the DingTalk Platform

Subsequently, further elaboration of the findings with regards to learners' attitudes of DingTalk is presented below, with reference to the learners' quotations.

a) Sub-theme 1: Positive Attitude

Fascinated by "Like" button: 25% (F=15) of the sub-themes showed that the learners were fascinated by the "Like" button of the DingTalk platform. This function is common in many social media platforms and the majority of people like to be given a "thumb's up". The data garnered from some learners through the data sources demonstrated that:

"What's really interesting to me are the good comments and likes, it's engaging." (L4, Low, I, Week 8, Appendix F)

"Peer reviews are really great, especially since I got a lot of likes, I want more likes." (L26T, High, I, Week 8, Appendix F)

Similarly, in the open-ended questionnaires, one learner stated that:

"I really appreciated my teacher's and classmates' comments. They are always encouraging me to move forward." (L2, Low, OQ, Appendix F)

Enjoyed doing seamless learning activities: 23.33% (F=14) of the views showed that the learners enjoyed doing seamless learning activities on the DingTalk platform. The following responses and feedback represent how the learners felt happy and comfortable to do seamless learning activities:

"This Learning Circle helps create opportunities for practice. Whenever I want to make sentences using target vocabulary, I will quickly click the button to post a perfect artifact onto DingTalk platform."(L12, Medium, I, Week 8, Appendix F)

"Regarding the seamless learning activities, I have to say that I really enjoy doing them on the DingTalk platform, because you can see the comments and likes that your teachers and classmates give you in the Learning Circle immediately and you can think about them."(L26T, High, F, Week 8, Appendix F)

Enjoyed the Ranking function: 18.33% (F=11) of the views show that the learners enjoyed the Ranking function of the DingTalk platform. The reason as discussed above is that this function is popular and some learners were encouraged by the function to post more Chinese artifacts on the DingTalk platform. They enjoyed the "Statistical ranking function of artifacts", as one learner stated that:

"I really enjoyed the ranking function, it often motivates me to post more Chinese artifacts."(L24, Medium, I, Week 8, Appendix F)

Relished knowledge sharing in the Learning Circle: 8.33% (F=5) of the views reported that learners relished knowledge sharing in the Learning Circle. This may be because the HSK Level 4 Learning Circle is very safe, comfortable and useful. The data garnered from some learners through the data source (i.e., Interview) demonstrated that:

"I really like to share my daily lives with classmates and post Chinese content in HSK Level 4 Learning Circle." (L6T, Low, I, Week 12, Appendix F)

b) Sub-theme 2: Negative Attitude

Other voices, on the other hand, expressed dissatisfaction with the learners' attitudes towards using DingTalk, including annoyance from artifact posting notifications (F=8), feel awkward in commenting (F=4), and feeling isolated (F=3).

Annoyance from artifact posting notifications: It is essential to note that notifications pushed by DingTalk are self-selected; if learners do not like them, they can block them. Also, notifications of what and who posts an artifact, a comment or a reply were considered as feedback in DingTalk. This function is also self-selected (Figure 45). However, many learners like to tick the option to share their created artifacts with the HSK Level 4 learning group, which made some learners annoyed.



Figure 45 One of the 'Sharing' Options in Artifact Posting

One learner stated that:

"I don't like the notifications of who posts an artifact, it makes me feel stressed." (L5T, Low, I, Week 12, Appendix F)

Feel awkward in commenting: 6.7% (F=4) of the views reported that some learners felt awkward in commenting:

"Many of the comments given to me by some learners with low Chinese proficiency were incorrect, which made me feel very awkward and uncomfortable." (L31, High, F, Week 12, Appendix F)

Insolation: Some learners (F=3) felt isolated when they were studying Chinese by using the DingTalk platform. One learner stated that:

"The epidemic prevention and control policy for COVID-19 in China is so strict that in one case the whole neighbourhood was cordoned off. I've been locked in my dormitory for the last month and can't meet or eat with my friends, I'm so lonely." (L4, Low, I, Week 12, Appendix F)

3.2.3 Findings on Learners' Perceived Improvement in the Utilisation of SCVL

To address the RQ 3c of “To what extent do learners perceive that SCVL has improved their vocabulary learning of Chinese writing?”, the data garnered from the interviews, the open-ended questionnaires, and the learners’ feedback which related to learner perceived improvement in Chinese vocabulary learning and writing through the usefulness of SCVL were coded. Through the code identification process, two themes with six sub-themes were identified to investigate learners’ perceptions towards improvement in the utilisation of SCVL (Figure 46).

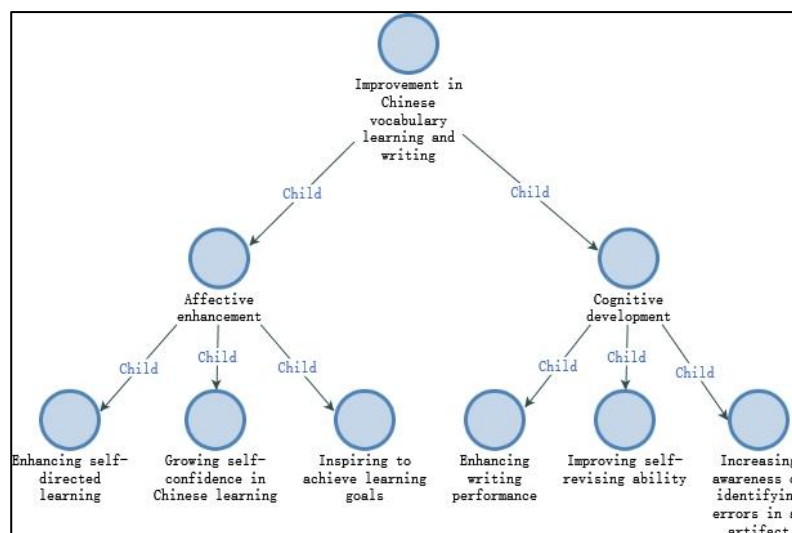


Figure 46 Learners' Perceptions Towards Improvement in Chinese Vocabulary Learning and Writing

While presenting the findings, the evidence from the two themes with the highest frequency were included to state the common view. The perceptions of “cognitive development” and “affective enhancement” of the learners were divided into six sub-themes in terms of “Increasing awareness of identifying errors in an artifact”, “Improving self-revising ability”, “Enhancing writing performance”, “Inspiring to achieve learning goals”, “Growing self-confidence in Chinese learning”, and “Enhancing self-directed learning”. Next, learners’ perceptions towards improvement in Chinese writing through the usefulness of SCVL are shown in Figure 47.

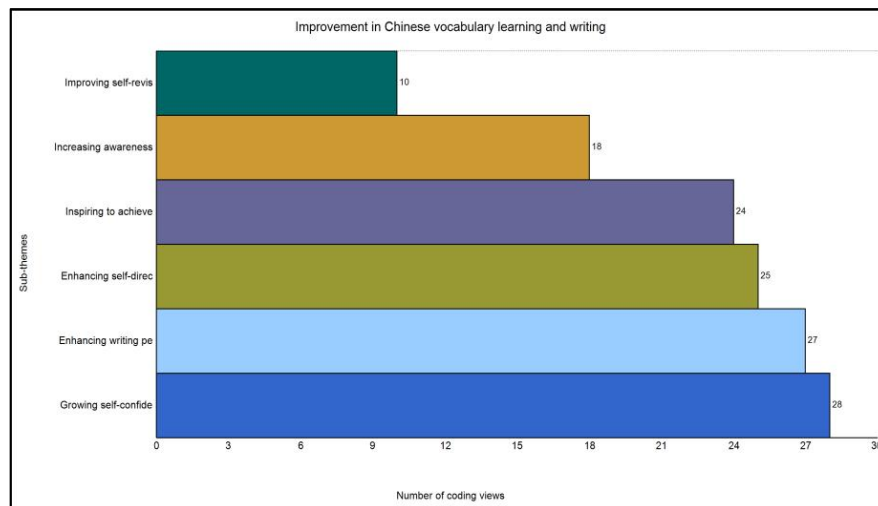


Figure 47 Number of the Learners' Perceptions Towards Improvement in Chinese Writing

Figure 47 illustrates the learners' perceptions towards improvement in Chinese writing, which examined their "Growing self-confidence in Chinese learning" ($F=28$); "Enhancing writing performance" ($F=27$); "Enhancing self-directed learning" ($F=25$); "Inspiring to achieve learning goals" ($F=24$); "Increasing awareness of identifying errors in an artifact" ($F=18$); and "Improving self-revising ability" ($F=10$). A total of 132 coded views were identified to demonstrate learners' perceptions towards improvement in Chinese writing through the usefulness of SCVL.

Subsequently, further explication of the findings with regards to learners' perceptions towards improvement in Chinese writing through the usefulness of SCVL is presented below.

3.2.3.1 Theme 1: Cognitive Development

Many scholars believe that cognitive development is the process by which human beings perceive, think, and gain understanding of his or her world through the interaction of genetic and learned factors (e.g., Brendel et al., 2002; Hwang et al., 2020; Klahr & Wallace, 2022). Take language development as an example; the processes of language learning, problem solving, thinking, and executive function are used to describe how language knowledge develops (e.g., Clark, 2004; Efstathiadi, 2019; Wen, 2021). Learners' perceived improvement of SCVL relates to the experience of cognitive development. Based on this, the theme of cognitive development was generated in this research. This sub-section yields insights of learners' cognitive development in the SCVL environment and specifically the impact of SCVL on CFL learners' awareness of errors in artifact, self-revising ability development, and the enhancement of writing performance (Figure 48).

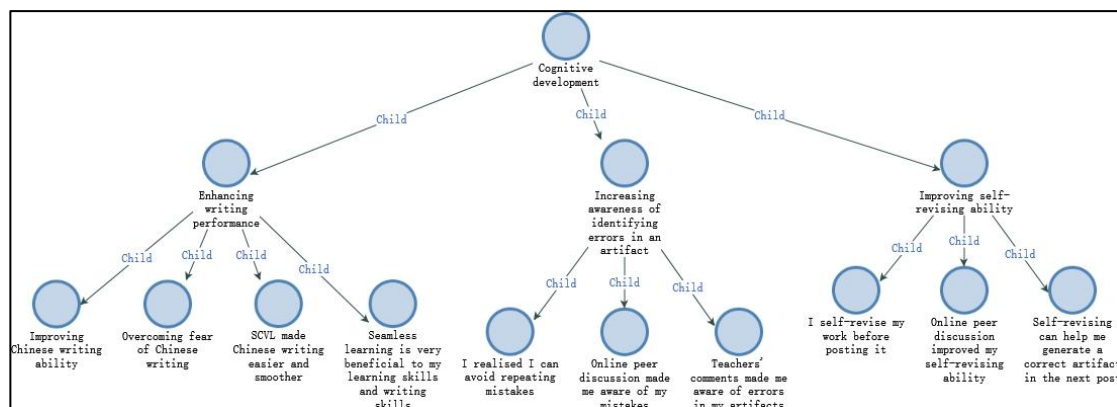


Figure 48 Learners' Perceptions of Cognitive Development

Subsequently, further explication of the findings with regards to learner cognitive development through the usefulness of SCVL is provided below.

a) Sub-theme 1: Increasing Awareness of Identifying Errors in an Artifact

A total of 13.64% (F=18) of views showed that learners' awareness of identifying errors in their artifacts had improved (refer to Figure 47). When the findings on "increasing awareness of identifying errors in an artifact" were analysed, some of the learners reported that online peer learning (Activity 3) was valuable to identify errors in their artifacts and made them become aware of their errors, as demonstrated by the following quotations:

"Online peer discussion activities of seamless learning had a lot of positive effects on my writing by means of my peers' comments on my artifact. Then, I have to say their comments are very kind to point out my mistakes, and I will be cautious in what I write in the next posts." (L27T, High, I, Week 12, Appendix F)

"As far as I am concerned, online peer discussion is very helpful in assisting me in identifying my mistakes in artifacts. Because we are discussing the artifact, I can think about their mistakes. It's helpful to reduce my mistakes." (L31, High, I, Week 16, Appendix F)

Likewise, as reflected in the open-ended questionnaires, the following comments represent how the learners had increased awareness of the errors in the artifact:

"I am indeed happy with my learning progress because when I create an artifact with photos, I can quickly spot the mistakes." (L6T, Low, OQ, Appendix F)

Notably, the Chinese instructor used online peer learning activities to interact with the learners. The educator's comments also increased the learners' awareness of the errors in artifacts, as illustrated by the following quotations:

"I think it's pretty good. When my teacher pointed out my mistakes indirectly, I had to think deeply before replying to the teacher's comments, and other classmates also helped me notice my mistakes of posted artifacts. That way, I hardly forget the mistakes I made in the past." (L15T, Medium, I, Week 12, Appendix F)

"I am very happy that the teacher commented on my artifacts, because the teacher's comments will let me realise my mistakes in my artifacts, and then I will correct them so that I don't make mistakes again." (L2, Low, I, Week 12, Appendix F)

The next section introduces sub-theme 2: Improving self-revising ability.

b) Sub-theme 2: Improving Self-revising Ability

There was a strong belief among the learners that one's own perseverance determines one's ability to self-revise. A total of 7.58% (F=10) of the views provided evidence of the improvement of the learners' self-revising ability (refer to Figure 47). For instance, the learners' responses through the data source (i.e., Feedback) revealed that they had developed the ability to correct the majority of their errors during the online peer discussion. Seamless learning has the potential to assist learners in activating cognition for achievement, but it is only through learner perseverance that the cognitive level can be sustained and learned information will be retained, as demonstrated by a learner below:

"This is my first time participating in a seamless learning study, and the amount of improvement through seamless Chinese vocabulary learning is incredible, even starting from scratch. Of course, 'practice makes perfect' and the more you engage through this method, the more knowledge you will gain." (L23, High, I, Week 12, Appendix F)

Hence, this was helpful in not only spotting and remembering mistakes, but also in triggering self-initiated forms of revising, finding a solution, and later checking whether problems were addressed properly:

"Hi teacher, online peer discussion had a lot of good effects on my writing by means of showing me my mistakes. Therefore, now I know in which part of my weakness I should self-revise and practice." (L16, Medium, F, Week 12, Appendix F)

Furthermore, the data gathered from this learner through another data source (i.e., Interview) confirmed the same perception on the improvement of the self-revision ability:

“I think I am quite good at correcting my mistakes. For example, ‘I try to review my artifacts before posting it onto DingTalk platform and I find several mistakes from different sorts. Some of them are very childish and some others belong to upper levels. I have realised the more I review my artifacts online, the more abilities I gain for revising my writing texts.’” (L16, Medium, I, Week 16, Appendix F)

c) Sub-theme 3: Enhancing Writing Performance

Another sub-theme related to the cognitive element of writing was enhancing writing performance in the three datasets. A total of 20.45% (F=27) of the views demonstrated the enhancement of learners’ writing (refer to Figure 47).

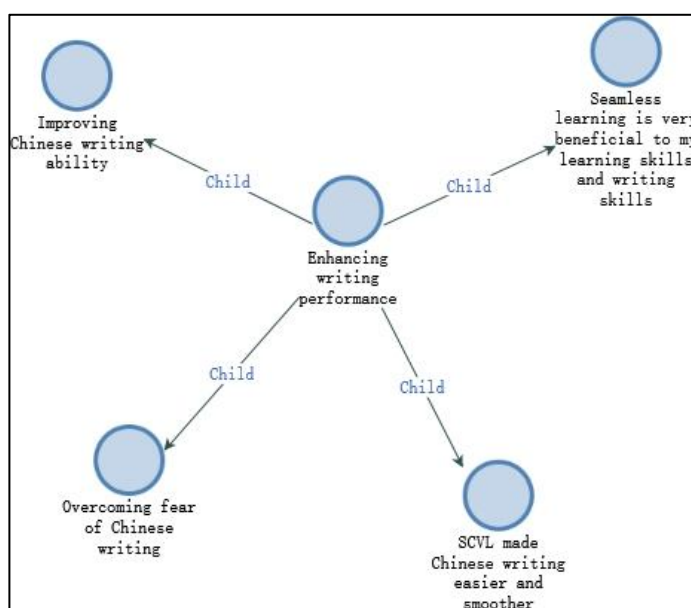


Figure 49 Learners’ Views on Enhancing Writing Performance

As shown in Figure 49, the findings on writing enhancement were identified, which reported that learners’ Chinese writing had improved (F=12); learners had overcome their fear of Chinese writing (F=6); SCVL made learners’ Chinese writing easier and smoother (F=6); and seamless learning is very beneficial to learners’ learning skills and writing skills (F=3). As demonstrated by the following quotations:

“I think I have improved my Chinese. Especially when I post sentences on the platform, I can create a lot of Chinese artifacts.”
(L7, Low, I, Week 12, Appendix F)

“After participating in this seamless learning study, I found that my Chinese writing has improved a lot, and I have posted a lot of sentences. Thanks to the encouragement of the teacher and the teacher who let us take the initiative to practice and learn in life, in doing so, I practiced the Chinese I learned in class.” (L11T, Medium, OQ, Appendix F)

Another significant perceived benefit of the SCVL according to the learners (i.e., Feedback) was its continuity and cross-situation for Chinese writing without boundary:

“Seamless Chinese vocabulary learning were great especially allow me to create artifacts across different learning contexts and give me more time to think and it did not kill my hope of getting better.” (L17, Medium, F, Week 16, Appendix F)

Moreover, the data garnered from this learner through another data source (i.e., interview) confirmed the impact of SCVL. An example is given below where a learner who had experienced many rounds of “sentence-paragraph-essay” artifact-making explained how the SCVL helped his learning by allaying his fear of Chinese writing:

“In the past, I was afraid to write because I didn’t know how to write or manage my writing. I didn’t know where to begin or where to end. When I learned the ‘sentence-paragraph-essay’ writing flow from your class, and then worked in your seamless learning environment and practised on those things online, I gained a lot of knowledge, and by creating Chinese artifacts and posting them online, this moment of sacredness diminished significantly.” (L6T, Low, PI, Appendix F).

A sub-theme focusing on the development of learners’ cognitive elements of writing indicated that learners were informed that seamless learning is very beneficial to their learning skill and writing skill. Through the seamless learning process, SCVL expanded the learners’ capacity to actively apply the learned vocabulary to their writing in their daily lives, as mentioned by three out of 32 learners in the Feedback data. As stated by one of the learners:

“In fact, I believe this method will assist us in improving my writing by informing me about common writing flows. Some things, such as writing, cannot be learned through reading because they come from our minds, so we must think about how to create an artifact and practise the learned vocabulary. So, seamless learning is a good way to improve our writing performance. It offers a variety of seamless learning activities to help us gradually improve our Chinese writing.” (L12, F, Week 16, Appendix F)

3.2.3.2 Theme 2: Affective Enhancement

This sub-section delves into the emotional responses that CFL learners perceived while working with SCVL. Since the majority of learners took part in this research for the first time, writing in a foreign language was considered a challenging situation for most of them due to the chances of making mistakes, failing to present ideas clearly, and a lack of vocabulary knowledge, which were very common. Consequently, the learners had to manage their emotional and motivational reactions despite the uncertainty and difficulty involved. Furthermore, it is accepted that affectivity plays an important role in learners’ learning effects and performances (e.g., Hwang et al., 2020; Lim & Richardson, 2021; Lin, 2020). Hence, to explore the learners’ affective enhancement, three sub-themes were identified and presented in Figure 50 below.

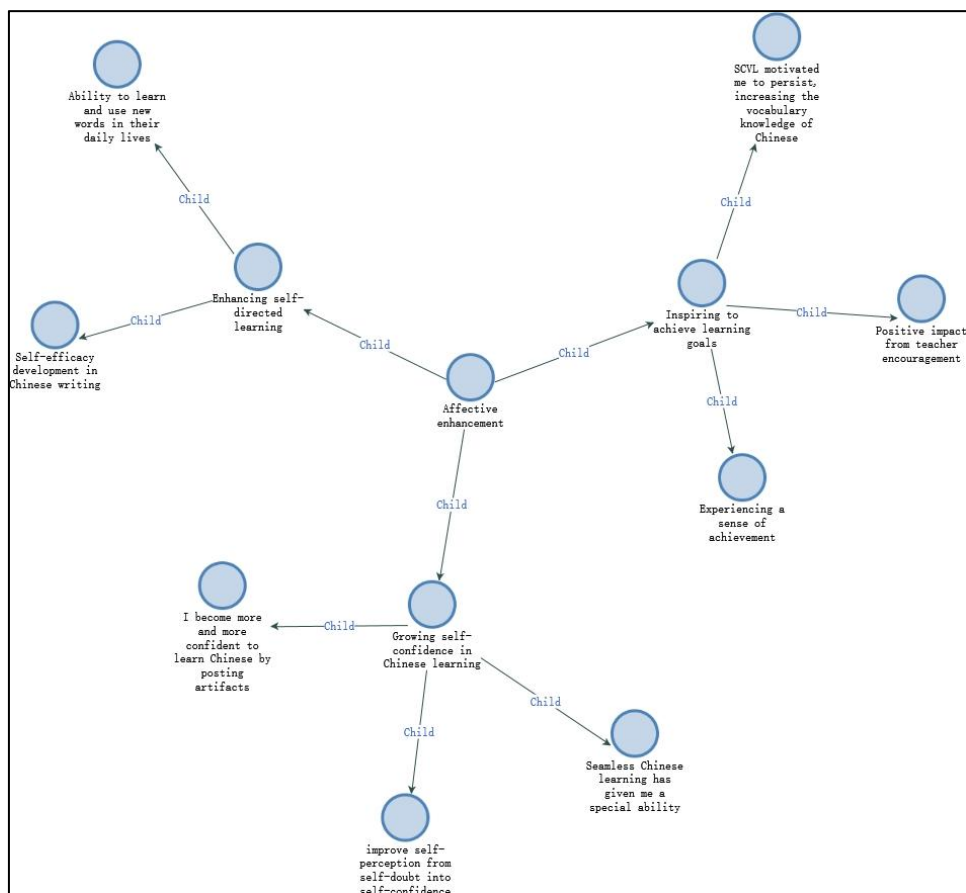


Figure 50 Learners’ Perceptions of Affective Enhancement

As shown in Figure 50, there are three sub-themes, which are “Inspiring to achieve learning goals”, “Growing self-confidence in Chinese learning”, and “Enhancing self-directed learning”.

The subsequent sections further explain the findings with regards to learners’ affective enhancement in terms of “Growing self-confidence in Chinese learning” (F=28), “enhancing self-directed learning” (F=25), and “Inspiring to achieve learning goals” (F=24) through the use of SCVL (refer to Figure 4.37).

a) Sub-theme 1: Inspiring to Achieve Learning Goals

A total of 18.18% (F=24) of the views illustrated the sub-themes of inspiration to achieve learning goals from the three datasets (refer to Figure 47). When the findings on these themes were analysed, many learners (F=15) stated that SCVL motivated them to keep up their learning and increase their vocabulary knowledge of Chinese. The learners reported that a positive impact was gained from the educator’s encouragement (F=5) and from experiencing a sense of achievement (F=4). As stated by one of the learners:

“This is a very good way to learn Chinese seamlessly. It not only gave me new ideas for writing, but also motivated me to learn continuously. I can learn a lot of new vocabulary and create a lot of interesting artifacts in different scenarios.” (L13, Medium, F, Appendix F)

Furthermore, some learners mentioned that learning creative writing skills was a good motivator for them to create Chinese artifacts:

“I am happy because I can understand you and I can make a short sentence because you showed us how to make a sentence!” (L1, Low, Week 4, Appendix F)

Likewise, another learner with low performance held a similar view on the educator’s encouragement, as illustrated below (L5T, Low, I, Week 4, Appendix F):

“Thanks to your encouraging me to post Chinese artifacts, I really feel that my writing is better and better, thank you so much I hope I can reach my aims.”

To further verify the sub-theme, a learner with high performance in Chinese was interviewed and explained that:

"I quickly adapted to posting Chinese artifacts in the Learning Circle and I was happy because my teacher could also comment immediately and he often encouraged us to post our work using the vocabulary we were learning , it makes me expand my vocabulary in daily life and achieve my goal."(L26T, High, Week 4, Appendix F)

Moreover, the data garnered from another data source (i.e., Open-ended questionnaires) confirmed the sub-theme, as one learner stated that:

"My level improved a lot after I took HSK Level 4 course, especially with Mr. Zhou because he simplified the information for us and I understood a lot from him, and he encouraged and supported us, at first I could not write sentences and then the teacher trained me to write sentences, and then I started writing sentences and paragraph, I am very thankful to my teacher."(L9, Low, OQ, Appendix F)

Regarding learners' view on "Experiencing a sense of achievement" in the interview dataset, it was apparent that a "like" and good compliments of one's artifacts given by the classmates or educator will make one proud. This is demonstrated by the following quotation:

"I enjoy interacting with my classmates in the Learning Circle, I enjoy it because not only do I get a lot of likes and good comments, I also get a lot of help from my classmates to edit my work, which makes me proud!"(L15T, Medium, I, Week 8, Appendix F)

Not only that, in the final week, L15 stated that his writing progress was tracked and he was proud of his achievement:

"I am highly inspired, as I can compare my previous written texts with newest one each time, I saw a good achievement and am proud of myself."(L15T, Medium, I, Week 16, Appendix F)

Although doing many seamless learning activities made some learners tired and stressed, online peer discussion was still a fascinating experience, as demonstrated by one learner in the feedback dataset:

"Although I am sometimes tired of studying, when I see my teachers and other learners giving me credit for my work, I become happy and have a sense of achievement that inspires me to continue studying."(L8, Low, F, Week 11, Appendix F)

Surprisingly, some learners were observed to have reached their learning goals through the use of seamless learning:

“Through the seamless learning method, I have been able to create a consistent and sustainable Chinese language learning routine that has helped me reach my learning goals. The continuous exposure to language content and the ability to apply my learning in real-life situations has been invaluable.” (L20, Medium, I, Week 16, Appendix F)

b) Sub-theme 2: Growing Self-confidence in Chinese Learning

A total of 21.21% (F=28) of the views illustrate the sub-theme of growing confidence in Chinese learning (refer to Figure 47). The findings show that the learners were more confident to learn Chinese by posting artifacts (F=15) and improved their self-perception from self-doubt into self-confidence (F=7). In the interviews, many learners mentioned that SCVL helped them improve their self-confidence (F=6). Two learners stated that:

“I enjoyed the process of seamless Chinese vocabulary learning, especially when my teachers and classmates upvoted my artifact with a ‘like’, which made me become self-confident in Chinese writing.”(L4, Low, I, Week 16, Appendix F)

“I feel like my self-confidence has improved a lot since I started the program. I used to doubt my abilities, but now I feel more capable and confident in what I can accomplish. I also feel that I have significantly improved my Chinese writing skills, as I am now able to construct longer sentences and learn independently.”(L17, Medium, I, Week 16, Appendix F)

Besides that, the learners believed that by thinking, identifying, and correcting errors, they were expanding their knowledge and developing their CFL writing abilities:

“Seamless Chinese learning has really helped me make progress. In Learning Circle, the teacher and my classmates kindly corrected my artifacts, and then I was also able to identify some mistakes in my artifacts (not posted yet). After revising, I posted new, correct sentences, which made me learn a lot. This is a very useful method, and it makes me more confident in learning Chinese.” (L22, High, I, Week 16, Appendix F)

Additionally, improving self-perception from self-doubt into self-confidence was also evident in other datasets (e.g., Open-ended questionnaires, Feedback). Overcoming self-doubt made most of the

learners become increasingly confident, which was closely related to their ability to apply their learned vocabulary into their lives and think and integrate their ideas into artifact-making, as one learner explains:

“Seamless Chinese learning has given me a special ability to organise and practice ideas in my daily writing, and then use the learned Chinese in my life. In this way, it has had a positive effect on my self-confidence to a large extent. In addition, I have found that it has been able to make my writing more coherent. In my opinion, this self-confidence is an advantage because In the past, I used to be afraid of writing; I had a lot of difficulty starting and finishing an essay.” (L7, Low, F, Week 16, Appendix F)

Another aspect of the learners' growing self-confidence was their increased courage to write. In tandem with this aspect, other aspects of learners' Chinese skills were reported to have been positively influenced as follows:

“Having participated in the seamless learning activities, I have now found the courage to express my views without fear or doubt and become more and more confident in learning Chinese! And I can create the proper Chinese artifacts in different scenarios...” (L8, Low, OQ, Appendix F)

Furthermore, the data garnered from another data source (i.e., Open-ended questionnaires) confirmed the views of writing with increasing confidence, as illustrated in the following quotation:

“I become more and more confident to learn Chinese after participating the seamless learning study...My writing ability got better by doing lots of seamless learning activities...” (L10, Low, OQ, Appendix F)

One learner noted that giving feedback to classmates by spotting errors in their texts can improve the feedback givers' self-confidence in CFL writing:

“Additionally, this ability that I can correct others' mistakes would increase my self-confidence a lot...” (L21, Medium, OQ, Appendix F)

c) Sub-theme 3: Enhancing Self-directed Learning

A total of 18.94% (F=25) of the views highlighted the sub-theme of enhancing self-directed learning (refer to Figure 47). The findings presented show that learners had the ability to learn and use new words in their daily lives (F=13) and develop self-efficacy in Chinese writing (F=12). As noted by the interviewees, 13 out of 32 (i.e., 40.6%) learners considered the SCVL design as being influential in

increasing their ability to learn and use new words in their daily lives, as the following quotation represents:

“When I was learning and using HSK Level 4 vocabulary, I also encountered a lot of HSK level 5 vocabulary, and I learned it by the way. And I also found that when I used Chinese in my life, I also learned some words that I rarely use, such as ‘幻灭的梦disillusioned dream’, which is a lyric. There are also some Wuhan dialect words, such as ‘弯管子’ and ‘滴滴答’. Ha ha!” (L26T, High, I, Week 16, Appendix F)

In the same vein, one learner with medium Chinese performance informed that:

“Not only learn new words, but also use them: ‘Now I know what is the difference between ‘常常(Changchang)’ and ‘往往(Wangwang)’ and where it is appropriate to use each one.” (L8, Low, F, Week 16, Appendix F)

Furthermore, the nature of the seamless Chinese HSK Level 4 course encouraged the learners to place new words into the context of their daily lives; almost all the learners were aware of it, as one comment from the open-ended questionnaire dataset revealed:

“First of all my vocabulary has really improved, every time I take a picture or do a seamless learning activity I learn new vocabulary unexpectedly, last time I took the bus to the mall I had to use the word traffic jam, I not only used the word traffic jam but I also learned the word ‘加塞congestion and the word ‘头盔helmet’ for a motorbike I also learned the word ‘helmet’ for motorbikes. My teacher complimented me on the way I learned.” (L27T, Medium, OQ, Appendix F)

Moreover, fostering learners’ self-directed learning ability was one of the aims of the research. This purpose was perceived by some of learners, as the data gathered from another data source (i.e., Interview) demonstrated that:

"I started to become more active and create more sentences and passages for different scenarios. I can decide for myself what scenes and what HSK4 vocabulary to use and post them in my study circle. Then my teacher and classmates would comment and like me, which made my Chinese improve a lot! It has made me a more active learner!" (L9, Medium, I, Week 16, Appendix F)

"I feel that my vocabulary has really improved and that I have mastered vocabulary in various scenarios through this seamless learning, in addition to the Chinese vocabulary I have studied in my textbooks. For example, the word '蚊帐mosquito net' I learned in the supermarket, and when I was a guest at my Chinese friends' house, I learnt from them that '上梁不正下梁歪the upper beam is not correct and the lower beam is not correct'. I thought it was so interesting." (L29, High, I, Week 16, Appendix F)

Along with more attention to enhancement of vocabulary use, there were reports of improvement in the learners' ability to generate correct and appropriate Chinese artifacts. Notably, the interview data showed that 12 of the 32 learners (37.5%) perceived online peer discussion as helpful in developing a higher level of Chinese writing self-efficacy. This is shown in the quotation below:

"I find online peer discussion to be very useful because it can help me notice my mistakes and benefit from the comments from classmates, learn something new, and then go on to create Chinese artifacts and make my Chinese better and better." (L13, Medium, I, Week 16, Appendix F)

Again, this develops a firm belief that it is possible to have good L2 knowledge through sustained effort and practice, as is visible in the learners' comments as the following quotations show:

"I can feel that I have written many, many sentences and I never noticed that I could do so well with mine, although I still have many questions." (L1, Low, I, Week 16, Appendix F)

"Hi teacher, I really feel that I am able to use vocabulary accurately to write a good paragraph in Chinese, Thank you." (L19, Medium, F, Week 16, Appendix F)

Such perceptions make a positive impact to the learner's mental L2 writing skill, which is vital in examinations where such thoughts are usually re-awakened (Klahr & Wallace, 2022; Saunders & Wong, 2020). The contribution of self-efficacy is also able to improve outcomes (Klahr & Wallace, 2022).

Moreover, during online peer discussion, learners consciously noticed mistakes, took them on board, and then revised them on their own. This clearly shows another important aspect of learner self-efficacy, as noted by these learners:

"Thanks to online peer discussion, I can now notice my faults and try to avoid them. it has become a habit to reread my writings and i am so glad I have made it this far." (L14, Medium, I, Week 16, Appendix F)

"I think that's so important and so useful to learners like me can understand their own mistakes and correct them, and understand as soon as possible their mistakes." (L30, High, F, Week 16, Appendix F)

"It could be fantastic, if it became possible to see my classmates' comments. Because I can learn from their mistakes and be ware not to repeat them and also I sooner notice problem that I might face them in the near future." (L2, Low, I, Week 16, Appendix F)

Learning from and avoiding their peers' mistakes were mentioned by some learners:

"I think if I can see my classmates' feedback, I would be learning sooner because I can see other mistakes which is unknown for me before that and maybe I have these mistake but I didn't know these are false. This is good way for me because I can see another writing and thinking about a topic which I write." (L26T, High, I, Week 16, Appendix F)

It was important to four learners to see their peers' writing, and they argued that it would be inspiring and a source for new ideas to assist them in their own writing, as represented in the following quotation.

"If you let us to correct our classmates essays and after that even let us to compare the way we correct our friends mistakes with your way, it can be extremely useful for us. I believe that whenever we can correct our friend mistakes we can take more care of staying away from the same mistakes." (L6T, Low, I, Week 16, Appendix F)

Overall, it is apparent from the above quotations that most of the learners perceived improvements from SCVL.

3.3 Summary

Combining above results in a comprehensive exploration of the research study, encompassing both quantitative and qualitative data interpretations. This amalgamation of methodologies bolsters the robustness of the data analysis, enabling the researcher to derive more precise and meaningful conclusions. Specifically, this study provides valuable insights into the effectiveness of SCVL in enhancing productive vocabulary growth and lexical richness among CFL learners, while also delving into their experiences and perceptions of this approach.

The quantitative findings of this study are noteworthy and suggest that SCVL has a significant impact on enhancing Chinese writing performance. The results indicate a significant increase in the adoption of SCVL over time to improve productive vocabulary growth in terms of TTR and LFP. Moreover, the adoption of SCVL resulted in a noticeable improvement in the lexical richness of Chinese writing, as evidenced by an increase in lexical diversity and sophistication and a decrease in lexical errors. These findings contribute to the understanding of the usefulness of SCVL as a means of enhancing Chinese vocabulary learning, and its potential value for language learners in promoting the development of writing performance.

The qualitative findings on the other hand unveils that despite encountering challenges within the SCVL environment, learners found the experience to be both valuable and rewarding. Furthermore, the findings underscore that, despite their initial scepticism and unfamiliarity with novel forms of seamless learning, CFL learners genuinely relished the SCVL experience. Participants consistently expressed their satisfaction, enjoyment, excitement, fun, and appreciation for the experience, deeming it helpful and stimulating.

Notably, it was observed that some learners encountered limitations within the DingTalk platform, where posted artifacts could not be withdrawn or modified. Similar to other social media platforms, the artifact had to be deleted and re-posted to effect changes. Nonetheless, the study underscores the value of the DingTalk platform, which has garnered popularity among learners and has been positively perceived.

These findings offer significant insights into learners' perceptions of how SCVL can enhance Chinese writing, showcasing predominantly positive attitudes towards the use of SCVL and its impact on learners' cognitive and affective development.

4. DISCUSSION

The main goal of this research is to investigate productive vocabulary growth and lexical richness for Chinese writing in an SCVL environment to improve learners' language proficiency in terms of writing and foster their ability to engage in self-directed learning. To fulfil this overarching goal, this section is structured according to the three main research questions as set in Section 1.6, which are:

1. To what extent is SCVL able to enhance productive vocabulary growth in Chinese writing?
2. To what extent does SCVL enhance the lexical richness of Chinese writing?
3. What are learners' experiences, perceptions, and improvements in vocabulary learning through the utilisation of SCVL?

However, in keeping with the fully integrated nature of the mixed methods research design in this research, some findings relating to learners' experiences, challenges, and perceptions (RQ 3) are discussed together with RQ 1 and 2 since the qualitative and quantitative analyses mutually inform and influence each other.

Next, three aspects of Productive Vocabulary Growth of Chinese Writing (Section 4.1), Lexical Richness of Chinese Writing (Section 4.2), and Learners' Experiences, Perceptions, and Improvements in Vocabulary Learning through the Utilisation of SCVL (Section 4.3) are discussed. These three aspects were selected because they offer a comprehensive understanding of the impact of SCVL on Chinese learners' vocabulary learning and writing performance (Song & Hwang, 2020; Wong et al., 2021). Productive vocabulary growth measures the increase in the number of words that learners have used in their writing under exposure to SCVL. Lexical richness measures the diversity, sophistication, and errors in learners' vocabulary use in their writing. Lastly, learners' experiences, challenges, and perceptions offer insights into the usefulness of SCVL as a language learning model and informing factors that may affect its implementation and adoption. By analysing these three aspects, researchers can evaluate the positive outcomes of SCVL and identify ways to enhance its design and implementation to better support CFL learners' vocabulary learning and writing performance (Aw et al., 2016; Wong et al., 2016; Zhang et al., 2021).

4.1 Productive Vocabulary Growth of Chinese Writing

In RQ 1, learners' productive vocabulary growth in Chinese writing was measured using TTR sentence, TTR paragraph, and TTR essay, indicators of the learners' number of word types and word tokens used for sentence/paragraph/essay artifact-making and adapted Chinese LFP (i.e., the HSK Level 4 vocabulary distribution in essay artifacts). A two-way ANOVA was conducted to investigate whether there were differences over time, and post-hoc test were used to examine the different performance groups across the four stages. These are discussed in the subsections below.

These two aspects are crucial for understanding the productive vocabulary growth of Chinese writing. The number of vocabulary used in all artifacts provides insight into the overall vocabulary growth of Chinese writing, indicating the number of unique words that were employed in written Chinese. This metric can help measure the depth of vocabulary knowledge of Chinese learners and identify areas for improvement (e.g., Kristanto & Citrasukmawati, 2023; Sun et al., 2010; Wong et al., 2016). On the other hand, the HSK Level 4 vocabulary distribution in essay artifacts provides a more specific and targeted analysis of the vocabulary proficiency of Chinese learners. HSK Level 4 is a widely recognised measure of Chinese proficiency (e.g., Huang et al., 2023; Mo, 2015; Zeng, 2022), and analysing the distribution of these words in essays can

help educators identify common mistakes and areas for improvement in vocabulary learning (Huang et al., 2023; Kristanto & Citrasukmawati, 2023). Together, these two aspects provide a comprehensive picture of the productive vocabulary growth of Chinese writing and help educators and learners track their progress and identify areas for improvement.

4.1.1 The Number of Vocabulary Used in All Artifacts

Firstly, in terms of sentence artifacts, the number of vocabulary used for sentences showed an upward trend over time in different performance groups. This positive outcome indicates that the SCVL can positively influence learners' vocabulary that were used for sentences artifact-making. These findings are consistent with previous research on productive vocabulary learning in Chinese writing such as Aw et al. (2016) and Wong et al. (2016) which examined the usefulness of using seamless learning in Chinese language. However, unlike previous studies which focused on Chinese primary learners' Chinese idiom learning (e.g., Aw et al., 2016; Wong et al., 2016), the present investigation focuses on CFL undergraduates' HSK Level 4 learning in Chinese Mainland.

Many scholars argue that from a dynamic standpoint, no single factor can directly explain a learner's language system change (e.g., Jiang et al., 2019; Hsieh, 2016). Nonetheless, further investigation has revealed some key reasons for this positive vocabulary growth. It is possible that "social learning" is one of the key components of SCVL. As proposed by Luo and Watts (2022), L2 learners only become fluent if they have the opportunity to experience the target language during social interactions with other people in the real world (Krashen, 1981). This may reflect the language exposure hypothesis generalised by Ortega (2014), which implies that language learning could be related to social norms and practices by interacting with native speakers and engaging with the native language's society. Notably, DingTalk is an SCVL platform that aims to foster a mediated social network for the Chinese language learning community (Yan, 2021; Zhang, 2021). It nurtures a social network where language learning and applications are intertwined over time. This lends support to Wong et al. (2017) and Lewis et al. (2010), which underlined that operating social networks with lucidness can promote peer feedback and can be a potential device to contribute to knowledge construction. Notably, DingTalk can be regarded as a seamless learning space to bridge in and outside of classroom-related activities that learners use to organise their learning experiences (Yan, 2021; Zhang, 2021).

It is also likely that the learners paid more attention to Chinese writing or adopted specific learning or writing strategies as they prepared for the upcoming HSK Level 4 test at the end of the semester (March-July 2022). To pass the HSK Level 4 exam, CFL learners must achieve high marks in listening (a total score of 100), reading (a total score of 100), and writing (a total score of 100). They are required to get at least 180 points (no less than 60 points in each item) for their degree programmes. However, learners might have concentrated more on sentence artifacts due to availability of time and/or input from educators (i.e., obtained new words in the passages of the HSK Level 4 Standard textbook).

Additionally, the present study's findings could be compared with previous research on language learning and vocabulary learning to further contextualise their significance. For example, research has shown that exposure to a diverse range of vocabulary through reading can improve language proficiency (Pellicer-

Sánchez, 2020). The current study's findings suggest that SCVL activities such as artifact creation may offer a complementary approach to enhance learners' vocabulary skills.

One significant discovery regarding sentence artifacts was that the high-performance group had the highest TTR sentence values, while learners in the low and medium performance groups demonstrated positive improvement.

In general, these results revealed that the dimension of productive vocabulary growth plays an important role in L2 production. Learners at higher levels appear to use adequate vocabulary to generate ideas, develop them, and present them in their writing (Fu, 2020; Wong et al., 2021). This finding is in line with previous research that has shown a positive relationship between vocabulary range and language proficiency (Cao & Tian, 2020; Fu, 2020). The results of this study may have practical implications for educators seeking to assess learners' language proficiency through artifact creation activities.

However, it is important to note that the low performance and medium performance groups also demonstrated positive improvements in their TTR sentence over time. This finding suggests that SCVL activities such as artifact creation may offer a useful way to promote language learning outcomes for learners at all levels of proficiency. This statement aligns with the perspective of Aw et al. (2016) and Wong et al. (2016) regarding the significance of the artifact creation process in promoting learning among individuals.

Compared to previous research on vocabulary learning, this process is consistent with what Bains et al. (2022) witnessed in a problem-based course where undergraduates acquired professional vocabulary increasingly through social interactions. These learners advanced from unelaborated word use to meaning development and elaboration, and finally to using them as conceptual tools for problem solving.

Likewise, the findings of this research lent some support to Lave and Wenger's (1990) situational learning theories. Learners' artifact-making activities in their daily life can be characterised as spontaneous meaning making through interactions with their living/learning contexts to trigger the retrieval of the relevant learnt vocabulary to be used in authentic contexts. According to Yao et al. (2021), when the learner senses that their in situ-encounters with objects, people and/or events are suitable topics for artifact creation, they may appropriate such contextual affordances to mediate meaning making, which in turn mediates their language learning (e.g., Safiah et al., 2020; Wong et al., 2016; Yao et al., 2021). As such, it is critical to close the learners' passive-active vocabulary gap (i.e., to assist the learners in transforming more passive vocabulary into active vocabulary) (e.g., Aw et al., 2016; Chen & Xiao, 2022; Wong et al., 2021). The number of vocabulary used for sentences increased with learners' Chinese proficiency over time, as expected.

Next, the TTR of paragraphs showed a positive growth pattern as shown in Chapter 3. While the interaction effect of TTR paragraphs in different performance groups was complicated, one important finding was that the number of vocabulary used per paragraph increased positively across the four learning stages. The findings suggest that the learners in this research were able to increase their vocabulary usage in paragraph artifact creation over time, which is a positive outcome through the use of SCVL. Vocabulary growth, as the fundamental dimension of lexical competence, frequently distinguishes learners with good L2 proficiency from those with low proficiency (e.g., Laufer, 1995; Wang, S. & Wang, H. Z., 2021; Wong et al., 2016). More importantly, the number of vocabulary used for Chinese writing increased rapidly over the 16 weeks as the learners were engaged in vocabulary knowledge building practice through the use of SCVL. The growth of vocabulary and language knowledge appeared to be mutually beneficial. In other words, new Chinese words were identified by all CFL learners and became part of their productive written

vocabulary (i.e., artifact-making) through extensive SCVL and online interactions. These findings are in line with Wong et al. (2016), who found that CFL learners could similarly benefit from creating Chinese artifacts to construct their vocabulary knowledge and develop their productive vocabulary of Chinese writing. However, it is worth noting that the two studies had distinct learner characteristics and task types. In the current study, the writing samples were produced by college learners with a range of academic performance levels, while Wong et al.'s (2016) study was conducted with Chinese primary school grade 3 learners with medium to low academic performance levels. Notably, college-level learners used longer sentences compared to the younger learners despite having studied the language for a relatively short time (Nasiba & Norboyevich, 2022; Song & Hwang, 2020; Wong et al., 2016). The observed differences in vocabulary growth between the two studies may be attributed to differences in learner variables and instructional practices. Moreover, it should be noted that while Wong et al. (2016) focused on Chinese idiom writing tasks, the present study involved various writing tasks, such as narratives and picture description activities, which were based on HSK Level 4 vocabulary. Hence, the selection of writing tasks may have influenced learners' vocabulary production.

While this finding is inconsistent with some previous studies (e.g., Bao, 2019; Plakans et al., 2019; Tan et al., 2014), another likely reason for this finding is that writing paragraphs or essays necessitates many factors, such as learners' creative thinking, intelligence, and others, however, these are beyond the scope of this research. This interpretation is supported by previous research (e.g., Hsieh, 2016; Tan et al., 2014; Plakans et al., 2019; Zhang 2022). For instance, Tan et al. (2014) investigated the integration of using the iPad in Chinese creative writing pedagogy and discovered that learners' creative thinking in writing improved significantly. Similarly, in a study investigating a method for improving L2 writing, Plakans et al. (2019) and Zhang (2022) suggest that L2 learners should strive to balance various factors, including content, organisation, intent, audience, vocabulary, punctuation, spelling, and mechanics when writing.

The current study also revealed differences in TTR paragraph across the three performance groups. The high performance group had significantly higher TTR paragraph than the medium performance group, and the medium performance group had noticeably higher TTR paragraph than the low performance group. However, at Stage 3, the TTR paragraph of the medium and low performance groups were very close. This could be because some CFL learners may have become fatigued with the seamless learning activities during DBR Stage 3 (weeks 9-12), as indicated by some of the quotations (refer to L8, Low, F, Week 11; L13, Medium, I, Week 12). This finding is consistent with Ramalingam et al. (2021), who suggested that positive experiences and emotions can motivate foreign language learners to be more engaged in the learning process.

With regards to the essay artifacts, prior to the second stage, the learners' number of vocabulary used for essay artifacts among the three different performance groups was not significant and even declined (high performance group) and stagnated (low and medium performance groups). One possible explanation for this finding is the intermediate and advanced learners' "fossilisation" as their Chinese proficiency improves. "Language fossilisation" is a broad term used to describe many forms of arrested progress in L2 learning (e.g., Aini, 2020; Cheng, 2020; Hwang, 2022; Selinker, 1972). This phenomenon keeps learners at the bottleneck stage of learning, preventing them from making significant progress (Aini, 2020; Hwang, 2022). Hwang's (2022) study supports this idea, as they found that the vocabulary production ability of EFL learners improves significantly as their language competence progresses from elementary to intermediate levels. However, this ability often stagnates as learners progress from intermediate to advanced levels

(Hwang, 2022). Also, according to the findings of the qualitative analysis from Stage 1, 1-2 learners think that seamless learning is the same as their university's online learning, which leads to bad learning habits and learning strategies during the learning process, which in turn affects learners' learning, for instance, making them have a less serious attitude about producing their work or become less motivated, etc. As stated by one learner:

"From the beginning, I disliked posting Chinese artifacts on the DingTalk platform because I was used to the platform my university used. And this learning mode is also online learning, I think it is similar to my university. However, after one month of learning Chinese, I found that the seamless learning activities arranged by the teacher are particularly like a 'Great adventure'. Whenever after class, we were encouraged to take pictures outside with our mobile phones, look for the scene, and then think about how to create an artifact and post it onto DingTalk, which is very interesting. I'm so proud of myself." (L12, Medium, I, Week 4, Appendix F)

Some Chinese scholars have documented the phenomenon of language fossilisation. For instance, Wei (2008) observed in their study of psycholinguistics where after significant progress has been made, skill learning may slow down, stagnate, or even regress, and that this temporary pause may be the high point of progress and the preparation period for the next learning cycle to improve. Likewise, as claimed by Hsieh (2016), learners' lexical and syntactic components grew in a non-linear and non-parallel manner with both progress and regression during the process of writing in Chinese as a second language.

Moreover, the findings obtained support the findings of other studies such as Cheng (2020) and Zhang (2022), who argued that the phenomenon where the productive vocabulary growth of the learners' essays slows down or even has a downward trend can be referred to as a "plateau-phenomenon". Hence, in the present research, the vocabulary plateau phenomenon in learners' essays may potentially be caused by two major factors: insufficient language input and limited language output. Firstly, most learners in the medium and high performance groups were under greater employment pressure, as finding an ideal job takes up a lot of their time in the fourth year of university. Second, since the main academic tasks in the spring semester were graduation preparation and thesis writing, they have fewer classes in the fourth year. As a result, these two main reasons were likely to impede the development of learners' Chinese vocabulary capacities.

In a nutshell, the current findings of the research on the number of vocabulary used in essays are very similar to those of the previous study, demonstrating that both progress and regression are significant characteristics of L2 development over time as well as the phenomenon of the vocabulary plateau in learners' essays (e.g., Aini, 2020; Cheng, 2020; Hwang, 2022). Moreover, the findings support Nation's (2001) assertion that language learning from context is a cumulative process that results in small but significant gains with each encounter.

Hence, this research suggests that the learners' Chinese writing performance in sentences, paragraphs, and essays have improved through the use of SCVL, regardless of their proficiency level in the language. In

general, the findings confirm a positive growth in the productive vocabulary of Chinese writing through the integration of SCVL into CFL learners' learning, which is consistent with previous studies (e.g., Wong et al., 2016; Luo, 2021; Tan et al., 2018).

4.1.2 The HSK Level 4 Vocabulary Distribution in Essay Artifacts

Regarding the adapted Chinese LFP in relation to the distribution of learners' HSK Level 4 vocabulary in essay artifacts, it should be noted that, to prevent overwhelming readers with excessive statistical detail, only the comparisons of the percentages of HSK Level 4 words (i.e., LFP) were presented. This is because one of the main purposes of the research is to encourage the learners to be more inclined to present their thoughts and experiences using the target vocabulary they have learned (i.e., more use of HSK Level 4 words). Moreover, HSK level 1-3 words are simple and commonly used words by the learners. There is no such need to investigate the learners' vocabulary use for HSK level 1-3.

The findings of the study reveal a significant improvement in the LFP of the high, medium, and low performance groups in essay writing, as evidenced by the learners' HSK Level 4 vocabulary distribution across the four stages. These findings align well with prior research. Wong et al. (2016) emphasised that the learners' LFP for vocabulary growth in a seamless CFL learning environment showed a positive increasing trend over time. The current research reported a substantial difference in the LFP of CFL learners based on the distribution of HSK Level 4 vocabulary in their essay artifacts. These variations, according to Laufer and Nation (1995), should be regarded as strong indicators of learners' productive vocabulary growth in writing. This may be attributable to the nature of continuous learning, contextualisation, flexibility, and integration in the SCVL used in this research. Seamless learning enables learners to connect their in-class learning to out-of-class learning without any boundaries or leveraging technology to support learning across different contexts and environments (Mouri et al., 2018; Hiew et al., 2018). In this research, the learning of vocabulary begins with the educator's input. This is followed by the contextualised learning of words outside of the classroom, which leads to the authentic use of vocabulary learned in various contexts. This gradually extends, in a bottom-up manner, to the writing of sentences, paragraphs, and ultimately essays. The findings support Siemens's (2005) connectivism theory, where seamless learning is not bound by any specific location but rather consists of networks of connections constructed from experience and interactions among learners, technologies, and their surroundings (Goldie, 2016; Xiao et al., 2021). The application of the connectivism theory to SCVL highlights the significance of networks and technology in fostering ongoing and connected learning (Aw et al., 2016; Hambrock & De Villiers, 2023). In this study, four interactive seamless learning activities were implemented through the use of mobile devices and DingTalk platform to facilitate learner interaction. The aim was to establish a dynamic and interconnected learning environment that could assist learners in expanding their vocabulary knowledge in a relevant and meaningful way.

Overall, the findings suggest that long-term vocabulary knowledge building practice has a positive effect on the development of productive vocabulary growth (Fu, 2020; Wong et al., 2021). As elaborated in Chapter 3, a number of SCVL activity designs may have contributed to learners' productive vocabulary knowledge building. These included in-class learning engagement; contextualised sentence-making and photo-taking; online peer learning; and learning consolidation. As an example, through online peer discussion, learners

browsed and commented on each other's artifacts, including those posted by learners whose Chinese proficiency was higher than their own, facilitated by a mix of learners with different levels of HSK 3 Chinese proficiency. During peer interaction, they frequently encountered new vocabulary, which they then considered, learned, and applied in their subsequent writing. The finding supported Zhao's (2021) assertion that social interactions with other people expose learners to rich and diverse input and output, which is critical. The more frequently a learner encounters a vocabulary item, the more likely he is to learn the word. The integration of different modes of learning (e.g., formal and informal learning, personal and social learning, etc.) involving both language input and output allows for deeper processing of language and knowledge (Luo & Watts, 2022; Wong et al., 2016, 2021). Language use and language learning co-occur through this integrated process, with language use for meaning-making in mediating language learning.

Regarding learners' HSK Level 4 vocabulary distribution among the three performance groups, the LFP for the high performance group was significantly higher than the medium performance group, and LFP for the medium performance group was higher than the low performance group.

When comparing previous research, this finding is in line with Laufer and Nation's (1995) study on the same topic in investigating LFP in English-language essays. As many scholars believe, the higher the language competence, the more vocabulary will be produced (e.g., Alahmadi et al., 2020; Brooks, 2021; Duff et al., 2015). This finding is interesting given the fact that in using HSK Level 4 words in their writing, as discussed previously, all of the CFL learners with mixed Chinese proficiency levels attended the seamless Chinese HSK Level 4 learning course and were encouraged to apply them to their daily lives. However, when it comes to the production of HSK Level 4 words, the results were quite different. A possible explanation is that many learners in the medium-performance-group prepared for the upcoming HSK Level 4 test at the end of the semester. This explanation was supported by the qualitative data (e.g., refer to L3, Low, F, Week 4; L21, Medium, OQ; L23, High, F, Week 4) (Appendix F).

In conclusion, the finding that the SCVL had a positive impact on learners' vocabulary usage for sentence, paragraph, essay artifacts, and LFP underscores the potential of seamless learning as an active learning intervention for improving language learning outcomes.

4.2 Lexical Richness in Chinese Writing

RQ 2 investigated the enhancement of lexical richness in Chinese writing by CFL learners with high to low academic performances across the four learning stages. Learners' lexical richness of Chinese writing is measured by lexical diversity (Uber index value), lexical sophistication (LS), and lexical errors (LE). A two-way ANOVA was conducted to investigate whether there were differences over time, and post-hoc test were used to examine the different performance groups across the four stages. The discussion of "Lexical Diversity" (Section 4.2.1), "Lexical Sophistication" (Section 4.2.2), and Lexical Errors" (Section 4.2.3) is presented below.

The three aspects of lexical richness of Chinese writing, namely lexical diversity, lexical sophistication, and lexical errors, are important in evaluating the quality of Chinese writing. Lexical diversity refers to the variety of words used in writing, and it is an indicator of a learner's lexical resourcefulness (e.g., Zheng, 2016; Treffers-Daller et al., 2018). A higher lexical diversity score indicates a wider range of vocabulary and can lead to more interesting and engaging writing (e.g., Treffers-Daller et al., 2018; Woods et al., 2023; Zhang et al., 2021). Lexical sophistication measures the level of complexity and advanced vocabulary used in writing (e.g., Can & Tian, 2020; Zhang, 2019) and is an indication of a learner's mastery of the language

(e.g., Can & Tian, 2020; Zhang et al., 2021). A higher rate in this aspect shows that the learner is able to use more advanced vocabulary and structures to convey their ideas successfully (Read, 2023; Zhang et al., 2021). Lexical errors refer to mistakes made in vocabulary usage that can hinder successful communication (e.g., Laufer and Nation, 1995; Fu, 2020). By analysing these three aspects, educators and learners can identify areas for improvement and work towards enhancing the lexical richness of Chinese writing (Badilla & Núñez, 2020; Zhang, 2022).

4.2.1 Lexical Diversity

Generally, the findings on lexical diversity in all artifacts reported in Chapter 4 show that significant differences in U values of high, medium, and low performance groups were observed over time.

The study's findings revealed a significant and positive increase in the diversity of vocabulary use for all performance groups, particularly from Stage 3 onwards. This indicates that CFL learners were able to employ a broader range of word types and word tokens in their sentence, paragraph, and essay writing as they advanced through the active use of SCVL. As suggested by Johansson (2009), lexical diversity is determined by a text's vocabulary variety. In order to be considered as highly lexically diverse, the speaker or writer must use a large number of different words with no or little repetition in their utterances and writings.

According to the language exposure hypothesis (Efsthadi, 2019; Ortega, 2014), increasing the frequency of linguistic exposure in multiple contexts is an important way of increasing linguistic exposure. The significant increase in lexical diversity observed among various learning groups over time may be related to the amount of linguistic exposure provided in the features of seamless learning, which combines formal and informal learning, individual and social learning, and the physical world and cyberspace.

Next, when looking at findings from different performance groups, variation across learner groups was also observed in the research. These findings indicate that the diversity of vocabulary in the written texts of CFL learners may be closely related to the learners' Chinese proficiency, where the higher the learners' Chinese proficiency, the more diverse the vocabulary used in their written texts (Zhang J. J., 2019; Zhang M. J., 2022). In other words, the findings imply that as vocabulary grows, so does vocabulary diversity, and vocabulary usage improves significantly over time. This is consistent with previous research on the development of writing in Indo-European languages (e.g., Alshehri, 2022; González, 2017; Spoelman and Verspoor 2010).

A comparison of the above suggests that the level of L2 proficiency may be another factor influencing the use of a diverse range of vocabulary in written texts. This coincides with findings from previous studies (Nasiba & Norboyevich, 2022; Zhang, M. J., 2022; Zhang et al., 2021). As learners' proficiency in Chinese increases, they tend to produce a more diverse range of vocabulary in their written texts. All the studies showed a significant increase in lexical diversity across L2 levels.

Specifically, one of the key findings of this study is that the comparison of "U" paragraphs and essays written by high-performance learners and medium-performance learners, as well as low-performance learners and medium-performance learners, showed a moderate difference between the two performance groups. Specifically, high-level learners generally produced writings with more diverse vocabulary. These findings are in line with previous research on lexical diversity in Chinese writing (e.g., Zhang, J. J., 2019;

Zhang, H., 2021; Zhang, M. J., 2022). However, in contrast to their previous study which used a static approach to collect L2 learners' written texts, the present investigation utilised dynamic approaches to investigate the development of lexical diversity among the same learners.

This finding indicates that vocabulary size plays a crucial role in the production of L2 output (Laufer, 1995). Generally, learners at a higher level tend to utilise adequate vocabulary to generate, develop, and present their ideas in writing (Raimes, 1985). Vocabulary size is considered to be a fundamental dimension of lexical competence and often distinguishes learners with good L2 proficiency from those with low proficiency (Laufer, 1995; Webb & Rodgers, 2009).

Moreover, compared to the other two groups, learners' lexical diversity in all artifacts is generally low in the writing of the low performance group. One possible explanation for this lower lexical diversity could be due to limited language exposure to words and the nature of vocabulary learning (Nation, 1995; Zhang et al., 2021). Because the low performance group only recently completed HSK Level 3 and was still in the early stages of L2 writing, their exposure to a wide range of words may be insufficient. Furthermore, since vocabulary learning is receptive (Nation, 2001; Mo, 2015; Zhang, J. J., 2019), low performance group learners in the early stages of vocabulary learning are more likely to learn vocabulary receptively. As a result, they may struggle to find appropriate words to express their ideas (Zhang, J. J., 2019).

Also, as Ellis (2013) discovered, learners will learn more words as their language exposure increases, but their productive vocabulary expands slowly. As a result, it is incredibly difficult for the low-performance-group of CFL learners to produce a broader variety of vocabulary in their writing. This finding is similar to past studies that focused on advanced learners (e.g., Zheng, 2018; Wang, 2017). The rate of increase between low and medium performance groups, however, differs (Zhang, 2020; Zhang et al., 2021). Zhang et al. (2021), for example, discovered that the lexical diversity of Chinese beginner learners increased significantly each school year. The different learning performance groups studied could explain the disparity in the findings. Unlike their previous study, which focused on Chinese beginner learners, the current research examines CFL intermediate learners.

Overall, the lexical diversity of CFL learners increased gradually over time across the three performance groups investigated in this research. The findings suggest that SCVL could be adopted by educators to teach new words according to graded vocabulary lists and offer various kinds of activities in formal learning settings, such as vocabulary exercises and extracurricular reading, to expose learners to new words. Next, many different kinds of learning activities will be set up for CFL learners to encourage them to use their mobile phones whenever and wherever they wanted to learn and apply the vocabulary they learned in a variety of informal contexts. Finally, they may produce more diversified lexical words gradually.

4.2.2 Lexical Sophistication

As analysed earlier, strong evidence of lexical sophistication proved that the learners' advanced word use across the four stages according to the National Graded Vocabulary List (2010) showed significant improvement after 16 weeks (Table 4.24). This finding and that of Zhang, M. J. (2022) showed that LS rates increased with L2 writing proficiency level.

The CFL learners' significant improvement in lexical sophistication may be attributed to the ample opportunities to practice, which was made available with the use of social learning (Meltzoff et al., 2009).

Advanced words were used and discussed by learners through extensive online peer discussion and social learning, and they then became part of the productive written vocabulary. Similarly, learners may create artifacts such as annotated photos or slides in the classroom or off-campus and share them online to promote knowledge construction and social learning (e.g., Wong et al., 2012; Wong et al., 2016). This supports the constructivist (Mohammed & Kinyo, 2020) theory to a certain extent. As witnessed by Mohammed and Kinyo (2020), the role of neo-constructivism in construction and social learning enables learners to apply, understand and recall certain concepts and skills, which are used to make lessons relevant. Therefore, the present study contends that SCVL serves to advance the principles of neo-constructivism, which prioritises learner-centred learning wherein learners are responsible for their own learning through active exploration and experience. In this context, the role of the educator is to guide and facilitate learners in their learning. Specifically, SCVL activities 1, 2, and 4 were deemed to have been deliberately constructed to align with the neo-constructivist theory.

As demonstrated by the findings, as Chinese proficiency improved, the vocabulary knowledge increased, individual knowledge subsequently expanded, and the number of advanced words used by CFL learners in essays increased considerably (e.g., Nasiba & Norboyevich, 2022; Zhang, J. J., 2019; Zhang, M. J., 2022). However, as shown in Chapter 3, although the LS grew slowly, the growth rate increased from 17.07% (Stage 1) to 24.16% (Stage 4). A possible explanation is the excessive consumption of basic vocabulary in L2 writing by learners of different levels (e.g., Fairclough & Belpoliti, 2016; Laufer & Nation, 1995; Lei & Yang, 2020; Qin & Wen, 2007). According to Laufer and Nation (1995), the high frequency of basic vocabulary characterises the writing of many L2 learners. Similarly, this finding is in line with Fairclough and Belpoliti's (2016) discovery that L2 Spanish learners frequently use basic vocabulary in their Spanish writing. Therefore, the rate of increase in lexical sophistication is slow over the course of a semester of learning writing. It is also likely that these CFL learners used an "avoidance strategy" (e.g., Cao & Tian, 2020; Lei & Yang, 2020) to avoid using advanced words when writing in this research.

The research also found variations across the learner groups when looking at findings from different performance groups. When compared to the low and medium performance groups, learners' lexical sophistication in essay artifacts was generally high in the writing of the high performance group from stages 1 to 4. One potential reason is that all learners learned more advanced words over time and attempted to use them in writing, which enhanced their sophistication (e.g., Can & Tian, 2020; Zhang, J. J., 2019). However, vocabulary production requires in-depth knowledge of vocabulary, including its meaning, syntax, collocation, and pragmatics (Can & Tian, 2020; Fu, 2020). It can be challenging for learners with a low Chinese level (i.e., HSK Level 3 scores are 180-210 points) to convert this knowledge into an inherent productive vocabulary system in a short period of time. This finding is consistent with past studies that focused on lexical sophistication of L2 writing (e.g., Fu, 2020; Wu et al., 2019; Zhang et al., 2021). For example, Wu et al. (2019) discovered that HSK Level 4 Thai Chinese learners struggled to understand the meaning of vocabulary, apply what they have learned, and convert receptive vocabulary into productive vocabulary as much as possible. As a result, the lexical sophistication of Thai Chinese learners increased slowly, particularly for low and medium Chinese level learners whose output lexicon was far from sufficient. Furthermore, optimal exposure according to the language exposure hypothesis accelerates L2 acquisition, whereas reduced exposure causes linguistic duress and slows the L2 acquisition process (Efsthathiadi, 2019; Ortega, 2014; Zhang et al., 2021). More importantly, advanced words necessitate a higher critical mass for

learners to master (Wu et al., 2019; Zhang et al., 2021). Taken together, these findings indicate that learners in the four learning stages exhibit significant differences in their lexical choices.

4.2.3 Lexical Errors

After conducting an analysis of lexical errors in essay artifacts, the findings of this study indicate a linear improvement in lexical error rates as SCVL stages increased. This finding is consistent with the results reported in the Chapter 4, which showed a decrease in lexical error rates from stages 1 to 4. These results suggest that the SCVL approach employed in this research was successful in reducing the lexical errors made by CFL learners in their writing. Notably, the reduction in lexical errors was observed across essays, demonstrating the positive impact of this approach on CFL learners' overall writing performance. These findings contribute to the existing literature on the usefulness of vocabulary learning approaches in reducing lexical errors in CFL learners' writing (e.g., Homayouni, 2022; Zhang et al., 2021; Zhu & Wang, 2013).

One possible explanation for this finding is that SCVL Activity 4, which involves the consolidation and correction of sentence, paragraph, and essay artifacts, may have contributed to the observed improvement in vocabulary use. Through this weekly consolidation process, learners were able to further enhance their vocabulary knowledge, which may have facilitated their participation in seamless learning activities over multiple cycles.

Additionally, the findings are supported by the situated learning theory, which emphasises the importance of learning in authentic contexts and through active participation in social activities (Lave & Wenger, 1990; Yao et al., 2021). In the context of language learning, this theory suggests that learners should be immersed in real-world language and use situations to develop their language skills (Lave & Wenger, 1990). By providing learners with opportunities to use Chinese words in authentic communication situations, an SCVL environment based on the situated learning theory could help decrease lexical errors (Wong et al., 2021).

Past research has shown that authentic language use in context can lead to better vocabulary learning (e.g., Aw et al., 2016; Luo & Watts, 2022). By using vocabulary in real-life situations, learners are more likely to remember the words and their meanings as they are linked to the context and the experience of using them (Luo & Watts, 2022). It is worth noting that in comparison to previous studies (Aw et al., 2016; Wong et al., 2016; Zhang et al., 2021) that did not specifically address learners' feedback on artifact errors, providing learners with feedback on their errors in context made the learning process more meaningful and useful (e.g., Evans et al., 2010; Wichadee, 2013; Yilmaz, 2020). Learners were more likely to remember the correct form of lexicon if they receive feedback that is directly linked to a specific context and experience (Yilmaz, 2020). This is supported by some learner's quotations (e.g., refer to L2, Low, I, Week 16; L14, Medium, I, Week 16; L30, High, F, Week 16), where interactive elements in an SCVL environment can increase motivation and engagement (Wong et al., 2021) which can further support the decrease of lexical errors. Learners who are motivated and engaged are more likely to actively participate in communication activities, provide opportunities to practice the words they have learned, and receive feedback on their errors (Saeed & Al Qunayeer, 2022; Tai & Chen, 2020; Yilmaz, 2020; Wong et al., 2021).

The findings of this research are very similar to those of many previous studies (e.g., Tian, 2019; Zhang, J. J., 2019; Zhang, M. J., 2022), despite differences in learners' demographics. While previous studies

focused on advanced learners who had been studying Chinese for several years and had passed HSK level 5, the current learners' Chinese proficiency levels range between HSK Level 3 and 4, and their academic performance varies from low to high. Tian's (2019) study on the productive vocabulary development of senior Southeast Asian foreign learners found that the lexical errors of advanced CFL learners decreased in volatility over eight months of narrative compositions. Hence, CFL learners of this research exhibited a slightly different trend in the development of LE, with a decreasing trend observed.

The present research also revealed variations across learning groups when examining findings from different performance groups. Compared to the high performance group, the low and medium performance groups experienced a rapid decline from stages 1 to 3. One possible explanation is that the writing tasks selected may influence lexical error rate. This explanation is supported by Tian's (2019) claim that narrative Chinese writing is a relatively simple writing task in which learners make fewer mistakes than in topical writing.

Moreover, the findings of the research are partially in line with Zhang, J. J. (2019) who discovered that the learners' performance in lexical errors varies depending on the writing topic assigned by the educator. The findings of Zhang, J. J. (2019) are similar to this research, where that study's writing assignment was about "an unforgettable event or person". It was discovered that the lexical errors in CFL learners with low to high Chinese proficiency reported a non-linear decrease (Zhang, J. J., 2019, p. 41). Nevertheless, unlike previous studies, the current research involved different types of writing tasks (e.g., narratives, picture description activities) for all CFL learners in different stages.

Hence, many scholars suggest that the writing tasks chosen could affect learners' lexical performance in lexical errors (e.g., Cao & Tian, 2020; Tan et al., 2014; Zhang, 2021). Many scholars also believed that tracking the learning performance of different groups of learners across time is too difficult to achieve, so one dimension of a research study (i.e., longitudinal or cross-sectional studies) is recommended to investigate their writing performance (e.g., Aw et al., 2016; Zhang et al., 2021). On the contrary, the current research presents a combination of longitudinal intervention and cross-sectional study that examines vocabulary growth and lexical richness in CFL learners of different levels.

Interestingly, the low and medium performance groups' LE generally stabilised from stages 3 to 4. This raises the question of whether lexical knowledge development for learners temporarily halts (e.g., Badilla & Núñez, 2020; Chen et al., 2015; Huang & Qian, 2003; Zhang et al., 2021). According to some scholars, as Chinese proficiency improves, the number of advanced words in the writings of learners with high academic performance may increase (e.g., Badilla & Núñez, 2020; Chen et al., 2015; Corder, 1967; Zhang et al., 2021). Thus, in the last two phases of this research (stages 3 and 4), the more learners attempt to use advanced words, the more likely they are to make mistakes. As a result, an increase in lexical errors does not necessarily indicate the end of lexical knowledge development. Instead, it may contribute to the learning benefits of advanced vocabulary and interlanguage development (Badilla & Núñez, 2020; Chen et al., 2015; Corder, 1967).

According to Corder (1967), errors reflect the learner's attempts to establish an interlanguage system through the process of hypothesis testing. In this process, learners construct hypotheses about the target language and test them using evidence from the language in use. They revise the hypotheses that deviate from the target language norms based on feedback so that their interlanguage system progresses towards the target language along the spectrum.

As many scholars argue, no single factor can directly explain a learner's L2 system change from a dynamic standpoint (Jiang et al., 2019; Hsieh, 2016). In the present research, the occurrence of lexical errors may be attributed to the learners' lack of productive knowledge of these words as they attempt to grapple with them in L2 writing. Essentially, this is a hypothesis testing procedure. Learners scrutinise their memorisation of sophisticated word forms during this process, and their interlanguage system will become more in line with the target language (e.g., Aw et al., 2016; Badilla & Núñez, 2020; Jiang et al., 2019; Zhang, 2022).

In summary, building solid vocabulary is an essential part of successful second language learning (e.g., Efsthadi, 2019; Masita, 2020; Zhang, 2021), reading ability, communicative ability, and academic achievement. With reference to lexical richness elements in the L2 learners' writing, lexical diversity, lexical sophistication, and errors were discussed. The findings suggest that lexical richness is essential to the output of Chinese writing.

4.3 Learners' Experiences, Perceptions, and Improvements in Vocabulary Learning through the Utilisation of SCVL

This section synthesises the findings of the mixed-method research to provide empirical perspectives and inferences based on the quantitative and qualitative findings. It is organised according to the three sub-research questions of RQ 3, which are:

1. What are learners' experiences in the utilisation of SCVL?
2. What are learners' perceptions of the DingTalk platform use in an SCVL environment?
3. To what extent do learners perceive that SCVL has improved their vocabulary learning of Chinese writing?

In this research study, the understanding of the positive outcomes of SCVL relies on three key aspects: learners' experiences, perceptions, and improvements in vocabulary learning.

4.3.1 Learning Experiences in the Utilisation of SCVL

Many findings from previous studies support the outcomes of the present research (e.g., Abdullah & Hashim, 2021; Aw et al., 2016; Ramalingam et al., 2022). The findings of previous research indicated the positive impact of the implementation of seamless learning on the development of learners' language learning skills. Wong et al. (2016) found that the use of seamless learning can considerably improve learners' CFL learning. Despite initial scepticism and unfamiliarity with new forms of seamless learning, learners genuinely enjoyed the SCVL experience (refer to L1, Low, OQ; L23, High, I, Week 16; L32, High, OQ) (Appendix F).

The one sample t-test revealed that after the SCVL research study, learners gained positive experiences with the use of SCVL. This outcome is similar to the findings of the research carried out by Kawauchi (2008) which focused on EFL learners' CALL-based vocabulary learning experience. Positive experiences and affections were recognised as a motivating factor for foreign language learners to be active in the learning process (Ramalingam et al., 2021). This finding implies that the use of SCVL in learning Chinese vocabulary is likely to make the learners become active learners. Interestingly, Kawauchi's (2008) finding was very similar to the findings indicated in the qualitative data of the current research. According to the

qualitative data, the majority of CFL learners reported having positive experiences based on two themes: affective engagement, and issues and challenges they encountered while participating in SCVL. The majority of learners expressed positive emotions towards participating in seamless learning activities (e.g., in-class learning engagement, online peer learning). Some of them, for instance, found it enjoyable to post Chinese artifacts (e.g., refer to L10, Low, F, Week 2; L11T, Medium, OQ; L25, High, I, Week 8) (Appendix F). The learners' positive experiences could be attributed to their perception of the benefits gained from using SCVL mediated by mobile devices. This is coherent with the claims of many scholars (e.g., Abdullah & Hashim, 2021; Wong et al., 2017; Xiao et al., 2021) that in this digital age, learners are relatively comfortable with modern technologies and tools, which can increase their learning motivation.

Furthermore, the majority of CFL learners reported feeling benefited, as indicated by the sub-theme "Benefited (F=30)". For instance, the majority of CFL learners strongly agreed that various seamless learning activities had improved their soft skills, such as social skills, problem-solving skills, and creativity skills (see, for example, L28, High, OQ; L8, Low, F, Week 8; L19, Medium, OQ) (refer to Appendix F). This finding is promising, as many educators perceive developing soft skills in learners as a challenging task (Malik, 2018) in formal classroom learning. Involvement in seamless learning activities enabled the learners to develop such skills, as seamless learning combines formal and informal learning, individual and social learning, and others, and therefore gives learners opportunities to enhance their interpersonal skills (Ramalingam et al., 2021). These findings are in line with many studies (e.g., Lan & Lin, 2016; Ramalingam et al., 2021; Wong et al., 2016). For instance, the studies conducted by Lan and Lin (2016) and Jiang and Li (2018) also obtained similar findings on the benefits of soft skills. Moreover, some findings from previous studies proved that skills such as problem solving and critical thinking can be improved in learners through the use of seamless learning (e.g., Chee et al., 2017; Tan & Liu, 2016; Wong et al., 2021). Fundamentally, the concept of seamless learning encompasses captivating and interactive features (e.g., Wong et al., 2016; Xiao et al., 2021) such as social learning (e.g., Casey & Goodyear, 2015; Ko et al., 2021; Wen, 2021; Rogers et al., 2022) and the profound stimulation of information exchange. In the case of an L2 learner, the necessity to gain CFL social skills is typically assigned a top priority. Accordingly, their learning strategies were optimised (e.g., Jiang & Li, 2018; Lan & Lin, 2016). In similar fashion, Luo and Yang (2016) found that the incorporation of seamless CFL learning activities promoted a favourable Chinese language learning environment, which encouraged communication, elevated social interaction among learners, and fostered a sense of solidarity among them. This outcome was also supported by Ramalingam et al. (2022) and Liu et al. (2019), as their findings stated that seamless learning plays a huge role in equipping learners with all the skills they would need in various industries.

However, this research cannot deny the existence of several challenges in implementing SCVL. For example, some learners in the study identified noisy formal learning environments and poor internet connections as common issues (e.g., refer to L3, L4, Low, I, Week2; L12, Medium, I, Week 2) (Appendix F). Additionally, the COVID-19 pandemic restrictions were also reported as a challenge (refer to L3, Low, F, Week 6; L6T, Low, I, Week 8; L26T, High, I, Week 12) (Appendix F). These findings are supported by previous studies that have also identified similar challenges in technology-enhanced language learning (Blin & Munro, 2008; Liang & Li, 2020).

The findings of this study revealed that classroom management was one of the key challenges faced by the learners. The qualitative data collected through interviews showed that a noisy formal learning environment was a major issue for the learners (e.g., refer to L2, Low, I, Week 2; L13, Medium, I, Week 2; L28, High, I,

Week 2) (Appendix F). This finding is consistent with the previous research by Bao (2019), who emphasised the importance of addressing classroom management issues in any form of classroom instruction. In addition, a study by Wang and Sun (2020) also found that successful classroom management practices can improve learners' learning outcomes and create a more positive learning environment.

Another problem faced by learners concerned poor internet connection, with CFL learners feeling concerned that unreliable internet access may become a barrier to their participation in formal learning and independent study (e.g., refer to L4, Low, F, Week 2; L12, Medium, I, Week 2; L25, High, I, Week 4) (Appendix F). Such concerns were consistent with previous research that identified IT and internet literacy as potential barriers to successful seamless learning implementation (e.g., Chan et al., 2006; Durak & Cankaya, 2018; Godber, 2021). Thus, it is imperative for educators to assist learners who may face technological disadvantages in their home environment by ensuring that such learners receive priority access to university internet facilities (Godber, 2021; Kayalar, 2022).

Next, the COVID-19 pandemic restriction was another challenge to learners' informal learning experience. In this aspect, many academicians believed that the COVID-19 pandemic has affected almost all learning modes in some way (e.g., Scherer et al., 2019; Godber, 2021; Yin, 2022). Due to the COVID-19 pandemic, learning had taken place at home, in accordance with the Chinese government's policy of social distancing (Yin, 2022). Educators and learners did not meet physically but were instead linked by technology, equipment, and resources. Nonetheless, the qualitative data showed that learning was not entirely online; learners continued to study in a variety of environments (e.g., supermarket, coffee shop) (e.g., refer to L7, Low, OQ; L10, Low, I, Week 14; L18, Medium, OQ) (Appendix F). This was also supported by Luluk's (2021) arguments that seamless learning allowed learners to choose when and where they wanted to learn, as well as how seamless learning could improve the learning experience of CFL learners under this condition. Hence, this research suggests that the learners' overall learning journey was enjoyable due to the benefits of SCVL towards their improvement of Chinese vocabulary learning and writing.

4.3.2 The Learners' Perceptions of DingTalk Platform Use

The one sample t-test of SCVLQ (B) indicated that the CFL learners had great perceptions towards the DingTalk platform in an SCVL environment. One possible explanation is that the learners appreciated the fact that the DingTalk platform was free to use. This interpretation is supported by qualitative data (e.g., refer to L3, Low, I, Week 2; L15T, Medium, OQ; L27T, High, F, Week 2) (Appendix F). Numerous scholars posit that a learner's attitude towards language learning can be significantly impacted, either positively or negatively, by the ease of using the social media platform (e.g., Sobaih et al., 2021; Wong et al., 2017; Zhang & Cao, 2021; Zhao, 2021).

Additionally, as shown in the qualitative data, 77.5% of learners had positive opinions on the DingTalk platform. The qualitative findings presented three themes regarding the DingTalk platform, which are perceived Ding Talk's ease of use, perceived usefulness of DingTalk, and attitudes towards using the DingTalk platform. The findings imply that the use of the DingTalk platform in the SCVL environment was useful and convenient and provided a novel learning space. This is in line with many previous studies which have discovered the DingTalk platform as very useful as it has various functions such as information

interaction, educator-learner interaction, resource sharing, and openness of teaching platform (Yan, 2021; Zhao, 2021). Likewise, there were more interactive forms of learning facilities in the DingTalk platform, such as virtual classroom, Learning Circle, community, and more. These characteristics enabled the learners to learn independently besides learning in formal online classes (Yan, 2021; Zhao, 2021). Furthermore, DingTalk's "fast turnaround time" supported Han's (2021) argument that unlike classroom-based learning, DingTalk is a seamless learning platform that learners can access from anywhere, at any time, and on any mobile device.

The DingTalk platform, which was employed by SCVL, created an important environment for learners and educators to share information regardless of time and place, allowing them to conduct seamless learning activities and have online peer discussions between educator-learner and learner-learner. It also helped the learners express themselves better. These findings had some similarities with those of Wong et al. (2016). Based on past studies (e.g., Peng, 2019; Sobaih et al., 2021; Wong & Looi, 2019), social media or online communities built with Web 2.0 technologies, have emerged as a new social hub. Social media is increasingly used to support learners' communicative and creative endeavours, in addition to playing a more crucial role in the lives of younger generations (Wong & Looi, 2019). It also has the potential to promote language learning. For starters, it provides a social space where language practice can take place outside of the classroom 24 hours a day, seven days a week. Second, social networks have the potential to place language learning in more genuine social contexts (Peng, 2019). Both are essential for authentic language learning, where language is learned through socialisation and application (Sobaih et al., 2021). Social media may now provide affordances to support the design of a seamless integration to language learning. The findings show that learners were motivated by the DingTalk platform to learn outside of the classroom. This is explained by the platform, which is user-friendly and provides learners with flexibility. This explanation is supported by the qualitative data (e.g., refer to L6T, Low, I, Week 2; L21, Medium, OQ; L31, High, F, Week 2) (Appendix F).

Again, learners perceived the usefulness of DingTalk in terms of their consistency in writing practice on the DingTalk platform and the helpful Learning Circle function to vary their use of vocabulary in different contexts. This finding is consistent with the recent studies conducted by Aguayo and Eames (2017) and Song and Hwang (2020) who had witnessed the impacts of mobile devices and social media applications on increased learning motivation, positive perceptions to language learning, and others in foreign language education. Additionally, the findings of this study confirm the theory of situational learning, which advocates for the importance of contextualising vocabulary learning within appropriate contexts, as suggested by linguists and language learning theorists (e.g., Aw et al., 2016; Nation, 2001; Wong et al., 2017). Contextual learning, informed by research in the field of pragmatics, helps bridge the gap between learning linguistic forms and developing skills for real-life language use (e.g., Abdullah, & Hashim, 2021; Ge et al., 2021; Wong et al., 2016). However, other voices present negative views of learners regarding the use of DingTalk for seamless learning activities and interactions. With regards to the ease of use of DingTalk, learners expressed dissatisfaction with the platform's inability to modify posted artifacts, which had to be deleted instead. This issue can be attributed to the fact that almost all social media platforms do not allow modifications to already-posted posts, only deletion and re-posting. Many scholars (e.g., Han, 2021; Sobaih et al., 2021; Wong & Looi, 2019; Zhang & Cao, 2021) have also recognised this inconvenience. This explanation is further supported by qualitative data (e.g., refer to L5T, Low, I, Week 2; L21, Medium, I, Week 4; L24, High, I, Week 4) (Appendix F).

The findings on theme 3 (“Attitudes towards using DingTalk platform”) revealed that perceived use of DingTalk affected learners’ attitudes. The findings show that learners’ attitudes towards SCVL research were influenced by their perceptions of using the DingTalk platform. This finding highlights the importance of considering learners’ attitudes towards technology in educational research studies. The finding of this research is agreement with the predictions of Scherer et al. (2019) and Yan (2021), who suggested that the perceived usefulness of technology influences attitudes towards its use. Accordingly, attitude is one of the factors that has an impact on a person’s L2 learning (e.g., Lin et al., 2022; Opoku-Darko, 2023; Suo et al., 2022). Many scholars similarly believe that the affective dimension as an important factor can have certain roles and influences on the learning process in increasing or decreasing the chance of success (e.g., Alharbi & Alnoor, 2022; Houssein et al., 2022; Mayordomo et al., 2022). In the study by Kim et al. (2008), attitude has a significant effect on one’s behavioural perception, which suggests that individuals were more likely to use a learning model if they felt positive about it. This finding is in accordance with Zhang and Caos’ (2020) findings, which affirmed that perceived ease of use strongly affects attitudes towards the use of social media platform (e.g., QQ, DingTalk, Chaoxing), which consequently leads to the purpose to use that platform. This finding suggests that learners who had positive perceptions on the DingTalk platform were more likely to have a positive attitude towards the use of SCVL. This explanation is further supported by qualitative data (e.g., refer to L4, Low, I, Week 8; L12, Medium, I, Week 8; L26T, High, I, Week 8) (Appendix F).

On the other hand, despite the instructor’s support and encouragement, there were also learners who were less involved and who preferred to keep a comparatively lower profile both in the research data collection process and in vocabulary learning of Chinese writing. The passivity of such learners posed a challenge in determining their views and perceptions in the data collection process. The most informative account from such learners belonged to Learner 7, whose feedback provided some thought-provoking insight into his difficulties in doing seamless learning activities (refer to L7, Low, F, Week 11) (Appendix F). Along similar lines, Lin (2020) explained that emotional impact can negatively influence learning. In sum, all findings were deduced from the literature and were supported by prior research as presented above.

4.3.3 Perceived Improvement of Vocabulary Learning in Chinese Writing

The one sample t-test of SCVLQ (C) indicated that there was a significant difference in the scores. As such, the learners perceived that the use of SCVL had improved their vocabulary learning of Chinese writing. In addition, the examination from the qualitative findings of the CFL learners’ perceptions of SCVL in improving their vocabulary learning of Chinese writing in this research demonstrated that generally, most of the learners voiced their satisfaction with the usefulness of SCVL (e.g., refer to L9, Low, I, Week 4; L16, Medium, I, Week 12; L32, High, OQ) (Appendix F).

To begin with, the CFL learners’ increasing awareness of errors in an artifact and their ability to self-revise implied that they may be able to find a diverse range of learning opportunities and alternative solutions for learning vocabulary and dealing with incorrect artifacts (e.g., refer to L6T, Low, F, Week 11; L17, OQ; L31, High, I, Week 16) (Appendix F).

During the initial stages of SCVL, learners may have relied heavily on educator feedback. However, this reliance was not a cause for concern as their “facilitated learning” was likely to evolve into self-directed

learning over time (Rindaningsih et al., 2021). Many CFL learners in this present research were aware that they should review their previously posted artifacts, which received peer feedback, before creating new artifacts. They recognised errors in their previous artifacts and self-revised them based on feedback from both the educator and classmates. As a result, they were able to create new artifacts using the target vocabulary with fewer mistakes. This finding is supported by the qualitative data collected from the CFL learners (e.g., refer to L6T, Low, F, Week 11; L17, OQ; L31, High, I, Week 16) (Appendix F). In interviews conducted with the CFL learners, many of them mentioned that they reviewed their previous work and identified errors in artifacts based on feedback received from their educator and peers (refer to L27T, High, I, Week 12) (Appendix F). This indicates that they were actively engaged in the learning process and had taken steps to improve their Chinese vocabulary learning. Previous research has also shown that feedback from both peers and educators can have a positive impact on CFL learners' Chinese writing (Wang & Sun, 2016; Zhang & Yang, 2019). By revising their previous work based on feedback received, the CFL learners in this research were able to improve their Chinese vocabulary learning in writing over time (Wang & Sun, 2016).

This discovery corroborates with Swain's (1985) Comprehensible Output Hypothesis, which posits that producing comprehensible output is critical to second language learning. It also supports Nation's (2001) "notice-retrieve-generate" explanation of the cognitive processes involved in vocabulary acquisition, emphasising the importance of consciously noticing new vocabulary, retrieving it from memory, and actively generating new language using the newly acquired words. Additionally, the findings are consistent with the levels of processing theory (Lim & Richardson, 2021), which proposes that deeper, more meaningful processing of information leads to better memory retention and retrieval. All these theories highlight the importance of language production activities in L2 learning processes because they enable the learners to identify gaps in their language knowledge and elicit feedback and corrections (e.g., Aw et al., 2016; Laufer, 1995; Lewis et al., 2010; Wong et al., 2021). Likewise, as supported by the quantitative findings above (refer to Chapter 4), the frequency of language output activities performed by individual learners in the SCVL environment was correlated with their Chinese vocabulary proficiency.

In essence, the CFL learner should identify discrepancies between the status quo and established learning goals to bridge the gap between their language knowledge and writing (Chen & Xiao, 2022; Wong et al., 2021). One of the key findings indicated that the learners were inspired to achieve learning goals. SCVL motivated them to keep up their learning and increase their vocabulary knowledge in Chinese. This is supported by the interview data (e.g., refer to L1, Low, I, Week 16; L15T, Medium, I, Week 16; L30, High, I, Week 16) (Appendix F), where the learners reported that a positive impact was gained from educators' encouragement and they experienced a sense of achievement through the use of SCVL. In addition, interviews with learners revealed that educators' monitoring of learners' learning processes and progress, as well as the encouragement they received, had a direct influence on learning outcomes (e.g., refer to L2, Low, OQ; L16, Medium, I, Week 12; L29, High, OQ) (Appendix F). During the initial stages, the learners performed passively to follow the instructions of their educators when tasked to take photos, post comments online, and engage in peer reviews. However, as the research advanced, the majority of the CFL learners become more motivated and self-directed, and their cognitive processing activities were enhanced accordingly. The qualitative data lends support to this interpretation, as some CFL learners expressed the belief that SCVL had a substantial influence on their capacity to acquire and utilise new

words in their everyday activities. This is exemplified by the following statement made by one of the learners:

"I feel that my vocabulary has really improved and that I have mastered vocabulary in various scenarios through this seamless learning, in addition to the Chinese vocabulary I have studied in my textbooks. For example, the word '蚊帐 mosquito net' I learned in the supermarket, and when I was a guest at my Chinese friends' house, I learned from them that '上梁不正下梁歪 the upper beam is not correct and the lower beam is not correct'. I thought it was so interesting." (L29, High, Week 16, Appendix F)

Notably, learners' cognitive and affective development was also perceived to boost their self-efficacy by gaining self-confidence and experiencing a sense of achievement, which was evident in the learners' comments (e.g., refer to L4, Low, I, Week 16; L12; Medium, F, Week 16; L22, High, I, Week 16) (Appendix F). This assertion is in line with the findings of Aw et al. (2016) and Wong et al. (2021), who contend that learners' self-efficacy in learning and self-assurance in expressing themselves directly impacted the quantity of artifacts they generated and their engagement in peer learning. In the same vein, the CFL learners believed that through the process of identifying and correcting errors, they were enhancing their CFL writing performance and augmenting their knowledge, as exemplified by the following statement:

"Seamless Chinese learning has really helped me make progress. In Learning Circle, the teacher and my classmates kindly corrected my artifacts, and then I was also able to identify some mistakes in my artifacts (not posted yet). After revising, I posted new, correct sentences, which made me learn a lot. This is a very helpful method, and it makes me more confident in learning Chinese." (L20, Medium, Week 16, Appendix F)

The findings imply that, as a result of SCVL, the CFL learners' self-perception had progressed from self-doubt to self-confidence, yielding a realistic self-concept (Chen & Xiao, 2022; Chuang et al., 2018). The inspiring nature of the "ranking" function of DingTalk platform encouraged each learner to work harder in the next step to outperform themselves and their classmates (e.g., refer to L3, Low, F, Week 8; L12; Medium, OQ; L24, High, I, Week 8) (Appendix F). It was inspiring for learners to observe how many artifacts were counted by the function, which was described as a competition with oneself and others. This finding directly supports Zhang's (2021) assertion that the creation of a competitive environment and a rise in individuals' desire to prove themselves to others in the class can clarify why some learners favour DingTalk. Some learners, on the other hand, expressed dissatisfaction with the function. as demonstrated by the following statement:

"I do not like it, because some of learners are not good at Chinese writing and few artifacts posted, it can lead to upsetting their classmates and humiliating them." (L1, Low, I, Week 8, Appendix F)

One of the key findings indicate that through the seamless learning process, SCVL expanded the learners' capacity to actively apply the learned vocabulary to their writing in daily lives. This claim could be substantiated by the qualitative data (e.g., refer to L9, Low, I, Week 16; L20, Medium, I, Week 12; L29, High, OQ) (Appendix F). This is further exemplified by the following statement:

"In fact, I believe this method will assist us in improving my writing by informing me about common writing flows. Some things, such as writing, cannot be learned through reading because they come from our minds, so we must think about how to create an artifact and practise the learned vocabulary. So, seamless learning is a good way to improve our writing performance. It offers a variety of seamless learning activities to help us gradually improve our Chinese writing."
(L12, Medium, F, Week 16, Appendix F)

In sum, the findings suggest that learners' vocabulary learning for Chinese writing has improved through the interactive and parallel development of cognitive and affective processes.

4. CONCLUSION

In conclusion, this research provides empirical evidence from both quantitative and qualitative perspectives that the use of SCVL with the "three-in-one" (sentence, paragraph, and essay) artifact-making writing process, guided by four DBR stages, can significantly improve productive vocabulary growth and lexical richness in writing among CFL learners. The 16-week intervention aimed to promote a productive and interactive learning process and advance a "Seamless Chinese Vocabulary Learning in Promoting Vocabulary Growth and Lexical Richness in Writing" model. Thus, in order to improve the language proficiency of CFL learners and cultivate their ability to learn independently, appropriate measures need to be taken. Overall, seamless learning should be highly appreciated and recommended to improve teaching practices (e.g., Barrett et al., 2022; Hambrock & De Villiers, 2023; Kayalar, 2022).

A remarkable discovery from this study is that the learners' passive-active vocabulary gaps were eliminated through social media-based activities conducted over a period of 16 weeks. As evidenced by many scholars, the seamless learning platform provides active use of vocabulary (e.g., Aw et al., 2016, Chen & Xiao, 2022; Wong et al., 2021). Most importantly, it nurtures a social network in which language learning and applications are intertwined over time (Luo & Watts, 2022; Xiao et al., 2021; Yan, 2021). These findings suggest that the learners developed a proactive and spontaneous disposition towards meaning making by interacting with their living spaces (Luo & Watts, 2022; Xiao et al., 2021; Wong et al., 2021). This led to a

significant increase in their vocabulary and a more diverse use of learned vocabulary, which resulted in a reduction in lexical errors and an improvement in their Chinese writing. It is concluded in this research that the high and medium performance groups adapted well to the SCVL intervention and demonstrated significant improvements in their vocabulary use. The intervention, unfortunately, appeared to be less beneficial for low performance learners, as they did not show much progress in their Chinese essay writing, as evidenced by metrics such as U essay. Despite progressing at a slower pace, improvements were observed throughout the four stages of the study. Nonetheless, these findings offer promising initial evidence that the development of deep, interactive, and sustained vocabulary knowledge can result in substantial gains in Chinese vocabulary growth (Wang, S. & Wang, H. Z., 2021; Wong et al., 2016; Zhao, 2021). In addition, lexical richness is essential to the production of writing (e.g., Laufer and Nation, 1995; Read, 2000; Qin and Wen, 2007; Zhang et al., 2021). Learners with a large and diverse lexical knowledge are thought to be more proficient in Chinese (e.g., Laufer and Nation, 1995; Zhang et al., 2021).

Moreover, despite some contradictory impressions and challenges encountered through SCVL, the findings revealed that the learners tried their best to overcome challenges and the majority of them enjoyed the SCVL learning experiences. For instance, they created situations for SCVL despite the COVID-19 policy restrictions from the Chinese government. They found the DingTalk features to be simple and helpful, the seamless HSK Level 4 learning courses to be relevant and useful, and the ranking function of the DingTalk platform to be motivating. Surprisingly, they perceived that the SCVL improved their soft skills, which support their social learning and future human relationship development, as well as their learning skills, which may improve their employability. They also revealed that the SCVL integrated into the taught module was perceived as refreshing and beneficial. As a result, the “embedded” SCVL journey inspired them to pursue more self-directed learning as part of their ongoing professional development (Barrett et al., 2022; Hambrock & De Villiers, 2023; Kayalar, 2022).

Overall, SCVL has numerous benefits and is widely recognised as an investment in one’s personal and professional development (e.g., Aw et al., 2016; Wong et al., 2016; Wong et al., 2021). By acquiring Chinese language skills, individuals can gain access to new experiences and opportunities and develop a deeper appreciation for the language and culture (Wong et al., 2021). As such, learning Chinese is a valuable tool that can help individuals to expand their knowledge and skill sets, and enhance their career prospects (e.g., Qin and Wen, 2007; Wong & Looi, 2019; Zhang et al., 2021).

5. RECOMMENDATION

The prevalent use of online and mobile technologies is catalysing an upgrade of existing teaching and learning modes among language educators (e.g., Godber, 2021; Yin, 2022; Wong et al., 2021). Furthermore, this new era that has been shaped by the effects of the COVID-19 pandemic requires higher education institutions to recognise these changes and realise that learners need diverse learning options (Godber, 2021; Yin, 2022). By promoting a seamless learning mode of learning, learners are exposed to formal and informal learning, individual and social learning, physical and virtual learning, and others (e.g., Hambrock & De Villiers, 2023; Xiao et al., 2021; Wong et al., 2021). Based on this, indicators for future work are also provided in this research.

First, this research could be replicated. Given the overwhelmingly supported positive outcomes of the research, this research can be replicated as some scholars emphasise the importance of research replication as an indicator of viable research (Plucker & Makel, 2021; Sikorski & Andreoletti, 2023). A replication could help researchers see if the current findings could be ascertained in another research of Chinese language or other languages such as Japanese, French, Malay language, and others.

Second, gender differences could be explored further (Główka, 2014; Wong & Looi, 2019). A future study could account for the disparities in demographic information. It would be interesting and crucial to gain knowledge of gender differences in learners' achievement, learning experiences, perceptions, and learning activities (Wong & Looi, 2019).

Third, different samples could be investigated (Kayalar, 2022; Hambrock & De Villiers, 2023). While seamless learning was used for undergraduate CFL learners at intermediate level in this research, the question of how it can benefit other Chinese proficiency levels and non-degree adult CFL learners in China are issues which require further exploration. Further research in this direction would contribute to the existing body of literature and demonstrate whether seamless learning is limited to undergraduate CFL teaching and learning.

Fourth, the research design could be modified. This research employed a mixed-method approach guided by the DBR method to examine 32 CFL learners' learning performance of Chinese writing. It would be interesting and crucial to generalise the research findings to a larger population; hence, future research may adopt a more quantitative research design (Hambrock & De Villiers, 2023; Kayalar, 2022).

Fifth, the scope of research could be expanded. This research aimed to investigate the use of seamless learning in the teaching or learning vocabulary and not on grammar, Chinese speaking, listening or other aspects. Given that grammar is a contentious topic in foreign language education (Pawlak, 2021; Yang, 2023) and that the motivation for incorporating seamless learning in CFL is to improve learners' communicative competence, future research is needed to investigate how seamless CFL learning can be applied to facilitate grammar competencies as well as listening and speaking tasks (e.g., Kayalar, 2022; Wong et al., 2021).

Sixth, for future research, it would be of interest and worth considering to conduct SCVL on another social media platform to examine potential differences. The different platforms utilised for seamless learning may yield different learning outcomes, and thus it is worth investigating in future studies (Hambrock & De Villiers, 2023; Wong et al., 2021).

Seventh, future research is recommended to evaluate educators' integration of seamless learning in CFL instruction, as well as how educator training in this area can impact both their instruction and learners' learning (Kayalar, 2022; Luluk, 2021; Wong & Looi, 2019).

Ultimately, future research can aid seamless teaching and learning from the emic perspective (Kayalar, 2022) where the ratio of online teaching to traditional teaching should be reconsidered (Kayalar, 2022; Wong & Looi, 2019; Wong et al., 2021)..

CONSENT

It is not applicable.

ETHICAL APPROVAL (Refer to Appendix G)

This study was conducted in accordance with the recommendations of the Research Ethics Committee at Universiti Teknologi MARA (UiTM). The protocol was approved by the REC under protocol number [600-TNCPI (5/1/6)]. All participants gave written informed consent in accordance with the Declaration of Helsinki.

REFERENCES

1. Abdullah, S. N. A., & Hashim, H. (2021). Seamless Language Learning in an ESL Context. *Creative Education*, 12(6), 1349-1363.
<https://doi.org/10.4236/ce.2021.126103>
2. Abdullah, S., Hashim, H., & Sofwan Mahmud, M. (2018). Using Mobile Application as an Alternative to Pre-Writing Strategy. *International Journal of Engineering and Technology*, 7(4), 143-147.
3. Aini, N. A., Mufid, M. K., & Eny, M. P. S. (2020). An Analysis on IL Fossilization Phenomenon in Students Writing Performance. *Eduvelop: Journal of English Education and Development*, 3(2), 114-130.
<https://doi.org/10.31605/eduvelop.v3i2.628>
4. Akdağ, F., & Özkan, Y. (2017). Enhancing writing skills of EFL learners through blogging. *The Reading Matrix: An International Online Journal*, 17(2), 79-95.

5. Alahma, A., & Foltz, A. (2020). Effects of Language Skills and Strategy Use on Vocabulary Learning Through Lexical Translation and Inferencing. *J Psycholinguist Res*, 49, 975-991 . <https://doi.org/10.1007/s10936-020-09720-9>

6. Alfadda, H. A., Mahdi, H. S. (2021). Measuring Students' Use of Zoom Application in Language Course Based on the Technology Acceptance Model (TAM). *J Psycholinguist Res*, 50, 883-900. <https://doi.org/10.1007/s10936-020-09752-1>

7. Alghamdi, A. H. (2013). Adapting Design-Based Research as a Research Methodology in Educational Settings. *International Journal of Education and Research*, 10 (1), 1-12.

8. Alharbi, R., & Alnoor, A. (2022). The influence of emotional intelligence and personal styles of dealing with conflict on strategic decisions. *PSU Research Review*, 6(3). 1-12.

9. Ali, W. (2020). Online and remote learning in higher education institutes: a necessity in light of COVID-19 pandemic. *Higher Education Studies*, 10(3), 1-10. <https://doi.org/10.5539/hes.v10n3p16>

10. Ali, Z., Mankash, M. A., & Ullah, N. (2022). Vocabulary Learning Strategies and their Influence on Language Proficiency of Multilingual Undergraduate ESL Learners. *Journal of Educational Research and Social Sciences Review (JERSSR)*, 2(3), 21-34.

11. Alina, Y. (2019). A comparative study on the validity of Pinyin and Reading-words questions in Chinese Vocabulary Testing [Doctoral dissertation, XinJiang University]. China National Knowledge Infrastructure Database.

12. Almaiah, M. A., Al-Khasawneh, A., & Althunibat, A. (2020). Exploring the critical challenges and factors influencing the E-learning system usage during COVID-19 pandemic. *Education and information technologies*, 25, 5261-5280.

13. Alowedi, N. A. (2020). Saudi Electronic University a Role Model in Implementing Blended Learning; Exploring the Experience of Female Students in the Department of English Language and Translation. *International Journal of English Language Education*, 8(1), 113. <https://doi.org/10.5296/IJELE.V8I1.16685>

14. Alshehri, A. (2022). Writing proficiency of Saudi EFL learners: Examining the impact of Lexical diversity. *Journal of Language and Linguistic Studies*, 18(S1), 519-529.

15. Alzu'bi, A. F., Singh, M. K. M., & Pandian, A. (2017). The Use of Learner Autonomy in English as a Foreign Language Context among Saudi Undergraduates Enrolled in Preparatory Year Deanship at Najran University. *Advances in Language and Literary Studies*, 8(2), 152-160. <https://doi.org/10.7575/aiac.all.v.8n.2p.152>
16. Ander, S. & Yıldırım, Ö. (2010). Lexical Errors in Elementary Level EFL Learners' Compositions. *Procedia Social and Behavioral Sciences*, 2, 5299-5303.
17. Anderson, T., & Shattuck, J. (2012). Design-Based Research: A Decade of Progress in Education Research. *Educational Researcher*, 41(1), 16-25. <https://doi.org/10.3102/0013189X11428813>
18. Archibald, M. M., Radil, A. I., Zhang, X., & Hanson, W. E. (2015). Current Mixed Methods Practices in Qualitative Research: A Content Analysis of Leading Journals. *International Journal of Qualitative Methods*, 14(2), 5-33. <https://doi.org/10.1177/160940691501400205>
19. Armellini, A., Teixeira, A. V., & Howe, R. (2021). Student perspectives on learning experiences in a higher education active blended learning context. *TechTrends*, 65(4), 433-443.
20. Aw, G. P., Wong, L. H., Zhang, X. J., Li, Y. Q., & Quek, G. H. (2016). MyCLOUD: A seamless Chinese vocabulary learning experience mediated by loud and mobile technologies. In C. Chai, C. Lim, & C. Tan (Eds.), *Future Learning in Primary Schools* (pp. 65-78). Springer. https://doi.org/10.1007/978-981-287-579-2_5
21. Azraii, A. B., Ramli, A. S., Ismail, Z. (2021). Validity and reliability of an adapted questionnaire measuring knowledge, awareness and practice regarding familial hypercholesterolaemia among primary care physicians in Malaysia. *BMC Cardiovasc Disord*, 21, 39 . <https://doi.org/10.1186/s12872-020-01845-y>
22. Badilla, D. C., & Núñez, V. M. (2020). Lexical Errors in EFL Students' Written Production. *LETRAS*, (68), 175-198. <https://doi.org/10.15359/rl.2-68.7>
23. Bains, M., Kaliski, D. Z., & Goei, K. A. (2022). Effect of self-regulated learning and technology-enhanced activities on anatomy learning, engagement, and course outcomes in a problem-based learning program. *Advances in Physiology Education*, 46(2), 219-227.
24. Bakke, van Eerde, D. (2015). An Introduction to Design-Based Research with an Example From Statistics Education. In: A. Bikner-Ahsbabs, C. Knipping, & N. Presmeg (Eds.), *Approaches to Qualitative Research in*

Mathematics Education: Advances in Mathematics Education (pp. 429-466). Springer. https://doi.org/10.1007/978-94-017-9181-6_16

25. Bao, G. (2008). A survey of the development of lexical richness in L2 compositions from a multidimensional perspective. *Computer-Assisted Foreign Language Education in China*, 12(3), 38-44

26. Bao, H. T. (2019). Study Written Evaluation of them the Writing would in Intermediate Chinese Level Overseas Students [Doctoral dissertation, Central China Normal University]. China National Knowledge Infrastructure Database.

27. Barab, S. & Squire, K. (2004). Design-based research: Putting a stake in the ground. *The Journal of the Learning Sciences*, 13(1), 1-14.

28. Barab, S. (2014). Design-based research: A methodological toolkit for engineering change. In R. K. Sawyer (Eds.), *The Cambridge handbook of the learning sciences* (2nd ed., pp. 151-170). Cambridge University Press.

29. Barrett, N. E., Liu, G. Z., & Wang, H. C. (2022). Seamless learning for oral presentations: Designing for performance needs. *Computer Assisted Language Learning*, 35(3), 551-576.

30. Becker, S. L. (2019). *Becoming Makers: A Designed-Based Research Study Investigating Curriculum Implementation Through Making* (Unpublished doctoral thesis). University of Calgary, Calgary, AB. <http://hdl.handle.net/1880/110614>

31. Beddoes, K. D., Jesiek, B. K., & Borrego, M. (2010). Identifying opportunities for collaborations in international engineering education research on problem-and project-based learning. *Interdisciplinary journal of problem-based learning*, 4(2), 3.

32. Bielaczyc, K. & Collins, A. (2007). Design research: Foundational perspectives, critical tensions, and arenas for action. In: J. Campione, K. Metz, & A. M. Palincsar (Eds.), *Children's learning in laboratory and classroom contexts: Essays in honor of Ann Brown*. Lawrence Erlbaum Associates.

33. Biggs, J. B., & Tang, C. (2007). *Teaching for Quality Learning at University: What the Student Does* (3rd ed.). McGraw-Hill Education: Open University Press

34. Boud, D., Keogh, R. and Walker, D. (2013). *Reflection: Turning Experience into Learning*. Routledge.

35. Bowles, J., & Large, A. (2008). Design-based research for LIS. *Library & Information Science Research*, 30(1), 39-46.

36. Brendel, J. M., Kolbert, J. B., & Foster, V. A. (2002). Promoting student cognitive development. *Journal of Adult Development*, 9, 217-227.
37. Brondolo, E. (2021). From building blocks to building hypothesis-testing research, San Diego, United States.
38. Brooks, G., Clenton, J., & Fraser, S (2021). Exploring the importance of vocabulary for English as an additional language learners' reading comprehension. *Studies in Second Language Learning and Teaching*, 11 (3). 351-376.
39. Brooks, S. (2018). How does perceived formality shape unheard challenging voices?. *The InTernaTional Journal of human resource management*, 29(5), 995 -1014.
40. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2), 77-101.
41. Brown, A. L. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *The Journal of the Learning Sciences*, 2(2), 141-178.
42. Brown, H. D. (2000). *Principles of language learning and teaching* (4th ed.). Longman.
43. Bryman, A. (2012). *Social research methods* (4th ed.). Oxford University Press.
44. Bryman, A., & Bell, E. (2015). *Business Research Methods*. Oxford University Press.
45. Burston, J. (2014). MALL: The pedagogical challenges. *Computer Assisted Language Learning*, 27(4), 344-357.
<https://doi.org/10.1080/09588221.2014.914539>
46. Byrne, C. (2022). What determines perceived graduate employability? Exploring the effects of personal characteristics, academic achievements and graduate skills in a survey experiment. *Studies in Higher Education*, 47(1), 159-176.
47. Calder, S. D., Claessen, M., Ebbels, S., & Leito, S. (2020). Explicit grammar intervention for young school-aged children with developmental language disorder: an efficacy study using single-case experimental design. *Language Speech and Hearing Services in Schools*, 51(2), 298-316.
https://doi.org/10.1044/2019_LSHSS-19-00060

48. Canals, L., & [REDACTED], Y. (2023). Towards a signature pedagogy for technology-enhanced task-based language teaching: Defining its design principles. *ReCALL*, 35(1), 4-18.
49. Cao, X. W., & Tian, X. (2020). The effect of task conception conditions on lexical richness in Chinese second language spoken output. *Learning Chinese*, 10(3), 82-91.
50. Cao, Y. S. (2020). The evaluation and investigations of Chinese learning apps [Master's Thesis, Suzhou University]. China National Knowledge Infrastructure Database.
51. Chai, C. S., Wong, L. H., & King, R. B. (2016). Surveying and Modeling Students' Motivation and Learning Strategies for Mobile-Assisted Seamless Chinese Language Learning. *Educational Technology & Society*, 19 (3), 170-180.
52. Chan, T. W., Roschelle, J., Hsi, S., Kinshuk, S. M., Brown, T., & Patton, C. (2006). "One-to-one technology-enhanced learning: An opportunity for global research collaboration". *Research and Practice in Technology Enhanced Learning*, 1(1), 3-29. <https://doi.org/10.1142/S1793206806000032>
53. Chang, K. E., Lan, Y. J., Chang, C. M., & Sung, Y. T. (2010). Mobile-device-supported strategy for Chinese reading comprehension. *Innovations in Education and Teaching International*, 47(1), 69-84. <https://doi.org/10.1080/14703290903525853>
54. Chang, T. J., Eamoraphan, S., & Thanavisuth, C. (2021). A Comparative Study of Attitudes Towards Learning Chinese as a Foreign Language of Grades 3-4 learners at an International School in Samut Prakarn, Thailand. *Scholar: Human Sciences*, 12(2), 79-94.
55. Chang, W. C., Khelil, N., & Hung, Y. C. (2020). Exploring the differences between leaders' and designers' communication styles: insights from industrial design micro-enterprises in Taiwan. *Journal of Enterprising Culture*, 28(3), 201-221.
56. Chee, K. N., Yahaya, N., & Ibrahim, N. H. (2017). Effectiveness of mobile learning application in improving reading skills in Chinese language and towards post-attitudes. *International Journal of Mobile Learning and Organization*, 11(3), 210-225. <https://doi.org/10.1504/IJMLO.2017.10005992>
57. Chen Hsieh, J. S., Wu, W. C. V., & Marek, M. W. (2017). Using the flipped classroom to enhance EFL learning. *Computer Assisted Language Learning*, 30(12), 1-21. <https://doi.org/10.1080/09588221.2015.1111910>

58. Chen, B., Ma, L., Matsuzawa, Y., & Scardamalia, M. (2015). The Development of Productive Vocabulary in Knowledge Building: A Longitudinal Study. In O. Lindwall, P. Häkkinen, T. Koschman, P. Tchounikine & S. Ludvigsen (Eds.), *Exploring the Material Conditions of Learning: The Computer Supported Collaborative Learning* (pp. 443-450). The International Society of the Learning Sciences.
59. Chen, M., & Xiao, X. (2022). The effect of social media on the development of students' affective variables. *Front. Psychol*, 13. <https://doi.org/10.3389/fpsyg.2022.1010766>
60. Cheng, Y. C. (2020). The Causes and Countermeasures of "Plateau Phenomenon" in English Vocabulary Learning. *Writer's World*, 11(4), 95-104.
61. Chien, T. C., Hung, H. C., Ku, Y. M., Wu, D. H., & Chan, T. W. (2022). Some thoughts on extending digital language learning research. *Bilingualism: Language and Cognition*, 25(3), 384-385.
62. China National Office for Teaching Chinese as a Foreign Language (NOCFL). (2002). *Syllabus of Chinese Language Program for Foreign Students in Colleges and Universities*. Beijing Language and Culture University Press.
63. Chinese Testing International (Ed.) (2009). *HSK Level III*. <http://www.chinesetest.cn>
64. Chuang, H. H., Weng, C. Y., & Chen, C. H. (2018). Which students benefit most from a flipped classroom approach to language learning? *British Journal of Educational Technology*, 49(1), 56-68. <https://doi.org/10.1111/bjet.12530>
65. Chuenyindee, T., Ong, A. K. S., Prasetyo, Y. T., Persada, S. F., Nadlifatin, R., & Sittiwatethanasiri, T. (2022). Factors affecting the perceived usability of the COVID-19 contact-tracing application "Thai chana" during the early COVID-19 omicron period. *International Journal of Environmental Research and Public Health*, 19(7), 4383.
66. Clark, E. V. (2004). How language acquisition builds on cognitive development. *Trends in cognitive sciences*, 8(10), 472-478.
67. Clarke, V., & Braun, V. (2013). *Successful Qualitative Research: A Practical Guide for Beginners*. *Psychologist*, 26(2), 120-123. <https://doi.org/10.46743/2160-3715/2014.1206>
68. Cohen, L., Manion, L., & Morrison, K. (2007). *Research Methods in Education* (6th ed.). Routledge Falmer.

69. Cohen, L., Manion, L., & Morrison, K. (2011). *Research Methods in Education* (7th ed.). Routledge.
70. Collins, A., Joseph, D., & Bielaczyc, K. (2004). Design research: Theoretical and methodological issues. *The Journal of the Learning Sciences*, 13(1), 15-42.
71. Collins, C. H., Patricia, M. L., Grange, J. M., & Falkinham, J. O. (2004). *Collins and Lyne's Microbiological Methods* (8th ed.). Hodder & Stoughton.
72. Common European Framework of Reference for Languages. (2023, March 2). In Wikipedia. <https://zh.wikipedia.org/w/index.php?>
73. Corbett, F., & Spinello, E. (2020). Connectivism and Leadership: Harnessing a Learning Theory for the Digital Age to Redefine Leader in the Twenty-First Century. *Heliyon*, 6(1), 1-9. <https://doi.org/10.1016/j.heliyon.2020.e03250>
74. Corder, S. P. (1967). The Significance of Learners' Errors. *International Review of Applied Linguistics in Language Teaching*, 5, 161-170. <http://dx.doi.org/10.1515/iral.1967.5.1-4.161>
75. Corder, S.P. (1967). The significance of learner's errors. *International Review of Applied Linguistics in Language Teaching*, 5(4), 161-170.
76. Creswell, J. W. (2007). *Qualitative Inquiry and Research Design: Choosing Among Five Approaches*. Sage Publications.
77. Creswell, J. W. (2015). *A concise Introduction to Mixed Methods Research*. Sage Publications.
78. Creswell, J. W., & Plano Clark, V. L. (2011). *Designing and Conducting Mixed Methods Research*. Sage Publications.
79. Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and Conducting Mixed Methods Research* (3rd ed.). Sage Publications.
80. Cui, Y. H. (2003). Teaching Types of Chinese Teaching. *Application of Language and Characters*, 18(2), 49-55.
81. Dai, L., Wang, L., & He, Y. (2022). Exploring the effect of wiki-based writing instruction on writing skills and writing self-efficacy of Chinese English-as-a-foreign language learners. *Frontiers in Psychology*, 13, 1-11.
82. Darling, H. L., Flook, L., Cook, H. C., Barron, B., & Osher, D. (2020). Implications of educational practice of the science of learning and development. *Applied Developmental Science*, 24(2), 97-140.

83. Dawadi, S., Shrestha, S., & Giri, R. A. (2021). Mixed-methods research: A discussion on its types, challenges, and criticisms. *Journal of Practical Studies in Education*, 2(2), 25-36.
84. Dede, C. (2004). If design-based research is the answer, what is the question? *Journal of the Learning Sciences*, 13(1), 105-114.
85. Dinar, M., Shah, J. J., Cagan, J., Leifer, L., Linsey, J., Smith, S. M., & Hernandez, R. V. (2015). Empirical Studies of Designer Thinking: Past, Present, and Future. *ASME. J. Mech. Des*, 137(2), 21-31.
<https://doi.org/10.1115/1.4029025>
86. Downes, S. (2019). Recent Work in Connectivism. *European Journal of Open, Distance and E-Learning*, 22(2), 112-131. <https://doi.org/10.2478/eurodl-2019-0014>
87. Du, B. (2020). Research on O2O Mode in regional cultural infiltration of TCFL during the "Internet Plus" era. *Journal of Hebei United University (Social Science Edition)*, 18(6), 110-121.
88. Duff, D., Tomblin, J. B., & Catts, H. (2015). The Influence of Reading on Vocabulary Growth: A Case for a Matthew Effect. *Journal of speech, language, and hearing research : JSLHR*, 58(3), 853-864.
https://doi.org/10.1044/2015_JSLHR-L-13-0310
89. Efstathiadi, L. (2019). Early Foreign Language Learning: Intensive Exposure, Vocabulary Development and the Cognitive Skills Involved. *Belgrade English Language and Literature Studies*, 11(1), 81-111.
90. Elbow, P. (1998). *Writing with power: Techniques for mastering the writing process*. Oxford University Press.
91. Elham, F. M., & Mohsen, H. (2016). A Seamless Learning Design for Mobile Assisted Language Learning: An Iranian Context. *English Language Learning*, 9(5), 206-213.
92. Ellis, R. (1994). *The study of second language acquisition*. Oxford University Press.
93. Engber, C. A. (1995). The relationship of lexical proficiency to the quality of ESL compositions. *Journal of Second Language Writing*, 4(2), 139-155.
[https://doi.org/10.1016/1060-3743\(95\)90004-7](https://doi.org/10.1016/1060-3743(95)90004-7)
94. Eskildsen, S. W. (2009). Constructing another language—Usage-based linguistics in second language acquisition. *Applied linguistics*, 30(3), 335-357.

95. Evans, N. W., Hartshorn, K. J., McCollum, R. M., & Wolfersberger, M. (2010). Contextualizing corrective feedback in second language writing pedagogy. *Language Teaching Research*, 14(4), 445-463.
96. Fairclough, M., & Belpoliti, F. (2016). Emerging literacy in Spanish among Hispanic heritage language university students in the USA: A pilot study. *International Journal of Bilingual Education and Bilingualism*, 19(2), 185-201.
97. Foomani, M. E., & Hedayati, M. (2016). A Seamless Learning Design for Mobile Assisted Language Learning: An Iranian Context. *Canadian Center of Science and Education. English Language Teaching*, 9(5), 206-213.
<https://doi.org/10.5539/elt.v9n5p206>
98. Fraenkel, J. R & Wallen, N. E. (2009). *How to Design and Evaluate Research in Education* (7th ed.). McGraw-hill.
99. Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). *How to design and evaluate research In education* (8th ed.). Mc Graw Hill.
100. Fragoulis, I., & Tsiplakides, I. (2009). Project-based learning in the teaching of English as a foreign language in Greek primary schools: From theory to practice. *English Language Teaching*, 2(3), 113-119.
101. Fu, L. Q. (2020). A Survey of Lexical Richness in Chinese Vocabulary growth of International Students at Intermediate and Advanced Levels. [Master dissertation, Shanghai International Studies University]. China National Knowledge Infrastructure Database.
102. Gan, C., & Mingsiritham, K. (2021). Using design-based research to develop innovation in open university in Thailand. *International Journal of Interactive Mobile Technologies (iJIM)*, 15(4), 126.
103. Gao, R. Y. (2020). Activity theory-based instruction design for teaching Chinese as a foreign language [Doctoral dissertation, East China Normal University]. China National Knowledge Infrastructure Database.
104. Gary, D. (2017). *Doing Research in the Real World* (4th ed.). Sage Publications.
105. Ge, X., Leifer, L., & Shui, L. (2021). Situated emotion and its constructive role in collaborative design: a mixed-method study of experienced designers. *Design Studies*, 75(3), 1-41.

106. Gibbs, G. R. (2014). Using software in qualitative analysis. *The SAGE handbook of qualitative data analysis*, 277-294.
107. Głowka, D. (2014). The impact of gender on attainment in learning English as a foreign language. *Studies in Second Language Learning and Teaching*, 4(4), 617-635.
108. Godber, K., and Atkins, D. (2021). COVID-19 Impacts on Teaching and Learning: A Collaborative Autoethnography by Two Higher Education Lecturers. *Front. Educ*, 6, [https://doi: 10.3389/educ.2021.647524](https://doi.org/10.3389/educ.2021.647524)
109. Goldie, J. G. S. (2016). Connectivism: A Knowledge Learning Theory for the Digital Age. *Medical Teacher*, 38(10), 1064-1069. <https://doi.org/10.3109/0142159X.2016.1173661>
110. Gon, S., & Rawekar, A. T. (2017). Effectivity of E-Learning through WhatsApp as a Teaching Learning Tool. *Journal of the Medical Sciences*, 4, 19-25.
111. González, M. C. (2017). The contribution of lexical diversity to college-level writing. *Tesol Journal*, 8(4), 899-919. <https://doi.org/10.1002/tesj.342>
112. Graham, S., Tuncanli, O. F., & Kaldirim, A. (2022). Improving writing skills of students in turkey: A meta-analysis of writing interventions. *Educational Psychology Review*, 34(2), 889-934.
113. Habgood, A. (2011). Motivating children to learn effectively: Exploring the value of intrinsic motivation in educational games. *Journal of the Learning Sciences*, 20(2), 169-206.
114. Halliday, M. A. K. (1989). *Spoken and Written Language*. Oxford University Press.
115. Hambrock, H., & De Villiers, F. (2023). Proposing a Seamless Learning Experience Design (SLED) Framework Based on International Perspectives of Educators from Five Higher Education Institutions. *Electronic Journal of e-Learning*, 21(1), 52-68.
116. Han, J. C. (2021). Research on the Application of Remote interactive Teaching based on DingTalk Platform in Comprehensive Chinese Course [Doctoral dissertation, Hei Longjiang University]. China National Knowledge Infrastructure Database.
117. Harmer, J. (2004). *How to teach English writing*. Pearson Education.

118. Harmer, N., & Stokes, A. (2014). The benefits and challenges of project-based learning. Plymouth University Press.
119. Hasnine, M. N., Ogata, H., Akapnar, G., Mouri, K., & Kaneko, K. (2020). Closing the experiential learning loops using learning analytics cycle: towards authentic experience sharing for vocabulary learning. *International Journal of Distance Education Technologies*, 18(3), 78-98.
120. He, S., & Yang, H. (2016). A case study of the use of the Pleco app in extensive reading class. *China Academic Journal Electronic Publishing House*, 3(2), 354-365.
121. Heil, C. R., Wu, J. S., Lee, J. J., & Schmidt, T. (2016). A review of mobile language learning applications: Trends, challenges, and opportunities. *The EuroCALL Review*, 24(2), 32-50. <https://doi.org/10.4995/eurocall.2016.6402>
122. Hiew, F. C., Sheard, J., Parthiban, R., & Chew, E. (2018, July 2-4). How Seamless are Technology-rich Learning Environments? The Voice of UT Educators. *Proceedings of the 23rd Annual ACM Conference on Innovation and Technology in Computer Science Education*, Larnaca. <https://doi.org/10.1145/3197091.3197125>
123. Homayouni, M. (2022). Peer assessment in group-oriented classroom contexts: on the effectiveness of peer assessment coupled with scaffolding and group work on speaking skills and vocabulary learning. *Lang Test Asia*, 12 (3), 61-77. <https://doi.org/10.1186/s40468-022-00211-3>
124. Hou, H. Q. (2017). Chinese learning App comparison based on the concept of seamless learning [Master's Thesis, Nanjing Normal University]. China National Knowledge Infrastructure Database.
125. Houssein, E. H., Hammad, A., & Ali, A. A. (2022). Human emotion recognition from EEG-based brain-computer interface using machine learning: a comprehensive review. *Neural Computing and Applications*, 34(15), 12527-12557.
126. Hsieh, Y. (2016). An Exploratory Study on Singaporean Primary School Students' Development in Chinese Writing. *Asia-Pacific Edu Res*, 25, 541-548. <https://doi.org/10.1007/s40299-016-0279-0>
127. Huang, J., Zhu, D., Xie, D., & Shu, T. (2023). Examining the reliability of an international Chinese proficiency standardized writing assessment: Implications for assessment policy makers. *Assessing Writing*, 55, 100693.

128. Huang, L. (2022, January). An empirical study on the fossilization of English language learning in the context of multimedia network teaching. In Proceedings of CECNet 2021: The 11th International Conference on Electronics, Communications and Networks (CECNet), November 18-21, 2021 (Vol. 345, p. 477). IOS Press.
129. Huang, L., & Qian, X. J. (2003). A study of generative vocabulary knowledge in Second language Chinese learners: a quantitative study based on picture-based compositions. *Chinese Learning*, 3(1), 56-61.
130. Huang, R., Tlili, A., Chang, T. W., Zhang, X. L., Nascimbeni, F., & Burgos, D. (2020). Disrupted classes, undisrupted learning during COVID-19 outbreak in China: application of open educational practices and resources. *Smart Learning Environments*, 7, 19. <https://doi.org/10.1186/s40561-020-00125-8>
131. Hulley, S. B., Cummings, S. R., Browner, W. S., Grady, D. G., & Newman, T. B. (2001). ing ready to estimate sample size: Hypothesis and underlying principles. *Designing Clinical Research-An Epidemiologic Approach*. Baltimore, Maryland: Lippincott Williams and Wilkins, 51-63.
132. Hwang, G. J., Sung, H. Y., Chang, S. C., & Huang, X. C. (2020). A fuzzy expert system-based adaptive learning approach to improving students' learning performances by considering affective and cognitive factors. *Computers and Education: Artificial Intelligence*, 1, 1-15.
133. Indrawan, E., & Jalinus, N. (2019). Review project based learning. *International Journal of Science and Research (IJSR)*, 8(4), 1014-1018.
134. Isik, A. D. (2018). Use of technology in constructivist approach. *Educational Research and Reviews*, 13(21), 704-711.
135. Ismatovna, A. Y. (2023). Moodle—as an Effective Learning Management System in the Modern Digital World. *International Journal of Inclusive Education*, 2(3), 37-51.
136. Iwamoto, D. H., & Chun, H. (2020). The Emotional Impact of Social Media in Higher Education. *The International Journal of Higher Education*, 9, 239-247. <https://doi.org/10.5430/ijhe.v9n2p239>
137. Jahin, J. H., & Idrees, M. W. (2010). EFL major student teachers' writing proficiency  attitudes towards learning English. *Um Al-Qura University Journal of Education and Psychology Sciences*, 2(2), 9-73.
138. Jain, B. K. (2020). Formulating a Research Question/Hypothesis: The First Step.

139. James, [REDACTED] (1998). Errors in language learning and use. Longman.
140. Jarvis, S. (2002). Short texts, best-fitting curves and new measures of lexical diversity. *Language Testing*, 19(1), 57-84.
<https://doi.org/10.1191/0265532202lt220oa>
141. Jarvis, S. (2013). Capturing the diversity in lexical diversity. *Language Learning*, 63(s1), 87-106. <https://doi.org/10.1111/j.1467-9922.2012.00739.x>
142. Jiang, J. Y., Bi, P., & Liu, H. T. (2019). Syntactic complexity development in the writings of EFL learners: Insights from a dependency syntactically-annotated corpus. *Journal of Second Language Writing*, 46, 3-18.
<https://doi.org/10.1016/j.jslw.2019.100666>
143. Jiang, Z. F., & Bai, L. X. (2020). A Survey of Chinese learning motivation in countries along the Belt and Road. *Journal of Jiangxi Electric Power Polytechnic*, 33(3), 160-163.
144. Johnson, R. B. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, 33(7), 14-26. <https://doi.org/10.3102/0013189X033007014>
145. Johnson, R. B., Onwuegbuzie, A. J., & Turner, L. A. (2007). Towards a Definition of Mixed Methods Research. *Journal of Mixed Methods Research*, 1(2), 112-133. <https://doi.org/10.1177/1558689806298224>
146. Jon, J. E., Lee, J. J., & Byun, K. (2014). The emergence of a regional hub: comparing international student choices and experiences in South Korea. *Higher Education*, 67(5), 691-710. <https://doi.org/10.1007/s10734-013-9674-0>
147. Jurišević, M. & Pižorn, K. (2013). Young foreign language learners' motivation [REDACTED] Slovenian experience. *Porta Linguarum*, 19, 179-198.
148. Kapur, R. (2019). [REDACTED] Constructivism in Teaching-Learning Process. University of Delhi.
149. Kartal, B. (2022). Does It Matter Having Constructivist or Traditional Teaching Beliefs for Academic Achievement: A Study of Preservice Teachers. *International Dialogues on Education Journal*, 9(2), 96-127.
150. Kawauchi, C. (2008). Proficiency differences in CALL based vocabulary learning: The effectiveness of using "PowerWords". *FLEAT*, 5, 55-65.

151. Kaya, M., & Etin-Kaya, Y. (2021). Seamless computation offloading for mobile applications using an online learning algorithm. *Computing*, 103(1), 771-799. <https://doi.org/10.1007/s00607-020-00873-y>
152. Kayalar, F. (2022). Seamless Learning in Language Education: Work of Recent Pandemic. *Proceedings of IAC 2022 in Prague*, 1, 73.
153. Ke, X. H., & Li, H. B. (2008). Approaching the theory of Design Based Research. *Open Education Research*, 14(4), 50-53.
154. Klahr, D., & Wallace, J. G. (2022). *Cognitive development: An information-processing view*. Routledge.
155. Ko, E. G., & Lim, K. Y. (2021). Promoting English learning in secondary schools: design-based research to develop a mobile application for collaborative learning. *The Asia-Pacific Education Researcher*, 7(3). 1-13. <https://doi.org/10.1007/s40299-021-00562-0>
156. Krashen, S. D. (1981). *Second Language Acquisition and Second Language Learning*. Pergamon Press.
157. Krauss, J., & Boss, S. (2013). *Thinking through project-based learning: Guiding deep inquiry*. Corwin Press
158. Kristanto, W., & Citrasukmawati, A. (2023). Online Learning on Children's Language Development During the COVID-19 Pandemic. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 7(1), 336-344.
159. Krull, G. E. (2018). *Supporting seamless learning: Students' use of multiple devices in online and distance learning universities* (Doctoral dissertation, Universitat Oberta de Catalunya). CORE AC UK.
160. Kuh, G. D. (1996). Guiding principles for creating seamless learning environments for undergraduates. *Journal of College Student Development*, 37(2), 135-148.
161. Kvale, S., and Brinkmann, S. (2015). *Interviews: Learning the Craft of Qualitative Research Interviewing* (3rd ed.). Sage Publications.
162. Lai, W. H. (2014). *Using mobile instant messenger (WhatsApp) to support second language learning*. [Master thesis, University of Hong Kong]. The HKU Scholars Hub.
163. Lan, Y. J., & Lin, Y. T. (2016). Mobile seamless technology enhanced CSL oral communication. *Educational Technology & Society*, 19(3), 335-350.

164. Lan, Y. J., Sung, Y. T., & Chang, K. E. (2014). Bridging in-and-out class learning: Mobile seamless Mandarin learning. In: Y. Cao, T. Våljataga, J. Tang, H. Leung, M. Laanpere (Eds.), *Lecture Notes in Computer Science* (pp. 101-105). Springer. https://doi.org/10.1007/978-3-319-13296-9_11
165. Laufer, B. & Nation, P. (1995). Vocabulary size and use: Lexical richness in L2 written production. *Applied Linguistics*, 16(03), 307-322. <https://doi.org/10.1093/applin/16.3.307>
166. Laufer, B. (1998). The development of passive and active vocabulary in a second language: Same or different? *Applied Linguistics*, 19(2), 388-423 . <https://doi.org/10.1093/applin/19.2.255>
167. Laufer, B., & Goldstein, Z. (2004). Testing vocabulary knowledge: Size, strength, and computer adaptiveness. *Language Learning*, 54(03), 399-436. <https://doi.org/10.1111/j.0023-8333.2004.00260.x>
168. Laufer, B., & Nation, P. (1999). A Vocabulary size test of controlled productive ability. *Language Testing*, 16(1) , 33 -51. <https://doi.org/10.1177/026553229901600103>
169. Lave, J., & Wenger. E. (1990). *Situated learning: Legitimate peripheral participation*. Cambridge University Press.
170. Layali, K., & AlShlowiy, A. (2020). Students' Perceptions of e-Learning for ESL/EFL in Saudi Universities Time of Corona-virus: A Literature Review. *Indonesian EFL Journal*, 6(2), 97-108. <https://doi.org/10.25134/ieflij.v6i2.3378>
171. Lee, S., & Lee, D. K. (2018). What is the proper way to apply the multiple comparison test?. *Korean journal of anesthesiology*, 71(5), 353–360. <https://doi.org/10.4097/kja.d.18.00242>
172. Lei, S. Y., and Yang, R. Y. (2020). Lexical richness in research articles: Corpus-based comparative study among advanced Chinese learners of English, English native beginner students and experts. *Journal of English for Academic Purposes*, 47, 1-9.
173. Leshem, S., & Trafford, V. (2007). Overlooking the conceptual framework. *Innovations in Education & Teaching International*, 44(1), 93-105. <https://doi-org.proxy1.ncu.edu/10.1080/14703290601081407>
174. Lester, F. (2005). On the theoretical, conceptual, and philosophical foundations for research in mathematics education. *ZDM*, 37(6), 457-467.

175. Lewis, S., Pea, R., & Rosen, J. (2010). Beyond participation to co-creation of meaning: mobile social media in generative learning communities. *Social Science Information*, 49(3), 351-369. <https://doi.org/10.1177/0539018410370726>
176. Li, D. P. (2019). The study of Chinese learning based on SNS from the perspective of affordances. *Research in teaching*, 44(2), 61-66.
177. Li, J., Cummins, J., & Deng, Q. (2017). The effectiveness of texting to enhance academic vocabulary learning: English language learners' perspective. *Computer Assisted Language Learning*, 30(8), 816-843. <https://doi.org/10.1080/09588221.2017.1366923>
178. Li, R. L., & Wu, M. (2005). On two Principles of Vocabulary Teaching in Chinese as a Foreign Language. *Language teaching and Research*, 12(2), 41-47.
179. Lim, J., & Richardson, J. C. (2021). Predictive effects of undergraduate students' perceptions of social, cognitive, and teaching presence on affective learning outcomes according to disciplines. *Computers & Education*, 161, 104063.
180. Lin, G. Y. (2020). Scripts and mastery goal orientation in face-to-face versus computer-mediated collaborative learning: Influence on performance, affective and motivational outcomes, and social ability. *Computers & Education*, 143, 1-16.
181. Lin, R. Z. (2019). Study of Intermediate Chinese Writing Teaching to Foreign Students on Scaffolding Theory--Take Class E and F, Grade 2015 from Chinese Language Education of Huaqiao University as an example [Master's Thesis, Huaqiao University]. China National Knowledge Infrastructure Database.
182. Lin, Y. S., Lim, J. N., & Wu, Y. S. (2022). Developing and applying a Chinese character learning game app to enhance primary school students' abilities in identifying and using characters. *Education Sciences*, 12(3), 189.
183. Linnarud, M. (1986). *Lexis in Composition*. Lund Studies in English 
184. Litts, B. K. (2015).  Resources, facilitation, and partnerships: three design considerations for youth makerspaces. In *Proceedings of the 14th International Conference on Interaction Design and Children* (pp. 347-350). New York, NY: ACM
185. Liu, D. (2019). The Construction of a Seamless Learning framework for English Vocabulary. *Journal of Teaching and Learning*, 9(01), 43-47.

186. Liu, Z. (2022). Employment Analysis of College Students Under the Current Economic Situation. *International Journal of Management and Education in Human Development*, 2(01), 296-302.
187. Llach, M. P. A. (2011). Lexical Errors and Accuracy in Foreign Language Writing. *Multilingual Matters*.
188. Looi, C. K., Wong, L. H., So, H. J., Seow, P., Toh, Y., Chen, W., & Soloway, E. (2009). Anatomy of a mobilized lesson: Learning my way. *Computers & Education*, 53(4), 1120-1132. <https://doi.org/10.1016/j.compedu.2009.05.021>
189. Lu, Q. (2012). Review of Curriculum Learning Activity Design. *Audio-visual Education Research*, 20(7), 95-101.
190. Lu, X. F. (2012). The relationship of lexical richness to the quality of ESL learners' oral narrative. *The Modern Language Journal*, 96(2). 190-208.
191. Lu, Y. (2020). The study on Chinese vocabulary learning strategies of preparatory students in China [Doctoral dissertation, Huaqiao University]. China National Knowledge Infrastructure Database.
192. Luluk, S. (2021). Utilization of Seamless Learning as a Learning Model during COVID-19 Pandemic in Indonesia. *Scope Journal of English Language Teaching*, 5(2), 79-85.
193. Luo, H., & Yang, C. S. (2016). Using WeChat in teaching L2 Chinese: An exploratory study. *Journal of Technology and Chinese Language Teaching*, 7(2), 82-96.
194. Luo, J. M. (2021). Research and Design of WeChat Official Account for Learning Chinese Idioms [Master's Thesis, Shanghai Normal University]. China National Knowledge Infrastructure Database.
195. Luo, Y., & Watts, M. (2022). Exploration of university students' lived experiences of using smartphones for English language learning. *Computer Assisted Language Learning*, 1-26.
196. MacCallum, K. (2019). Seamless Learning Through Mixed Reality: A New Zealand perspective. In C. Glahn, R. Power, E. Tan, H. Hambrook, M. Specht, D. Parsons, T. Brown, D. Cristol, and K. Mac Cullum (Eds.), *Proceedings of the 18th World Conference on Mobile and Contextual Learning*, (pp. 16-18) Netherlands. <https://www.learntechlib.org/p/210617>

197. Maguire, M., & Delahunt, B. (2017). Doing a thematic analysis: A practical, step-by-step guide for learning and teaching scholars. *The All Ireland Journal of Teaching and Learning in Higher Education*, 8(3), 3351-33514.

198. Malecka, B., Boud, D., Tai, J., & Ajjawi, R. (2022). Navigating feedback practices across learning contexts: implications for feedback literacy. *Assessment & Evaluation in Higher Education*, 47(8), 1330-1344.

199. Malik, R. S. (2018). Educational Challenges in 21st Century and Sustainable Development. *Journal of Sustainable Development Education and Research*, 2(1), 9. <https://doi:10.17509/jsder.v2i1.12266>.

200. Masita, M. (2020). Teaching Vocabulary Using Blended Learning Method. *Ethical Lingua: Journal of Language Teaching and Literature*, 7(1), 128-135. <https://doi.org/10.30605/25409190.143>

201. Matee, G. L., Motlohi, N., & Nkiwane, P. (2023). Emerging perspectives and challenges for virtual collaborative learning in an institution of higher education: a case of Lesotho. *Interactive Technology and Smart Education*, 20(1), 73-88.

202. Maxcy, S. J. (2003). Pragmatic Threads in Mixed Method Research in the Social Sciences: The Search for Multiple Modes of Inquiry and the End of the Philosophy of Formalism. In: A. Tashakkori, & C. Teddlie (Eds.), *Handbook of Mixed Methods in the Social and Behavioural Sciences* (pp. 51-89). Thousand Oaks, Sage.

203. Mayordomo, R. M., Espasa, A., Guasch, T., & Martínez-Melo, M. (2022). Perception of online feedback and its impact on cognitive and emotional engagement with feedback. *Education and Information Technologies*, 27(6), 7947-7971.

204. McKenney, S., & Reeves, T. C. (2012). *Conducting Educational Design Research*. Routledge.

205. Meltzoff, A. N., Kuhl, P. K., Movellan, J., Sejnowski, T. J. (2009). Foundations for a new science of learning. *Science*, 325(5938), 284-288.

206. Meng, X. L. (2021). Experimental Research on Learning strategy of primary Chinese learners in the Quizlet environment [Doctoral dissertation, Central China Normal University]. China National Knowledge Infrastructure Database.

207. Mishra, P., Singh, U., Pandey, C. M., Mishra, P., & Pandey, G. (2019). Application of student's t-test, analysis of variance, and covariance. *Annals of cardiac anaesthesia*, 22(4), 407.

208. Mo, D. (2015). Differences in productive vocabulary knowledge between Chinese and non-Chinese Chinese learners and its impact on writing quality. *Journal of Yunnan Normal University (Teaching Chinese as a Foreign Language and Research)*, 12(5), 33-41.
209. Mohammed, S. H., & Kinyo, L. (2020). The Role of Constructivism in the Enhancement of Social Studies Education. *Journal of Critical Reviews*, 7(7), 249-256. <https://doi.org/10.31838/jcr.07.07.41>
210. Moon, M. D. (2019). Triangulation: A method to increase validity, reliability, and legitimation in clinical research. *Journal of emergency nursing*, 45(1), 103-105.
211. Mouri, K., Uosaki, N., & Ogata, H. (2018). Learning Analytics for Supporting Seamless Language Learning Using E-Book with Ubiquitous Learning System. *Journal of Educational Technology & Society*, 21(2), 150-163. <http://www.jstor.org/stable/26388390>
212. Mourougan, S. & Sethuraman, K. (2017). Hypothesis Development and Testing. *IOSR Journal of Business and Management (IOSR-JBM)*, 19(5), 34-40. <https://doi.org/10.9790/487X-1905013440>
213. Mykytiuk, S., Moroz, T., Mykytiuk, S., Moroz, M., & Dolgusheva, O. (2022). Seamless Learning Model with Enhanced Web-Quizzing in the Higher Education Setting. *iJIM*, 16(03), 5.
214. Nah, K. C. (2008). Language learning through mobile phones: design and trial of a Wireless Application Protocol (WAP) site model for learning EFL listening skills in Korea. (Unpublished doctoral dissertation). University of Queensland, Brisbane, Australia.
215. Nah, K. C., White, P., & Sussex, R. (2008). The potential of using a mobile phone to access the Internet for learning EFL listening skills within a Korean context. *ReCALL*, 20(3), 331-347.
216. Nasiba, S., & Norboyevich, U. B. (2022). Effective Strategies for Improving Writing Skills of Elementary English Language Learners. *Pioneer: Journal of Advanced Research and Scientific Progress*, 1(5), 24-27.
217. Nation, I. S. P. (2001). *Learning vocabulary in another language*. Cambridge: Cambridge University Press. <https://doi.org/10.1017/CBO9781139524759>

218. Nation, P. (1993) Using dictionaries to estimate vocabulary size: essential, but rarely followed, procedures. *Language Testing*, 10(1), 27-40.
<https://doi.org/10.1177/026553229301000102>

219. Nation, P. (2001). *Learning vocabulary in another language*. Cambridge University Press.

220. Nation, P., & Webb, S. (2011). *Researching and analyzing vocabulary*. Heinle.

221. Natow, R. S. (2020). The use of triangulation in qualitative studies employing elite interviews. *Qualitative research*, 20(2), 160-173.

222. Nazir, M., & Brouwer, N. (2019). Community of inquiry on Facebook in a formal learning setting in higher education. *Education Sciences*, 9(1), 10.

223. Nibrad, G. M. (2019). Methodology and Application of Two-way ANOVA. *International Journal of Marketing and Technology*, 9(6), 1-8.

224. Nkrumah, B., & Darko, J. O. (2020). A study of attitudes towards learning Chinese as foreign language in Ghanaian universities: A comparative study of University of Ghana and University of Cape Coast. *Integrity Journal of Education and Training*, 4(1), 8-15.

225. Odendaal, W., Atkins, S. & Lewin, S. (2016). Multiple and mixed methods in formative evaluation: Is more better? Reflections from a South African study. *BMC Med Res Methodol*, 16, 173 <https://doi.org/10.1186/s12874-016-0273-5>

226. Ogata, H., Hui, G. L., Yin, C., Ueda, T., Oishi, Y., & Yano, Y. (2008). LOCH: Supporting mobile language learning outside classrooms. *Mobile Learning and Organisation*, 2(3), 271-282.

227. Opoku-Darko, J. (2023). Ghanaian Students' Perceptions of Chinese Language Learning. *American Journal of Education and Practice*, 7(1), 26-35.

228. Ortega, L. (2014). Experience and success in late bilingualism. In *Proceedings of the 17th AILA World Congress*, Brisbane.

229. Pawlak, M. (2021). Teaching foreign language grammar: New solutions, old problems. *FOREIGN LANGUAGE ANNALS*, 54(4), 881-896.
<https://doi.org/10.1111/flan.12563>

230. Pellicer-Sánchez, A. (2020). Expanding English Vocabulary Knowledge through Reading: Insights from Eye-tracking Studies. *RELC Journal*, 51(1), 134-146. <https://doi.org/10.1177/0033688220906904>
231. Peng, L. Y. (2019). The application of WeChat platform to Chinese reading teaching under seamless learning concept [Doctoral dissertation, Guangxi University for Nationalities]. China National Knowledge Infrastructure Database.
232. Pilar, M., and Llach, A. (2007). Lexical errors as writing quality predictors. *Stud. Linguist*, 61(1), 1-15. <https://doi.org/10.1111/j.1467-9582.2007.00127.x>
233. Pimmer, C., Mateescu, M., & Gröbriel, U. (2016). Mobile and ubiquitous learning in higher education settings. A systematic review of empirical studies. *Computers in Human Behavior*, 63, 490-501. <https://doi.org/10.1016/j.chb.2016.05.057>
234. Plakans, L., Gebril, A., & Bilki, Z. (2019). Shaping a score: Complexity, accuracy, and fluency in integrated writing performances. *Language Testing*, 36(2), 161-179.
235. Plucker, J. A., & Makel, M. C. (2021). Replication is important for educational psychology: Recent developments and key issues. *Educational Psychologist*, 56(2), 90-100.
236. Pranjol, M. Z., Oprandi, P., & Watson, S. (2022). Project-based learning in biomedical sciences: using the collaborative creation of revision resources to consolidate knowledge, promote cohort identity and develop transferable skills. *Journal of Biological Education*, 1-17.
237. Qian, X. J. (2002). A preliminary study on vocabulary testing. *World Chinese Teaching*, 16(4), 54-62.
238. Qin, X. Q., & Wen, Q. F. (2007). *EFL Writing of College English Majors in China: A Developmental Perspective*. China Social Sciences Press.
239. Qiu, S. D. (2013). An Ontological Approach to Chinese-English Contrastive Linguistics. *Foreign Languages in China*, 13(2), 83-89.
240. Quinlan, K. M., & Renninger, K. A. (2022). Thinking employability: how students build on interest in a subject to plan a career. *Higher Education*, 84(4), 863-883.
241. Raimes, A. (1985). What Unskilled ESL Students Do as They Write: A Classroom Study of Composing. *Teachers of English to Speakers of Other Languages*, 19(2), 229-258.

242. Ramalingam, S., Yunus, M. M., & Hashim, H. (2021). Exploring ESL Learners' Blended Learning Experiences and Its Effectiveness through Web-Based Technologies. *International Journal of Evaluation and Research in Education*, 10(4), 1436-1445.
243. Ramalingam, S., Yunus, M. M., & Hashim, H. (2022). Exploring English as a Second Language Educators' Challenges of Teaching Communication Skills in Blended Learning Environments: A Malaysian Scenario. *Journal of Positive School Psychology*, 6(2), 1388-1405.
244. Read, J. (2000). *Assessing Vocabulary*. Cambridge University Press.
245. Read, J. (2023). Towards a new sophistication in vocabulary assessment. *Language Testing*, 40(1), 40-46.
246. Ren, C. Y. (2011). A study on vocabulary testing of Controlled output in Chinese as a second language. *Journal of Language and Writing*, 80(4), 110-115.
247. Richards, J. C., & Schmidt, R. W. (2013). *Longman dictionary of language teaching and applied linguistics*. Routledge.
248. Rindaningsih, I., Stegosauri, P., Kuswandi, D., & Ulfa, S. (2021). Development of seamless learning to facilitate formal and informal learning in elementary education. *The New Educational Review*, 12(5). 52-62.
249. Roschelle, J., Shechtman, N., Tatar, D., Hegedus, S., Hopkins, B., Empson, S., Knudsen, J., & Gallagher, L. P. (2010). Integration of Technology, Curriculum, and Professional Development for Advancing Middle School Mathematics: Three Large-Scale Studies. *American Educational Research Journal*, 47(4), 833-878. <https://doi.org/10.3102/0002831210367426>
250. Rosik, P., Komornicki, T., Duma, P., & Goliszek, S. (2022). The effect of border closure on road potential accessibility in the regions of the EU-27. The case of the COVID-19 pandemic. *Transport policy*, 126, 188-198.
251. Saeed, M. A., & Al Qunayeer, H. S. (2022). Exploring teacher interactive e-feedback on students' writing through Google Docs: factors promoting interactivity and potential for learning. *The Language Learning Journal*, 50(3), 360-377.
252. Safiah, I., Degeng, I. N. S., Setyosari, P., & Ulfa, S. (2020). Design and Development of Seamless Learning to Improving Learning Outcome of Islamic Economic Course: A Case Study in Indonesia. *Journal of e-Learning and Knowledge Society*, 16(3), 60-67. <https://orcid.org/0000-0003-1090-6941>

253. Salkind, N. J. (2010). Content Validity. Sage Publications.
254. Saunders, L., & Wong, M. A. (2020). Learning theories: Understanding how people learn. Instruction in Libraries and Information Centers.
255. Saunders, M., Lewis, P., & Thornhill, A. (2012). Research Methods for Business Students. Pearson Education.
256. Scantlebury, A., Cockayne, S., Fairhurst, C., Rodgers, S., Torgerson, D., Hewitt, C., & Adamson, J. (2020). Qualitative research to inform hypothesis testing for fidelity-based sub-group analysis in clinical trials: lessons learnt from the process evaluation of a multifaceted podiatry intervention for falls prevention. *Trials*, 21(1), 1-10.
257. Scherer, R., Siddiq, F., & Tondeur, J. (2019). The technology acceptance model (TAM): A meta-analytic structural equation modeling approach to explaining teachers' adoption of digital technology in education. *Computers & Education*, 128, 13-35.
258. Schmitt, N. (2000). Vocabulary in language teaching. Cambridge University Press .
259. Schmitt, N. (2014). Researching Vocabulary: A Vocabulary Research Manual. Foreign Language Teaching and Research Press
260. Selinker, L. (1972). Interlanguage. *Product Information International Review of Applied Linguistics in Language Teaching*, 10, 209-241.
<http://dx.doi.org/10.1515/iral.1972.10.1-4.209>
261. Seroshtan, [REDACTED] (2017). Design and application of Visual AIDS in Chinese Teaching based on Instagram [Doctoral dissertation, East China Normal University]. China National Knowledge Infrastructure Database.
262. Shin, M. H. (2018). Effects of Project-Based Learning on Students' Motivation and Self-Efficacy. *English Teaching*, 73(1), 95-114.
263. Shin, S. (20 [REDACTED]). Error analysis: Lexical errors produced by Australian KFL learners. *KAREC Discussion Papers*, 3 (3), 1-25.
264. Siemens, G. (2005). Connectivism: A Learning Theory for the Digital Age. *International Journal of Instructional Technology and Distance Learning*, 2(2), 3-10.

265. Sikorski, M., & Andreoletti, M. (2023). Epistemic Functions of Replicability in Experimental Sciences: Defending the Orthodox View. *Found Sci*, 1-18.
<https://doi.org/10.1007/s10699-023-09901-4>
266. Sobaih, A. E. E., Hasanein, A. M. & Elnasr, A. E. A. (2020). Responses to COVID-19 in higher education: Social media usage for sustaining formal academic communication in developing countries. *Sustainability*, 12(16), 6520.
<https://doi.org/10.3390/su12166520>
267. Song, Y., & Hwang, G. J. (2020). What “seams” have been bridged in seamless vocabulary learning? A review of the literature. *Interactive Learning Environments*, 6, 1-17. <https://doi.org/10.1080/10494820.2020.1789667>
268. Spoelman, M., & Verspoor, M. (2010). Dynamic patterns in development of accuracy and complexity: A longitudinal case study in the acquisition of Finnish. *Applied Linguistics*, 31(4), 532-553. <https://doi.org/10.1093/applin/amq001>
269. Steils, N., & Hanine, S. (2022). Effective creative crowd sourcing: A multi-dimensional evaluation framework. *Creativity and Innovation Management*, 31(2), 223-235.
270. Sun, X. M. (2008). A study on the mechanism of second language learners crossing the threshold of productive vocabulary [Doctoral dissertation, Central China Normal University]. China National Knowledge Infrastructure Database.
271. Sun, Y. Q., Zhang, J. W., & Scardamalia, M. (2010). Knowledge building and vocabulary growth over two years, Grades 3 and 4. *Educational Theory and Practice Faculty Scholarship*. 10.
https://scholarsarchive.library.albany.edu/etap_fac_scholar/10
272. Suo, Y. J., Ibrahim, M., & Muhamad Saad, N. (2022). The Impact of Attitude Towards Mandarin as A Foreign Language Achievement. *Al-Azkiyaa Jurnal Antarabangsa Bahasa Dan Pendidikan*, 1(2), 115–122.
<https://doi.org/10.33102/alazkiyaa.v1i2.31>
273. Swain, M. (1985). Communicative Competence Role of Input and Output. *Scribd*.
274. Tai, T. Y., & Chen, H. H. J. (2020). The impact of Google Assistant on adolescent EFL learners’ willingness to communicate. *Interactive Learning Environments*, 1-18.

275. Tan C., Liu M. (2016) Using ICT in Teaching the Chinese Language: Practices and Reflections from Singapore. In: K. Soh (Eds.), Teaching Chinese Language in Singapore. Springer. https://doi.org/10.1007/978-981-10-0123-9_4
276. Tan, C. L., Puah, L. D., Teoh, H. S., & Patrick, T. K. (2014). Integrating iPad into the Teaching of Creative Writing: A School-Based Research. *Journal of Chinese Language Education*, 12(24), 67-84.
277. Tang, J. Y. (2019). Research on Chinese vocabulary learning through Pleco [Doctoral dissertation, Zhejiang University of Science and Technology]. China National Knowledge Infrastructure database.
278. Terrell, S. (2012). Mixed-methods research method  es. *The Qualitative Report*, 17(1), 254-280.
279. Thomas, G. (2017). *How to Do Your Research Project: A Guide for Students*. Sage Publications.
280. Tian, W. W. (2019). A Study on the Productive Vocabulary Development of Southeast Asian Senior Foreign Students. [Master dissertation, Guizhou University]. China National Knowledge Infrastructure Database.
281. Tomasello, M. (2003). Constructing a Language: A Usage-Based Theory of Language Acquisition. Cambridge, MA: Harvard University Press
282. Tongco, M. D. C. (2007). Purposive Sampling as a Tool for Informant Selection. *Ethnobotany Research & Applications*, 5, 147-158.
283. Treffers-Daller, J., Parslow, P., and Williams, S. (2018). Back to basics: how measures to lexical variation can help discriminate between CEFR levels. *Applied Linguistics Review*, 39(3), 302-327. <https://doi.org/10.1093/applin/amw009>
284. Tu, Y. Z. (2014). Research on the influence of QQ-based after-school online tutoring on students' learning interest [Doctoral dissertation, Jiangxi University of Finance and Economics]. China National Knowledge Infrastructure Database.
285. Turnbull, D., Chugh, R. & Luck, J. (2021). Transitioning to E-Learning during the COVID-19 pandemic: How have Higher Education Institutions responded to the challenge?. *Education and Information Technologies*, 26, 6401-6419. <https://doi.org/10.1007/s10639-021-10633-w>

286. Ubaedillah, U., & Pratiwi, D. I. (2021). Utilization of information technology during the COVID-19 pandemic: Student's perception of online lectures. *Edukatif: Jurnal Ilmu Pendidikan*, 3(2), 447-455.
287. Underwood, J., Luckin, R., & Winters, N. (2014). MALL in the wild: Learners' designs for scaffolding vocabulary learning trajectories. In S. Jager, L. Bradley, E. J. Meima, & S. Thounesny (Eds.), *CALL design: Principles and practice; Proceedings of the 2014 EUROCALL Conference*, Groningen, The Netherlands (pp. 1-7). Research-publishing.net.
288. Verhoeven, L., & Perfetti, C. A. (2011) Introduction to this Special Issue: Vocabulary Growth and Reading Skill. *Scientific Studies in Reading*, 15(1), 1-7. <http://dx.doi.org/10.1080/10888438.2011.536124>
289. Victor, L. F., & Ha, N. (2021). Design-based research approach for teacher learning: a case study from Singapore. *ELT Journal*. ccab035, <https://doi.org/10.1093/elt/ccab035>
290. Wang, F., & Hannafin, M. J. (2005). Design-based research and technology-enhanced learning environments. *Educational Technology Research and Development*, 53(4), 5-23.
291. Wang, H. B. (2020). A comparative study of Chinese text classification and difficulty measurement in International Chinese Education. *Journal of Yunnan Normal University (Teaching Chinese as a Foreign Language and Research)*, 7(6), 1-14.
292. Wang, H. H., & Zhou, X. (2012). A diachronic study on the changes of lexical richness in the writing of non-English majors. *Foreign Language Teaching and Research*, 2. 40-44.
293. Wang, M. T. (2018). A review of seamless learning research. *Adult Education*, 38(12), 7-9.
294. Wang, S. & Wang, H. Z. (2021). Research on the Chinese vocabulary growth. *Journal of Chinese information processing*, 35(1), 17-24.
295. Wang, Y. X. (2017). Methods in Lexical Richness: An Overview. *Overseas Chinese Education*, 12(3), 1643-1652.
296. Wang, Y., & Sun, Y. (2016). The effect of peer feedback on writing performance of Chinese as a foreign language learners. *Foreign Language Annals*, 49(4), 638-652.

297. Wang, Y., Jiang, S., Wu, C., Cai, X., & Wang, F. (2022). Impact of the Global Megatrends, COVID-19, and Digital Economy on Professional Career Management Transformation in Asian Countries. *Sustainability*, 14(17), 10981.
298. Wang, Z. L. (2021). New Constructivism: Learning Theory in the Network Era. *China Distance Education*, 11(2), 11-18.
299. Wei, L. (2012). Construction of seamless English Language learning cyberspace via interactive text messaging tool. *Theory and Practice in Language Studies*, 2(8), 1590-1596.
300. Wei, W., & Chen, Y. R. (2021). Construction of Innovative Training Model for International Students in China under the Background of the Belt and Road Initiative. *Education Teaching Forum*, 12(3), 41-44.
301. Wei, X. P., (2008). Implication of IL Fossilization in Second Language Acquisition. *English Language Teaching*, 1(1). 127-131.
<https://10.5539/elt.v1n1p127>
302. Weinhandl, R., Lavicza, Z., & Schallert, S. (2020). Towards flipped learning in upper secondary mathematics education. *Journal of Mathematics Education*, 5(1), 1-15. <http://doi.org/10.31327/jme.v5i1.1114>
303. Wen, Y. (2021). Augmented reality enhanced cognitive engagement: Designing classroom-based collaborative learning activities for young language learners. *Educational Technology Research and Development*, 69(2), 843-860.
304. Wichadee, S. (2013). Peer feedback on Facebook: The use of social networking websites to develop writing ability of undergraduate students. *Turkish Online Journal of Distance Education*, 14(4), 260-270.
305. Wilcox, P. (2022). Laos in 2021:(Im) Mobility with Infrastructure and COVID -19. *Southeast Asian Affairs*, 2(1), 177-191.
306. Wong, E. Y. (2015). A Case Study of the Vocabulary Learning Strategy Use of Twenty Chinese ESL Learners in Australia [Doctoral dissertation, Griffith University]. Retrieved from <http://hdl.handle.net/10072/367486>
307. Wong, L. H. & Looi, C. K. (2019). Tracing the Decade Long Trajectory of Implementation Research in Mobile- and Social Media-Assisted Seamless Learning in Singapore. In *Proceedings of World Conference on Mobile and Contextual Learning 2019*, 141-148.
308. Wong, L. H., & Looi, C. K. (2010a). Vocabulary learning by mobile-assisted authentic content creation and social meaning-making: two case studies.

Journal of Computer Assisted Learning, 26(5), 421-433.

<https://doi.org/10.1111/j.1365-2729.2010.00357.x>

309. Wong, L. H., & Looi, C. K. (2010b, April 12-16). Mobile-assisted vocabulary learning in real-life setting for primary school students: two case studies.

Proceedings of the 6th IEEE International Conference on Wireless, Mobile, and Ubiquitous Technologies in Education, Taiwan.

<https://doi.org/10.1109/WMUTE.2010.26>

310. Wong, L. H., & Looi, C. K. (2011). What seams do we remove in mobile-assisted seamless learning: A critical review of the literature. Computers and Education, 57(4), 2364-2381.

<https://doi.org/10.1016/j.compedu.2011.06.007>

311. Wong, L. H., (2013). Analysis of students' after-school mobile-assisted artifact creation processes in a seamless language learning environment.

Educational Technology & Society, 16(2), 198-211.

312. Wong, L. H., Aw, G. P., Chai, C. S., & Liu, M. (2012). MyCLOUD: A seamless language learning environment for vocabulary learning and formal-informal cycles of writing activities. In B. S. Chang, C. Tan, T. Matsui, G. Biswas, L. H. Wong, T. Hirashima & W. Chen (Eds.), Proceedings of the 20th International Conference on Computers in Education (pp. 336-343). Asia-Pacific Society for Computers in Education.

313. Wong, L. H., Chai, C. S., Aw, G. P., & King, R. B., (2015). Enculturating seamless language learning through artifact creation and social interaction process. Interactive Learning Environments, 23 (2), 130-157.

<https://doi.org/10.1080/10494820.2015.1016534>

314. Wong, L. H., Chin, C. K., Tan, C. L., & Liu, M. (2010). "Students' personal and social meaning making in a Chinese idiom mobile learning environment".

Journal of Educational Technology & Society, 13(4), 15-26.

315. Wong, L. H., King, R. B., Chai, C. S., & Liu, M. (2016). Seamlessly learning Chinese: Contextual meaning making and vocabulary growth in a seamless Chinese as a second language learning environment. Instructional Science, 44

(5), 399-422. <https://doi.org/10.1007/s11251-016-9383-z>

316. Wong, L. H., Looi, C. K., & Aw, G. P. (2021). Does Seamless Learning Translate Seamlessly?: A Decade of Experiences in Adapting Seamless Learning Designs for Various Subjects, Levels and Technological

Settings. Scaling up ICT-based Innovations in Schools: The Singapore Experience, 269-289.

317. Wong, L. H., Milrad, M., & Specht, M. (2015). *Seamless Learning in the Age of Mobile Connectivity*. Springer.
318. Wong, L. H., Sing, C. C., & Aw, G. (2017). Seamless language learning: Second language learning with social media. *Comunicar. Media Education Research Journal*, 25(1). 10-20. <https://doi.org/10.3916/C50-2017-01>
319. Wong, L. H., Teo, C. L., Ogata, H., Song, Y., Wu, L., & Yu, F. Y. (2021). Leveraging Student-Generated Ideas (SGI) to facilitate socio-constructivist learning and conceptual change: The roles of technology in SGI learning trajectories. In M. Mercedes, T. Rodrigo, S. Iyer, & A. Mitrovic. (Eds.), *Proceedings of the 29th International Conference on Computers in Education* (pp. 777-782). Asia Pacific Society for Computers in Education (APSCE).
320. Wong, L., Chen, W., & Jan, M. (2012). How artifacts mediate small-group co-creation activities in a mobile-assisted seamless language learning environment. *Journal of Computer Assisted Learning*, 28(5), 411-498. <https://doi.org/10.1111/j.1365-2729.2011.00445.x>
321. Woods, K., Hashimoto, B., & Brown, E. K. (2023). A multi-measure approach for lexical diversity in writing assessments: Considerations in measurement and timing. *Assessing Writing*, 55, 100688.
322. Wu, J. F. (2016). A study on the development of lexical richness in English native speakers' Chinese writing. *World Chinese Teaching*, 30(1), 129-142.
323. Wu, J. F., & Hu, R. F. (2021). Effect of Task Complexity on the Argumentative Writing of CSL Learners. *Chinese Language Learning*, 4(3), 75-83.
324. Wu, J. P., & Zhao, X. N. (2021). Design of learning achievement system based on electronic learning file in seamless learning environment. *The Science Education Article Collects*, 20(3), 60-62.
325. Wu, S. N., Xu, H. D., & Li Y. L. (2019). A Study on the Characteristics of Chinese Writing Vocabulary complexity of Thai Students. *Overseas Chinese Education*, 7(1), 34-36.
326. Xiao, J., Liang, X. D., Huang, L. X., & Pan, Z. M. (2021). Focus and trends in seamless learning. *Distance Education in China*, 10(2), 66-75.
327. Xiao, L. (2018). The effect of task type on writing vocabulary richness of intermediate and advanced Chinese second language learners. *Language Teaching and Research*, 194(6), 40-51.

328. Xu, W. (2023). An Improved Computational Solution for Cloud-Enabled E-Learning Platforms Using a Deep Learning Technique. *International Journal of e-Collaboration (IJeC)*, 19(1), 1-19
329. Xu, X. Y. (2017). A Study on the Development of Productive Vocabulary of the International Students in China of Chinese Majors: A Study-based on Argumentative Chinese Writing [Doctoral dissertation, Central China Normal University]. China National Knowledge Infrastructure Database.
330. Yael, K., Keren, S. L., Rachel, L. P., & Tali, T. (2018). Supporting outdoor inquiry learning (soil): teachers as designers of mobile-assisted seamless learning. *British Journal of Educational Technology*, 49(6), 1145-1161. <https://doi.org/10.1111/bjet.12698>
331. Yan, S. (2021). Exploration of English group learning approach on DingTalk broadcast. *Journal of Zhejiang University of Science and Technology*, 33(2), 169-173.
332. Yang, L. (2013). Corpus-based study of lexical features of English essay written by Chinese college students. *Journal of Chengdu University of Technology*, 21(6). 98-103.
333. Yang, N. C. (2008). A history of DBR and a review on its research development. *Moden Educational Technology*, 18(5), 12-18.
334. Yang, Y. (2023). Research on Grammar Teaching in Senior High School Classes from the Perspective of Constructivism: A Case Study of Nanning No. 15 Middle School. *International Journal of Education and Humanities*, 6(1), 115-120.
335. Yao, Q. F., Zhu, Z., and Ma, H. L. (2021). Teaching Practice and Innovation Based on Situational Learning Theory in the Network Environment. *China Higher Education Research*, 14(2), 107-110.
336. Yılmaz, R. (2020). Enhancing community of inquiry and reflective thinking skills of undergraduates through using learning analytics-based process feedback. *Journal of Computer Assisted Learning*, 36(6), 909-921.
337. Yin, H. B. (2022). Empowering Student Learning in Higher Education: Pathways to Possibility. *ECNU Review of Education*, 5(1), 3-8. <https://doi.org/10.1177/20965311211073971>
338. Yin, R. (2006). *Case Study Research: Design and Methods*. Sage Publications.

339. Yu, C. B. (2017). Design of Personalized Learning Environment (PLE) Based on Group Function of QQ Journal of Beijing University of Posts and Telecommunications (Social Sciences Edition), 19(1), 1-7.
340. Yu, T. (2019). A Research on Chinese vocabulary learning apps based on IOS [Master's Thesis, Suzhou University]. China National Knowledge Infrastructure Database.
341. Yu, Z., Xu, W., & Sukjairungwattana, P. (2022). Examining Student Behavioral Intention of Superstar Learning System by Extending Its Technology Acceptance Model. International Journal of Web-Based Learning and Teaching Technologies (IJWLTT), 17(1), 1-16. <http://doi.org/10.4018/IJWLTT.305804>
342. Zafitsara, J., & Velo, N. M. A. (2022). Impact of the COVID-19 pandemic on the 2020–2021 academic year at Fianarantsoa University: the use of Facebook as a mode to switch to online learning. Research in Learning Technology, 30. <https://doi.org/10.25304/rlt.v30.2673>
343. Zaritsky, R., Kelly, A. E., Flowers, W., Ross, E., & O' Neill, P. (2003). A view from sister design efforts. Educational Researcher, 32(1), 32-34.
344. Zeng, C. (2022). A comparative study of the market demand for Chinese proficiency test preparation books: evidence from e-commerce data. Electronic Commerce Research, 1-24.
345. Zhang, F. (2021). Research on the Application of Online Teaching on the Platforms of “Ding Talk”, “Super Star” and “QQ” -- A Case Study of the Major of Teaching Chinese as a Foreign Language in Hebei Normal University [Doctoral dissertation, Hebei Normal University]. China National Knowledge Infrastructure Database.
346. Zhang, H. (2021). Lexical richness development in Chinese second language writing: empirical research based on Cambodian Chinese learners. Chinese as a Second Language Research, 10(2), 183-206. <https://doi.org/10.1515/caslar-2021-2002>
347. Zhang, H., Chen, M., & Li, X. (2021). Developmental Features of Lexical Richness in English Writings by Chinese Beginner Learners. Frontiers in Psychology, 24(12), 3-8. <https://doi.org/10.3389/fpsyg.2021.752950>
348. Zhang, J. J. (2019). On the developmental features of lexical richness in Chinese in Chinese writing by students from Southeast Asian countries. Journal of Yunnan Normal University, 17(1), 34-44.

349. Zhang, J. L. (2019). A study on the variation of learners' written vocabulary diversity for Chinese second language teaching. *Journal of Yunnan Normal University (Teaching and Research of Chinese as a Foreign Language)*, 99(4), 57-63.
350. Zhang, J., & Daller, M. (2020). Lexical richness of Chinese candidates in the graded oral English examinations. *Applied Linguistics Review*, 11(3), 511-533. <https://doi.org/10.1515/applirev-2018-0004>
351. Zhang, M. J. (2022). A Study on Lexical Richness in the Second Language Writing of Malaysia Learner. [Master dissertation, Beijing Foreign Studies University]. China National Knowledge Infrastructure Database.
352. Zhang, Q. B., & Cao, W. H. (2021). Research on the application practice of creating efficient online classroom based on "DingTalk group live Broadcast". *Education information in China*, 12(6), 5-9.
353. Zhang, S. L. (2021). Research on the Mutual Aid Teaching Mode of "Online Teaching Platforms and Social Platforms". *Journal of HUBEI Open Vocational College*, 34(16), 136-137.
354. Zhang, Y., & Yang, L. (2019). The effects of teacher and peer feedback on Chinese learners' writing skills. *Journal of Language Teaching and Research*, 10(3), 463-471.
355. Zhao, D. (2020). Analysis and Teaching Research on Chinese writing Errors of International students in China. *Journal of Higher Education*, 17(9), 5-8.
356. Zhao, F. M. (2021). Analysis of online teaching interaction between primary school teachers and students based on DingTalk platform. *Chinese Academic Journal Electronic Publishing House*, 16(5), 66-70.
357. Zhao, H. F. (2019). On the Use of QQ and WeChat in College English Teaching. *Journal of Beijing Institute of Graphic Communication*, 27(3), 71-75.
358. Zheng, Y. P. (2010). On Some New Models of Instruction for Overcoming Fossilization in English Learning. *Journal of Language Teaching and Research*, 1(2), 148-150.
359. Zheng, Y. Y. (2018). The multidimensional development of advanced learners' linguistic complexity. *Frontiers in Psychology*. 50, 218-229.
360. Zhou, W. (2020). Mobile Assisted Chinese Learning as a Foreign Language: An Overview of Publications between 2007 and 2019. *Frontiers in Psychology*, 15, 164-181. <https://doi.org/10.1007/s11516-020-0007-7>

361. Zhou, X., Low, H. L., & Goh, Y. S. (2022, June). Student Vocabulary Advancement in a Seamless Chinese Vocabulary Learning Environment. In 2022 IEEE 2nd International Conference on Educational Technology (ICET) (pp. 21-25). IEEE.

362. Zhu, H. M., & Wang, J. J. (2013). Developmental features of lexical richness in English writing: a self-built corpus-based longitudinal study. *Frontiers in Psychology*, 159, 77-86.

363. Zuckoff, M. W., Real, F. J., Klein, M. D., Abramson, E. L., Li, S.-T. T., & Gusella, M. E. (2019). Enhancing Educational Scholarship Through Conceptual Frameworks: A Challenge and Roadmap for Medical Educators. *Academic Pediatrics*, 19(2), 135-141. <https://doi-org.proxy1.ncu.edu/10.1016/j.acap.2018.08.003>

364. Zohrabi, M. (2013). Mixed Method Research: Instruments, Validity, Reliability and Reporting Findings. *Theory and Practice in Language Studies*, 3(2), 254-262. <http://dx.doi.org/10.4304/tpls.3.2.254-262>

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APPENDICE

APPENDIX A

Research Questionnaire

Dear participants,

The following questionnaire is a part of my research project that aims to investigate learners' perceptions towards the seamless Chinese vocabulary learning using social media platform - DingTalk. Your cooperation is highly appreciated.

Researcher: Xiaosheng Zhou

Contact number: 8

1. Background Information

Name and family name: (optional) _____

Age: _____ year old

Nationality: _____

How long have you been learning Chinese language before you came to China?

_____ year (s) _____ month (s)

How long have you been learning Chinese language after you came to China?

_____ year (s) _____ month (s)

HSK Level 3 scores: _____

2. Chinese learning Condition

1. What motivates you to learn Chinese language? (You may choose more than one)

- A. Be interested in Chinese culture.
- B. To find a good job.
- C. To do business with Mandarin speakers.
- D. To secure a better life in the future.
- E. Having a special interest in language studies.
- F. Nothing. My parents wanted me to study.
- G. Social needs.
- H. Due to the increasing importance of the Chinese language.
- I. Others (please state) _ _ _ _ .

2. What is your career plan after graduation?

- A. Be an interpreter.
- B. Be a Chinese language teacher.
- C. Do business in China.

- D. Back to home country to do business but getting product supply from China.
- D. Continue to do Master degree.
- E. Others (Please state) _ _ _ _ .

3. Apart from in class formal learning, how many hours do you spend on Chinese informal learning a day?

- A. less than half an hour.
- B. half an hour - two hours.
- C. an hour - two hours.
- D. two hours - three hours.
- E. Others (Please state) _ _ _ _ .

4. Please comment on “teacher-centric” Chinese classes. (You may choose more than one)

- A. I think it is good because teacher will guide me on everything related to Chinese learning.
- B. I think it is less effective as students will become passive listeners.
- C. I think it reduces the chances for me to do self-determined learning.
- D. I think it reduces the chances for me to apply what I have learned to my real life.
- E. Others (Please state) _ _ _ _ .

5. To what extent you prefer a “teacher-centric” Chinese class?

- A. No preference.
- B. Slightly prefer.
- C. Prefer.
- D. Strongly prefer.
- E. Very strongly prefer.

6. What kind of Chinese class are you looking forward to?

- A. A class with no learning activities (fully “teacher-centric” class).
- B. A class with simple learning activities such as playing language games, doing role play, etc.
- C. A class with reasonable learning activities to meet the learning requirements, such as vocabulary games, group interaction, oral presentation, etc.
- D. A class with learning activities throughout the lesson.
- E. Others (Please state) _ _ _ _ .

7. Which Chinese learning style do you prefer (You may choose more than one)

- A. Just listen to teacher's lecture.

- B. Learn from teacher's PPT.
- C. Read Chinese textbook.
- D. Watch video.
- E. Discuss with teachers and classmates.
- F. Use online platform to study by myself.
- G. Use mobile device and social media platform to learn.
- H. Others (Please state) _ _ _ _ .

3. Your aim for Chinese vocabulary learning

1. What methods does the teacher use in the formal classroom to teach new vocabulary? (You may choose more than one)
 - A. Synonyms.
 - B. Scenarios.
 - C. Audio-visual.
 - D. Definitions.
 - E. English translations.
 - F. Others (Please state) _ _ _ _ .

2. What aspects of the Chinese vocabulary knowledge do you want to improve? (You may choose more than one)
 - A. To reduce the errors of vocabulary usage.
 - B. To identify the features of vocabulary (semantic, collocation, etc.)
 - C. To integrate the previous and new vocabulary.
 - D. To increase the number of vocabulary or phrases.
 - E. Others (Please state) _ _ _ _ .

3. What are your vocabulary learning goals? (you may choose more than one)
 - A. Be able to use accurate vocabulary to write correct Chinese sentences.
 - B. Be able to use vocabulary accurately to write a good paragraph in Chinese.
 - C. Be able to correctly describe different scenes with appropriate vocabulary.
 - D. Be able to pass the HSK, BCT, MCT test, etc.
 - E. Be able to read Chinese books and articles.
 - F. Be able to understand and know Chinese film and TV works.
 - G. Others (Please state) _ _ _ _ .

4. What do you think of utilising mobile device and social media platform to enhance Chinese vocabulary learning? (you may choose more than one)

- A. I think they can help me learn Chinese vocabulary at anytime and anywhere.
- B. I think they can assist me in learning Chinese vocabulary outside of the classroom.
- C. I think they can help me seamlessly switch between the formal classroom and the informal one to learn Chinese vocabulary.
- D. I think they can help me do self-determined Chinese vocabulary learning.
- E. Others (Please state) _ _ _ _.

5. Through the use of mobile devices and social media platforms, learning Chinese vocabulary is easier than ever. What would you like to achieve most?

- A. To know the basic meaning of the vocabulary
- B. To identify specific meanings of vocabulary in different contexts.
- C. To use vocabulary flexibly in spoken and written Chinese.
- D. Others (Please state) _ _ _ _.

4. Your perceptions on Chinese vocabulary learning

(Kindly give your sincere response based on the following indicators, scored on five-point Likert Scale [1 as strongly disagree and 5 as strongly agree])

1 = Strongly disagree; 2 = Disagree; 3 = Somewhat agree; 4 = Agree; 5 = Strongly agree

Items	1 as Strongly disagree and 5 as Strongly agree				
1. It is important for me to master Chinese vocabulary for my Chinese course.	1	2	3	4	5
2. It is important for me to master written Chinese.	1	2	3	4	5
3. I believe I can do well in vocabulary learning in Chinese class.	1	2	3	4	5
4. I like the traditional methods of teacher-centric Chinese vocabulary learning in university.	1	2	3	4	5
5. I like the informal Chinese vocabulary learning in real and authentic situations.	1	2	3	4	5
6. I am interested in Chinese vocabulary learning outside of the classroom (at home, on campus, and other places, etc.).	1	2	3	4	5
7. I am happy to share content in Chinese about my daily life on	1	2	3	4	5

social media platform.					
8. I am interested in posting Chinese content on social media platform with vocabulary that I have learned in formal classroom.	1	2	3	4	5
9. Apart from in-class formal learning, I like to learn Chinese vocabulary whenever and wherever I am curious.	1	2	3	4	5
10. I am happy with the help of mobile devices and social media platforms to improve my informal Chinese vocabulary learning.	1	2	3	4	5

A. Seamless Chinese HSK level 4 vocabulary learning

Items	1 as Strongly disagree and 5 as Strongly agree				
1. I am comfortable with Chinese HSK Level 4 vocabulary learning through my mobile device outside of the classroom (at home, on campus, and other places, etc.).	1	2	3	4	5
2. I am able to learn Chinese HSK Level 4 vocabulary whenever I am curious to learn.	1	2	3	4	5
3. I am able to learn Chinese HSK Level 4 vocabulary from in class formal learning to out-of-class informal learning through the use of mobile devices and social media platforms.	1	2	3	4	5
4. Informal learning guided by teaching instructor in seamless Chinese HSK Level 4 vocabulary learning can support my formal classroom learning.	1	2	3	4	5
5. Guided informal learning under seamless Chinese HSK Level 4 vocabulary learning after class hours is important to improve the mastery of Chinese vocabulary.	1	2	3	4	5
6. It is interesting to learn Chinese HSK Level 4 vocabulary under seamless learning after class hours.	1	2	3	4	5
7. It is meaningful to connect my in-class learning to my out-of-class learning of Chinese HSK Level 4 vocabulary.	1	2	3	4	5

8. Guided seamless learning gives me confidence and motivation in learning Chinese vocabulary.	1	2	3	4	5
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B. Perception towards SCVL platform (DingTalk)

Items	1 as Strongly disagree and 5 as Strongly agree				
1. DingTalk learning platform is user friendly for posting Chinese artifacts comprised of sentences made using target vocabulary.	1	2	3	4	5
2. I don't find any problem in using DingTalk to post Chinese artifacts comprised of sentences made using target vocabulary.	1	2	3	4	5
3. I am able to take 2-3 photos of target vocabulary by myself to make sentences, paragraphs, or stories in my real-life contexts using mobile devices to illustrate the artifacts' meanings.	1	2	3	4	5
4. I am able to seamlessly and rapidly switch between different situations to make Chinese sentences or paragraphs, like from classroom to campus, from campus to supermarket, etc.	1	2	3	4	5
5. According to the situations given by instructors, I am able to use the target vocabulary to make paragraphs that best represent the situations on the DingTalk platform.	1	2	3	4	5
6. By posting Chinese artifacts comprised of sentences made using target vocabulary at anytime and anywhere on DingTalk platform, I am able to improve my Chinese faster as compared to before I joined seamless learning.	1	2	3	4	5
7. I am happy to post Chinese artifacts comprised of sentences made using target vocabulary on the DingTalk platform.	1	2	3	4	5
8. I am able to comment on artifacts created by other students on the DingTalk platform.	1	2	3	4	5
9. I enjoy giving comments on other students' posts on the DingTalk platform.	1	2	3	4	5

10. I am able to learn more vocabulary in the process of commenting and discussing with classmates on the DingTalk platform.	1	2	3	4	5
11. I enjoy about the comments and 'likes' given by teachers and students.	1	2	3	4	5
12. I enjoy about the informal Chinese vocabulary learning on DingTalk platform.	1	2	3	4	5

C. Chinese vocabulary growth and lexical richness

Items	1 as Strongly disagree and 5 as Strongly agree				
1. Through seamless Chinese vocabulary learning, I have mastered more vocabulary than usual.	1	2	3	4	5
2. Through seamless Chinese vocabulary learning, I am able to write sentences longer than before I joined seamless learning.	1	2	3	4	5
3. Through seamless Chinese vocabulary learning, I am able to joint together short paragraphs using target vocabulary to present a situation provided by instructors.	1	2	3	4	5
4. Through seamless Chinese vocabulary learning, I am able to find materials in real life and make Chinese artifacts comprised of sentences made using target vocabulary.	1	2	3	4	5
5. Through seamless Chinese vocabulary learning, I am able to observe, imagine and create situations in life, and describe the situations with learned vocabulary.	1	2	3	4	5
6. Through seamless Chinese vocabulary learning, I am able to blend in my real life to make Chinese artifacts comprised of sentences made using target vocabulary.	1	2	3	4	5
7. Through seamless Chinese vocabulary learning, I am able to learn new vocabulary by reading classmates' posts and comments.	1	2	3	4	5
8. Through seamless Chinese vocabulary learning, I have noticed	1	2	3	4	5

that the use of HSK level 4 vocabulary is increasing for myself in the formal and informal learning.					
9. Through seamless Chinese vocabulary learning, I have made fewer vocabulary mistakes (collocation errors, syntactic errors, meaning errors and Chinese characters errors.) in the formal and informal learning.	1	2	3	4	5
10. Through seamless Chinese vocabulary learning, I am able to help classmates correct and revise their Chinese artifacts comprised of sentences made using target vocabulary.	1	2	3	4	5

*Please comment on your progress/ performance in learning Mandarin before you start any seamless learning. _____

*Other comments (Please state)____

Thank you very much for your cooperation!

APPENDIX B

Interview Protocol

I-Open Interview

A: Hi , are you ready now?

B:

A: This is the second online interview that takes between 30-60 minutes during which you have the right to withdraw at any time (e.g. if you feel tired).

B:

A: Any information you exchange with me is extremely confidential and will never be used for any purposes other than research.

B:

A: First of all, thank you for participating in our 16-week (four-stage) study of seamless Chinese vocabulary learning. Since the study is over, how was your experience with seamless Chinese vocabulary learning?

B:

A: Do you understand what seamless learning is?

B:

A: (Excellent!) Apart from in-class formal learning, can you recall instances when you frequently used Chinese vocabulary to learn and practice Chinese outside of the classroom (at home, on campus, and other places, etc.)

B:

A: That's great! In the seamless learning environment of this study, what tools did you use to connect the knowledge of Chinese you gained in the classroom with your daily life?

B:

A: Well, seamless Chinese vocabulary learning refers to the seamless integration of learning experiences across various seamless integration of learning experiences, including in-and out-of-school contexts, individual and social learning, the physical world and cyberspace, etc.

In a seamless context, students can link and relate what they have learned in a formal learning setting to their daily lives by using portable digital devices and DingTalk as a seamless learning platform, enabling one to learn in different contexts to achieve continuous learning and self-determined learning. Does it make sense now?

B:

A: Well. I think you have noticed that learning was conducted in four-week phases, and that all students were an intact group of one class. What can you comment on this seamless Chinese learning class of 32 people?

B:

A: Due to the university's COVID-19 pandemic containment policy, we have to conduct online learning for 16 weeks. What do you think of the weekly (four-week period) seamless learning environment? Were there any changes to the Chinese class at each phase? Did you take your classes in the dormitory or somewhere else?

B:

A: Did you understand the seamless learning activities that the instructor created for the weekly (four-week period) learning content? For example, did you find an appropriate scene to use the target vocabulary provided by instructor?

B:

A: I found that most students (including you) did not post many artifacts in the first phase. What was the reason?

B:

A: In the second phase of seamless learning, the instructor no longer provided you with pictures or scenes or situations, but let you discover, take pictures, and create artifacts by yourself. What do you think of this mode of learning?

B:

A: Well, with each subsequent phase, I observed that you posted more and more artifacts. What prompted you to post so many artifacts? What do you think of the seamless learning design in each phase? Please describe it in detail (e.g. learning environment, teaching content, learning activities, etc.)

B:

A: In the third phase, the instructor found that you were gradually becoming familiar with seamless learning routines and starting to study independently. I am very pleased but I noticed that the interaction and comments between you and other students decreased. Do you know what happened? Why didn't you comment a lot?

B:

A: In the last phase, we only held one class a week. Apart from your university coursework (for example, some students have to prepare a graduation thesis, etc.), do you know of any other reasons that may have led to the adjustment of the study model in the last phase?

B:

A: What do you think of the last adjustment (once class per week)? What impact did it have on your seamless learning activities and Chinese vocabulary learning? What can you comment this adjustment? Was it acceptable?

B:

A: OK, you are great, thank you for answering these questions.

Then again:

A: How has your Chinese learning been recently? Are there many classes at the university?

B:

A: How many sessions do you attend per week? What classes are you taking this semester?

B:

A: Which subject do you think you are better at (Comprehensive Chinese, Speaking Chinese, Listening Comprehension, Reading Chinese etc.)? What is the reason behind this?

B:

A: Which subject do you think you are worse at? What is the reason behind this?

B:

A: Is your university still conducting online classes?

B:

A: What platform is being used? How do you feel about it?

B:

A: Do you usually use a computer, a mobile phone, or other devices for online classes?

B:

A: What methods do Chinese teachers in your university mainly use to teach Chinese?

B:

A: How do you feel about them? Please comment on it.

B:

A: How and where do you usually learn and practice Chinese after class?
 B:
 A: Do you study alone or with whom (mostly individual or group study)?
 B:
 A: How long do you study Chinese after class every day?
 B:
 A: Where do you usually conduct study?
 B:
 A: How do you learn Chinese? (Mobile phone, Ipad, PC, etc.)
 B:
 A: Do you still use Chinese in the content you post on social media platforms to share about your daily life? (Which platform do you use? How do you feel about it?)
 B:
 A: (Very good, I observe that you continue to share your daily life on DingTalk. Although our study is over, I didn't expect you to continue learning seamlessly. You are amazing!)
 B:

II Semi-structured interview

1. Please introduce yourself in 2-3 minutes!
 (name, nationality, time spent learning Chinese, purpose of learning Chinese, hobbies, family members, etc.)
2. What kind of person do you think you are?
3. What motivated you to learn Chinese (you might not know Chinese before)? When did you first come into contact with Chinese? Where? Do you have any stories related to Chinese language or China?
4. What are the motivations for learning Chinese? (Please explain in detail.)
5. Which of these motivations is the most fundamental one? (The most fundamental motivation for you to learn Chinese)
6. What is your career plan after graduation? (Is it related to Chinese? Where do you plan to work and what kind of work do you plan to engage in?)
7. What methods do you often use to learn Chinese? (Please explain them in detail.) What Chinese learning software do you use? (Please explain them in detail.)
8. When you come across new vocabulary, how do you deal with it and master it? How do

you use and practice new vocabulary in everyday situations?

9. Do you understand this word (s)? Can you use this word (s) in your daily life? In what situations can it (they) be used?

10. What do you think about DingTalk learning platform in posting artifacts? Please let me know how you use it (click--post--modify--delete and other buttons to post successfully)? How do you feel about it?

11. Do you find any problem in using DingTalk to post Chinese artifacts?

12. How many sentence artifacts can you create by yourself in one week? When and where do you prefer to post them on the DingTalk platform?(dorms, supermarkets, etc.)

13. Do you prefer to collaborate with your roommate or friends in making artifacts, or do you prefer to do it individually?

14. I observed that you have posted a lot of (less) works, why do you post so many (less) works? In what contexts (dormitory, supermarket, etc.) do you generally post more artifacts?

15. Can you comment on other students' artifacts? Do you like them?

16. Do you enjoy about the comments and 'likes' you receive from teachers and students?

17. How do you feel about comments made by students or teachers about your artifacts? Did you learn anything from the comments and reviews? Do you get upset if you encounter bad comments or reviews? How do you deal with it?

18. How do you feel about the messages or announcements you received from the DingTalk HSK level 4 learning group? Did these messages or announcements bother you? If yes, how did you deal with it?

19.Can you share the creation process of several artifacts? How did you come up with this work(s)? In what context do you use it? Please elaborate.

20. Overall, do you have any comments on our 16-week (four-stage) study of seamless Chinese vocabulary learning?

21. Overall, what are your comments and suggestions for our 16-week (four-stage) formal Chinese classroom study?

22. Overall, what are your comments and suggestions for the HSK level 4 learning circle of our 16-week (four-stage) DingTalk seamless learning platform?

23. Overall, what are your comments and suggestions for our 16-week (four-stage) Chinese language teaching?

24. Overall, what are your comments and suggestions for the design of our 16-week (four-

stage) seamless Chinese vocabulary learning environment? (For example, whether the design of Chinese classroom and seamless learning activities is reasonable, etc.)

25. What do you think of our Chinese class structure of one hour of formal learning and half an hour of informal learning (2:1) per class? Do you have any suggestions and comments on this?

26. Do you think there is any problem with topics posted by the instructor and your paragraph writing every two weeks? Did you feel nervous or stressed? How long did it usually take you to create a paragraph (150-200 Chinese characters)?

27. What do you think about our one-hour-limited essay writing (300 Chinese characters) every four weeks? Is the allocated time enough? Were you stressed or nervous?

28. How has the 16-week (four-stage) seamless Chinese vocabulary learning improved your Chinese learning? Also, describe the changes in your learning in each phase?

(Note, Chinese skills such as reading, writing, vocabulary, etc.; Chinese learning interest? motivation, etc.)

APPENDIX C

Interview Schedule with Learners

The interview will be done individually. Please write a date and a time you are free to be interviewed (Recommended every Friday, Saturday and Sunday). Every interview might take around 10-30 minutes per person.

DBR STAGE 1 DATE: March- April 2022 (Week 1-4) TIME: 9.30am-9.30pm

Name	Week/ Day	Available Time	Expected Platform
L1			
L2			
L3			
L4			
L5			
L6			
L7			
L8			
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L29			
L30			
L31			
L32			

Interview questions:

Q1. Can you please talk about your challenges encountered of learning Chinese up till now?

Q2. Is this the first time you post Chinese in the learning circle? how do you feel?

Q3. What do you think are the challenges you have encountered in your seamless learning process at this stage?

Q4. Can you please talk about your experience of learning Chinese during the first stage?

Q5. How do you find the time-limited (one hour) essay writing in the last class?

DBR STAGE 2 DATE: April- May 2022 (Week 5-8) TIME: 9.30am-9.30pm

Interview questions:

Q1. How do you think our seamless Chinese vocabulary learning? (e.g., the learning environment, seamless learning activities)

Q2. What's your experience when you are doing the seamless learning activities during this stage?

Q3. How do you feel about comments made by students or teachers about your artifacts?

Q4. Can please talk about your challenges encountered of learning Chinese during the second stage?

Q5. Do you have any comments on the 'Comparing one word with many sentences' activity?

DBR STAGE 3 DATE: May- June 2022 (Week 9-12) TIME: 9.30am-9.30pm

Interview questions:

Q1. What's your experience when you are doing the seamless learning activities during this stage?

Q3. Are you interested in posting Chinese content on DingTalk platform with vocabulary that you have learned in formal classroom?

Q4. How do you feel about comments made by students or teachers about your artifacts?

Q5. Do you think there is any problem with topics posted by the instructor and your paragraph writing every two weeks? Did you feel nervous or stressed?

DBR STAGE 4 DATE: June- July 2022 (Week 13-16) TIME: 9.30am-9.30pm

Interview questions:

Q1. Can you please talk about your experience of learning Chinese in last stage?

Q2. What do you think of the last adjustment (once class per week)? What impact did it have on your seamless learning activities and Chinese vocabulary learning? What can you comment this adjustment? Was it acceptable?

Q3. How has the 16-week (four-phase) seamless Chinese vocabulary learning improved your Chinese learning?

Q4. Have you achieved your initial vocabulary learning goals after participating the seamless learning research?

APPENDIX D

Target HSK Level 4 Vocabulary

Week1
不仅, 开玩笑、最好、共同、幸福、生活、浪漫、缺点、接受、羡慕、爱情、深、性格、幽默、从来
Week2
聚会、互相、逛、短信、联系、平时、讨厌、差不多、麻烦、正好、尽管、真正、困难、无聊、丰富
Week3
约会、印象、准时、判断、信心、紧张、另外、首先、专业、诚实、正式、留、改变、其次、挺
Week4
手忙脚乱、赚、以为、提、调查、原来、提前、计划、保证、提醒、生意、积累、经验、调查、按时
Week5
按照、顺利、感谢、打折、不得不、甚至、奖金、责任、肯定、方法、广告、实际、浪费、标准、消息
Week6
竟然、值得、活动、免费、修理、支持、骗、其中、购物、所有、获得、情况、举办、降低、一分钱一分货
Week7
估计、空气、咳嗽、严重、窗户、动作、后悔、来不及、反对、超过、植物、散步、指、说明、要是、脾气、减肥、辛苦、烦恼
Week 8
巧克力、堵车、心情、愉快、只要、放松、压力、发生、师傅、因此、距离、耐心、态度、到处、缺少
Week9
难道、坚持、主意、饼干、网球、轻松、赢、随便、通过、可是、正确、理想、汗、经历、暂时
Week10
幸福、成功、方向、富、开心、建议、职业、翻译、将来、发展、困、躺、穷、比如
Week11
流利、厉害、学期、猜、来得及、复杂、只好、精彩、无论、杂志、增加、阅读、然而、看法、同时
Week12
规定、死、也许、商量、并且、保护、盐、勺子、解释、对于、使用、引起、误会、节约、相反
Week13
观众、厚、大概、吃惊、遍、来自、申请、有趣、开心、继续、讨论、由、准备、京剧
Week14
打印、复印、道歉、戴、理发、零钱、包子、破、眼镜、租、厨房、房东、乒乓球、饺子、刀
Week15
凉快、热闹、难受、抱、活泼、排队、社会、竞争、受不了、交通、技术、安全、密码、付款、除此之外
Week16
放假、酸、推迟、钥匙、参观、旅行、民族、打扮、究竟、普通话、方言、小吃、收拾、出发、辣

APPENDIX E

One Example of Lesson Plan

Lesson Plan of “Standards of Happiness” (Stage 3)

【Contact hours】 : 1.5 hours (Out-of-class seamless informal learning time is not included.)

【Teaching objectives】

1. Through seamless Chinese vocabulary learning, learners will improve their interest and cognition in HSK learning;
2. Through seamless Chinese vocabulary learning, learners will master key vocabulary related to the ‘Standards of happiness’ in the HSK Level 4 textbook;
3. Through seamless Chinese vocabulary learning, learners will complete the topic activities set by the instructor in the classroom;
4. Through seamless Chinese vocabulary learning, learners will apply the vocabulary they have learned to daily life and create sentence-paragraph-essay artifacts using target vocabulary in a correct context.
5. Through seamless Chinese vocabulary learning, learners will be interested in Chinese writing and promote the use of various Chinese vocabulary.

【Seamless learning process in one cycle of 4 learning activities】

Activity 1 : In-class learning engagement (Formal learning)
Duration for formal learning (60 mins) : Texts : Conversational text 1 : 《孙月和王静聊王静的生活情况》 Conversational text 2 : 《高老师和李老师在谈幸福》 Conversational text 3 : 《小雨和小夏聊找工作的事情》 Descriptive text 1 : 有的人希望穿得再好一些，房子再大一些，认为经济条件越好人就越幸福。其实有很多富人过得并不愉快，而有些穷人却过得很快乐。有钱不一定幸福，因为很多东西都是不能用钱买到的，例如时间，感情，生活经历等。但是，从另外一个方面看，如果没钱，也很难过得幸福。当你生病了，如果由于缺钱而不能及时去看医生，你的健康都很难得到保证，就更别说幸福了。 Descriptive text 2 : 什么是幸福？有的人认为，工资高、能赚钱就是幸福；有的人认为，心情放松、身体健康才是幸福；也有人认为，能帮助别人就是一种幸福。还有人说，小时候幸福是一件东西，比如一块橡皮、一块糖，得到了就很幸福；长大后幸福是一种态度，生活的态度决定了我们幸福感的高低。那怎样才算是真正的幸福？其实，幸福并没有一个标准答案，每个人对幸福都有不同的理解。不管你认为幸福是什么？只要你用心去找，就一定能够发现它。

New vocabulary : 礼拜天、成功、不过、方向、富、开心、建议、职业、翻译、将来、发展、困、躺、穷、比如

Teaching resources : Chinese plus : <http://wz.chinesecio.com/?cat=10>

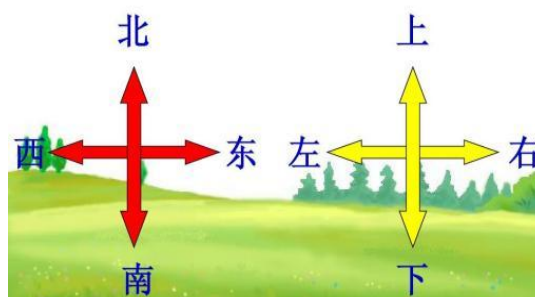
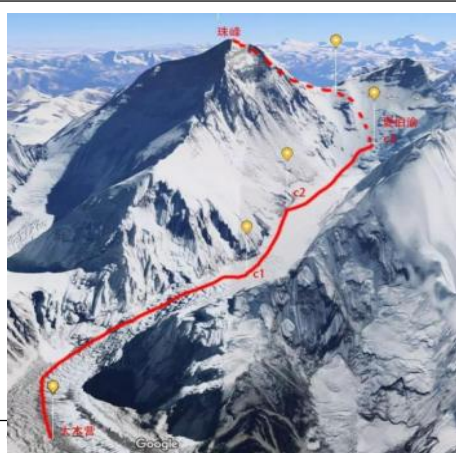
Activity 2 : Contextualised photo-taking and sentence-making (Informal learning)

Briefing on seamless learning activities (10 mins)

Getting start to do Activity 2:

Vocabulary for sentence artifact making (15个) : 礼拜天、成功、不过、方向、富、开心、建议、职业、翻译、将来、发展、困、躺、穷、比如

For instance: 1. The instructor provides learners with some pictures, and at the same time allows them to check some Chinese vocabulary through Pleco, and choose the vocabulary that best representing the situation to make sentences.



Target word: 建议



Target word: 翻译、职业

2. Topic discussion

Some people think that being rich is happiness, and some people say that being rich is not necessarily happiness. What do you think?



(Target words: (不过、富、穷、条件、发展、开心)

Note:

- (1) The instructor encourages learners to complete the seamless learning activities individually, and choose one or several words to make sentences.
- (2) The instructor encourages learners to use mobile phones or other devices to find pictures on the internet that can visually display or create situations to complete the seamless learning activities.
- (3) Learners post the sentence/ picture to the Learning Circle and share it with everyone on DingTalk, the social media platform.

Activity 3: Online peer learning (Informal learning)

- (1) The instructor stipulates that learners browse and comment on at least one learner's work.
- (2) After learners complete the mutual evaluation, each learner modifies their artifacts.
- (3) The instructor also joins the online peer learning to comment and correct learners' artifacts.

Activity 4: Learning consolidation (Formal learning)--20 mins

Comments and discussions are based on the integration of classroom learning and actual learning activities after class, and combined with the artifacts posted by learners inside and outside the classroom.

APPENDIX F

Key Quotations Across Three Datasets from CFL Learners Over 16 Weeks

Learner: L; Data Source: DS; Data Source: I: Interview; OQ: Open-ended questionnaire; F: Feedback

L	DS	Quotation & Interview Week
L1 Low	I	Week 2: I am not familiar with Learning Circle. My classmates all use it well. Week 2: There are many students in our class and the class is quite noisy. Week 4: I am happy because I can understand you and I can make a short sentence because you showed us how to make a sentence! But, the timed writing assignment in the first stage is making me anxious and under pressure. I don't feel adequately prepared for it yet. Week 8: I do not like it, because some of learners are not good at Chinese writing and few artifacts posted, it can lead to upsetting their classmates and humiliating them. Week 12: I'm struggling to find a suitable location to snap photos and post them due to the current COVID-19 prevention and control policies. Week 16: I can feel that I have written many, many sentences and I never noticed that I could do so well with mine, although I still have many questions. The seamless integration of Chinese language learning into my daily routine has facilitated the expansion of my vocabulary in day-to-day life, ultimately leading me to achieve my desired level of proficiency.
	OQ	Although I was skeptical about this study at first, slowly I found it interesting. And I found that I wrote more and more sentences in Chinese and fewer mistakes, but the new crown virus is so annoying. On the other hand, the teacher is very attentive to teach the students. Seamless learning is very helpful. Also, learning Chinese and posting Chinese artifacts using DingTalk are very motivated. It is a wonderful learning experience. I really improved my Chinese a lot.
L2 Low	I	Week 2: This is my first time participating in this study and it is very interesting. Specially, the Learning Circle is very interesting and safe. Week 2: The class is now quite noisy; 32 learners in one class is far too many. Also, I feel sorry that I seem to be experiencing some difficulties with my microphone at the moment.

		Week 4: I was fear of Chinese writing and can't manage to put words on the screen within the one-hour time limit. Week 8: The seamless learning classroom is good, but COVID-19 restriction policy has a side where I don't like it, for example, because I can't go anywhere. Week 12: I am increasingly fond of posting my artifacts now, which gives me the confidence to create more. However, sometimes I have too many assignments, so I can't create and post as much as I want to. I'm sorry, teacher. Week 12: I am very happy that the teacher commented on my artifacts, because the teachers comments will let me realise my mistakes in my artifacts, and then I will correct them so that I don't make mistakes again. But, sometimes the COVID-19 prevention and control policies have made it challenging for me to find an adequate place to take photos and post them. Week 16: It could be fantastic, if it became possible to see my classmates comments. Because I can learn from their mistakes and be ware not to repeat them and also I sooner notice problem that I might face them in the near future.
	OQ	I rejected this learning method from the beginning, because formal learning is also online learning, I think it is similar to university, but this seamless learning is so interesting, so interesting! Let me continue to study even after class, keep discovering and thinking about how to apply Chinese into my daily life, especially, posting Chinese artifacts in DingTalk. Also, I really appreciated my teachers and classmates comments. They are always encouraging me to move forward. It's very motivated, confident, and I am very proud of my Chinese improvement.
L3 Low	I	Week 2: This is my first time using DingTalk, I am very satisfied and it's very interesting, and it's free of charge. Week 2: My internet connection is not good, I often get disconnected. Also, there are too many students and the noise level is loud. And I have problem with classroom interactions in the platform. Week 4: The Learning Circle is very interesting and safe. Week 4: I feel stressed about the timed writing assignment in the first stage. I am not ready yet. Week 8: DingTalk is very user-friendly and it is very helpful to practise my learned vocabulary and do seamless learning activities at this platform.

		Week 12: I think it's great. When my teacher indirectly points out my mistakes, I have to think deeply and then respond to the teachers comments, and other classmates also help me learn. In this way, I almost never forget the mistakes I made before. Week 16: Having one class per week is helpful for me because I have other assignments to work on. Now I can study for HSK on my own, which is a good adjustment. I can make longer sentences and I make fewer mistakes Interaction with Chinese teachers is also very useful I know how I should write a good text. In addition, to be frank, after attending the seamless Chinese vocabulary learning study, I've finally found the courage to express myself without fear or hesitation.
	F	Week 4: I'm going to take the HSK 4 test at the end of July this year. I must practice Chinese well and learn vocabulary. Week 6: The COVID-19 virus prevents me from going to many places to post my artifact. Also, I have no means of sharing the artifacts on other social media platforms. Week 8: Wow, I just love the ranking function! It always gets me pumped to share more of my Chinese artifacts with the learning community. Week 11: when I am posting Chinese artifacts via my mobile phone, both the Learning Circle and DingTalk chat box are open. I am typing there in Learning Circle, DingTalk pops up a lot of messages to distract me. Week 16: As my Chinese language skills grew, so too did my desire to actively seek out new experiences and share them with others. I would often contemplate the appropriate vocabulary to use, then proceed to pen my thoughts in Chinese and post them to the Learning Circle for feedback. Importantly, these 16 weeks of study have made me feel that I have gained a lot. I found that this online course is different from my university's online courses, which are boring and lack teacher interaction. I feel that this seamless learning experience is too fulfilling, constantly learning. Although it can be tiring at times, my Chinese has improved, my writing has improved a lot, and I have learned many new vocabulary words.
	OQ	Seamless learning is very supportive of my HSK Level 4 vocabulary learning! Every time I go outside with my phone to take pictures and find a scene to create artifacts, The Learning Circle is very interesting and safe. Using DingTalk to learn Chinese was very motivated. I feel

		like I'm on an adventure. I will think about how to create one interesting artifact that is very stimulating. I think I have improved my Chinese. Especially when I post Chinese artifacts on the platform, I can write a lot of sentences in Chinese. I can write it whenever and wherever I am curious, as long as I want to study, I will do it. And the vocabulary has increased a lot, and the mistakes have also decreased. Overall, seamless learning has been enjoyable, beneficial, and helpful, consistently providing encouragement for my learning!
L4 Low	I	Week 2: It feels good to be able to do exercises immediately after studying and the Learning Circle is very interesting and safe. But, sometimes I cannot access the Learning Circle on my phone because my phone often has issues. Week 4: Aha, it's so easy to post artifacts in the HSK Level 4 Learning Circle. Just click the plus sign, then type Chinese, upload the photo and you can post it easily. Also, engaging in seamless learning activities within a Learning Circle is becoming increasingly interesting and secure. Week 4: When the deadline was approaching, I had just finished writing and at the moment of submission, I was so satisfied. I did it! Week 8: At first, what's really interesting to me are the good comments and likes, it's engaging. Also, I am having a great time learning Chinese through the Seamless Chinese language learning platform! It's different from the online classes I had at university, where I would often lose focus and become distracted. In this platform, I can interact with my classmates and teachers, share my artifact, and receive feedback that helps me to improve my Chinese language skills. I am now more confident. But, regarding the comments, because I feel that my Chinese is not very good, I am worried that others will be angry when I comment on their work, and also, it would be enough if the teacher provided comments. Week 12: The epidemic prevention and control policy for COVID-19 in China is so strict that in one case the whole neighbourhood was cordoned off. I've been locked in my dormitory for the last month and can't meet or eat with my friends, I'm so lonely. Week 16: I enjoyed the process of seamless Chinese vocabulary learning, especially when my teachers and classmates upvoted my artifact with a like, which made me become self-confident in Chinese writing. Also, the ranking function is hands down my favorite part of the

		Chinese learning platform. It never fails to inspire me to showcase more of my artifact and climb the ranks.
	F	Week 2: Hi Teacher, Sorry, I experienced difficulties with internet connection. And, I also find that the artifacts can't be shared on other social media platforms. Week 4: When I miss a class, the teacher will send us the replay of the class, and I will watch the replay in the dormitory the next day.
L5T Low	I	Week 2: It looks very fun. But, I'm a bit nervous because this is my first time to learn Chinese with DingTalk. Also, I found that my posted artifacts cannot be withdrawn or edited. Week 4: Thanks to your encouraging me to post Chinese artifacts, I really feel that my writing is better and better, thank you so much I hope I can reach my aims. Week 8: I don't like the fact that the teacher set up the activity which called compare multiple sentences using one word. The teacher asked us to compare our artifacts created using the same target vocabulary with each other. It hurts me very much because I am not good at Chinese writing. But, I'm fine with other activities. Also, it's very annoying that some learners comment haphazardly. Week 12: I don't like the notifications of who posts an artifact, it makes me feel stressed. And also, due to COVID-19 prevention and control policy, I'm facing difficulties in finding a place that is suitable for taking pictures and sharing them. Post: At the beginning, I had trouble adapting to DingTalk and couldn't enter the Learning Circle. With the help of my teacher, I was able to successfully post my Chinese artifacts. In the second stage, I felt it was great. The teacher first helped us, guided us, and commented on our artifact, and then gradually let us learn on our own. We are all adults and can understand quickly, and the teacher will interact with us regularly. I think it's very good this way. I sometimes get busy with exams, and also going out with my boyfriend, so I forget to post. But sometimes when I remember, I immediately post wherever I am. In the third phase, since we are already familiar with each other and often meet in person at the university to chat, we rarely comment or chat on DingTalk. The adjustment in the last stage is acceptable to me, and I think it's a

		good one. In the last stage, I can learn independently, and the teacher only helps me with difficult grammar and incorrect sentences during class, so many times I can learn by myself. Regarding the learning environment, since everyone's learning environment is different, it can be noisy in a formal classroom with many students, as in our case with 32 students. However, the design of the Seamless Vocabulary Learning Activity is very rich and meaningful, allowing me to connect Chinese with daily life. I am very satisfied and happy with it. I think it's not a problem, but some classmates complained that it was tiring, especially during the second round when they had to write a short essay and a long essay. I feel that my Chinese has improved in listening, speaking, and writing! For example, in terms of speaking, at first, I was afraid to say a word and couldn't form a sentence, but now I can speak freely, even though I make mistakes, but I have become brave and confident. Before, when I talked to Chinese people, they didn't understand, but now they understand when I speak, and I used to be not confident, but now I become more confident when talking to Chinese friends or writing messages. In terms of writing, it has also improved a lot. I write a lot of sentences, many of which are correct, without pressure.
	F	Week 6: The Ding Drive is an especially valuable tool that aids in my retention of Chinese vocabulary and sentences.
	OQ	The seamless learning has been really helpful and has helped me learn something new and at the same time I have reduced errors in my Chinese writing. Also, the HSK Level 4 Learning Circle is very protective and safe. I enjoy the artifacts making and posting them onto DingTalk platform. When the artifacts posted in DingTalk got many likes and comments, I am very motivated. But, when I want to share my Chinese artifacts posted in the HSK Level 4 Learning Circle to my friends, my friends can see and comment because they are not in this Learning Circle. I realised the Learning Circle is too sealed.
L6T Low	I	Week 2: I'm so satisfied with the seamless learning activities, and the Learning Circle is so interesting. Week 2: This is my first time using DingTalk, as I've been using Zoom before. I find the way of seamless learning is cool! And DingTalk very interesting because I can learn and share Chinese language content on it anytime and anywhere after class.

	Week 4: I was stressed when I was writing in one hour of limited time. I was worried that I would not be able to finish it, but in the end I did. Week 4: I'm constantly distracted by other things, such as eating, drinking, texting, or surfing the web for other purposes. And, it's hard for me to manage the time to finish the essay and then post it in the Homework function. Week 8: Getting used to the new online seamless learning environment has been very stressful under the COVID-19 pandemic situation and strict restriction policy. I have difficulty with time management and I have difficulty staying motivated. Week 8: I find it very useful. Because I use the words I just learned to make sentences, if there is a mistake, the teacher tells me, then I revise it and post it to the Learning Circle, it really helps a lot. Week 12: I really like to share my daily lives with classmates and post Chinese content in HSK Level 4 Learning Circle. Week 12: Although affected by the COVID-19 pandemic, I think this method allows me to decide where to study and create artifacts on my own. The pandemic does not affect me because seamless learning is helpful for my Chinese language learning. Week 16: if you let us to correct our classmates essays and after that even let us to compare the way we correct our friends mistakes with your way, it can be extremely useful for us. I believe that whenever we can correct our friend mistakes we can take more care of staying away from the same mistakes. Post interview: I am very satisfied. I saw many classmates taking photos and posting their artifacts, so I posted mine too. It was very interesting. Actually, we are very busy in our university, especially in the first phase. We were not very familiar with DingTalk because the teachers were using other platforms, and we were very busy. Therefore, the first phase was very busy. As I became more accustomed to using DingTalk every day, I started to post more. I am happy and satisfied with the comments from both the teachers and students. Thank you. I think DingTalk is really great, not only because it's free, but also because it's easy to use and I am very satisfied with it. As for how to operate it, I think it's very easy. You just need to click the "plus" button, then type in Chinese, upload photos and post it. Sometimes, teachers
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	and classmates will give comments and likes. I especially like it when people give me likes. I feel that my Chinese proficiency has improved, and I plan to take the HSK Level 4 exam. I believe I can pass it. I can write many sentences, and my writing has improved a lot. I make fewer mistakes, and I am becoming more and more interested in Chinese. In the third stage, I feel a bit tired, and I am also a bit busy with my college assignments and exams. Therefore, I feel pressured when it comes to writing sentences and paragraphs because I don't have much time and sometimes I don't write well. Usually, it takes me half an hour to write a paragraph. I can accept having class once a week in the last phase, and I really enjoy the meaningful course. With this schedule, I can do my university assignments, have more time to post Chinese artifacts, and prepare for the HSK Level 4 exam. I think the adjustment in the last phase is very good. In the past, I was afraid to write because I didn't know how to write or manage my writing. I didn't know where to begin or where to end. When I learned the sentence-paragraph-essay writing flow from your class, and then worked in your seamless learning environment and practised on those things online, I gained a lot of knowledge, and by creating Chinese artifacts and posting them online, this moment of sacredness diminished significantly. Overall, sometimes I can't hear the teacher well due to poor internet connection. Additionally, there are too many students in the class compared to my university where a class has a maximum of 10 students. With 32 students in the class, it's hard for me to participate and answer questions. Furthermore, some students disrupt the class by repeatedly asking if their video and audio are working, which is annoying to me.
OQ	At first, I am indeed happy with my learning progress because when I create an artifact with photos, I can quickly spot the mistakes. But, at stage one, I doubt the way of seamless learning. But after I experienced the seamless learning, I found out that I can read the correct pronunciation, my listening ability is much better than before, and I know more knowledge. Seamless learning methods are very helpful to my Chinese learning. Especially, the DingTalk platform was always motivating me to continue seamless Chinese vocabulary learning.

		Thank you teacher.
	F	Week 2: It was such great that after learning Chinese, I can quickly enter the Learning Circle and post my Chinese artifacts. Week 4: The Learning Circle is very fun and safe. Week 11: Now, I am able to identify which words are appropriate to use when creating Chinese artifacts using target vocabulary, and I make an effort to avoid using any inappropriate words.
L7 Low	I	Week 2: I am not used to using DingTalk platform to post Chinese because it is the first time I use. Week 2: The class is now very noisy. Week 4: I was too lazy to learn Chinese, so I took this course with the attitude of giving it a try, but when I posted my Chinese artifacts in the HSK Level 4 Learning Circle for the first time, I quickly received likes from my classmates, it was really interesting. I am very happy to study Chinese in DingTalk platform. Week 8: Seamless Chinese language learning is really fun! I realised that I was wrong in thinking that it was like the online classes in university, where I often got distracted and lost focus. In the seamless Chinese language classroom, I can interact with my classmates and teachers, give likes, and share my artifact. My teachers and classmates often give me comments and point out my mistakes, which not only doesn't make me angry but also can make me think more about the use of certain vocabulary, which helps me improve my Chinese language skills. I have more confidence. Week 12: I think I have improved my Chinese. Especially when I post sentences on the platform, I can create a lot of Chinese artifacts. To be able to post in everywhere, anytime, I am so happy.
	F	Week 3: At first, I wasn't very used to it because it was my first time using DingTalk for learning. But later, I slowly got the hang of it and started submitting my artifact. It's really amazing - I can learn Chinese in different places, like in coffee shops or in my dorm. I really enjoy this experience. Week 4: Seamless learning and the DingTalk platform gave me more time to post Chinese artifacts outside of school; and HSK Level 4 Learning Circle is very supportive of my vocabulary learning and writing. Week 11: A lot of activities! Mr. Zhou should consider the fact that a learner is staying at dormitory to avoid illness or infection from

		happening. Also, learners have lots of assignments from their schools. Too many tasks kill us! Not because of the coronavirus that causes us to die. Week 16: Seamless Chinese learning has given me a special ability to organise and practice ideas in my daily writing, and then use the learned Chinese in my life. In this way, it has had a positive effect on my self-confidence to a large extent. In addition, I have found that it has been able to make my writing more coherent. In my opinion, this self-confidence is an advantage because In the past, I used to be afraid of writing; I had a lot of difficulty starting and finishing an essay.
	OQ	Seamless learning is a flexible and fast scaffolding approach for my writing.especially, Online peer learning helps me a lot. My Chinese vocabulary learning skills have been improved. I can watch class videos whenever I forget what teacher taught, and to review the lesson before next class. The learning tool of DingTalk is convenient and motivating, I can learn Chinese anywhere, any time. I really enjoyed the seamless Chinese vocabulary learning. It's very helpful. My writing skills improved a lot and I can create lots of Chinese artifacts.
L8 Low	I	Week 2: I am sorry, I have a problem with my microphone. But I am very comfortable with it and happy to do seamless learning activities. Week 4: Thanks to the Ding Drive, I am able to better recall the Chinese vocabulary and sentences that I have learned. Week 16: Seamless learning has given me the opportunity to take ownership of my learning journey and develop my self-directed learning skills. By engaging in activities that align with my interests and learning goals, I have been able to enhance my ability to learn independently.
	OQ	Having participated in the seamless learning activities, I have now found the courage to express my views without fear or doubt and become more and more confident in learning Chinese! And I can create the proper Chinese artifacts in different scenarios! Most importantly, my Chinese has also improved, especially in writing, thinking and social skills. I have made a lot of new friends, and we often chat and comment on each other via DingTalk. Using DingTalk to learn Chinese is very encouraging and motivating. I like to give others likes and comments, but I prefer the teachers and classmates to give me likes and correct my sentences so that I can know my mistakes and then correct them. I am very happy with seamless Chinese vocabulary learning.
	F	Week 5: Hi, teacher, my posted artifacts are uneditable and irrevocable.

		Week 8: It is a new experience that has a lot of benefits. I become more creative and I am very happy with it. I can post them whenever and wherever I want, as long as I wish to do it. Also, I confess that DingTalk notifications of encouragement have a deep influence on me and motivate me to do my best. But if only we could learn face to face, the COVID-19 pandemic doesn't allow us to go to many places. Week 11: Although I am sometimes tired of studying, when I see my teachers and other learners giving me credit for my work, I become happy and have a sense of achievement that inspires me to continue studying. Week 12: I'm sorry, teacher. I don't think my Chinese is good, so I'm embarrassed to comment on others. But I like it when others comment on my work, and it makes me proud. Week 16: Not only learn new words, but also use them: Now I know what is the difference between 常常(Changchang) and 往往(Wangwang) and where it is appropriate to use each one. Moreover, I have found that my Chinese writing skills have improved. For example, I can write long and accurate sentences, and my teachers and classmates have given me compliments on my writing, which makes me increasingly confident.
L9 Low	I	Week 2: I am so excited to participate the seamless Chinese vocabulary learning research. I didn't meet problems when using DingTalk, it's very fun. And I like posting Chinese on the DingTalk platform, it's very interesting and helpful. Week 4: I am very satisfied with learning Chinese by using DingTalk because it's very helpful to practise my learned vocabulary. Week 8: Attending online classes in university often leaves me feeling tired, and the only purpose of attending classes is to earn credits. I don't feel a sense of accomplishment or achievement. However, in the seamless Chinese language classroom, where I am able to learn and apply what I've learned, I feel a sense of accomplishment, and I am very satisfied. One suggestion I have is to divide students into two classes to avoid noise and disturbances. BTW, I kind of like the fact that there is a Reminder function of DingTalk platform often reminding me to do the seamless learning activities. Week 12: I have been assigned so much homework from my school that I have no time to work on seamless Chinese vocabulary learning as I can't manage my time better.

		Week 16: I started to become more active and create more sentences and passages for different scenarios. I can decide for myself what scenes and what HSK4 vocabulary to use and post them in my Learning Circle. Then my teacher and classmates would comment and like me, which made my Chinese improve a lot! It has made me a more active learner. Also, I realised that I've learned some new words and at the same time, I've reduced my mistakes when writing.
	OQ	I didn't dare to speak when I took Chinese class before. Now I think I'm getting stronger and more confident in Chinese learning and Chinese writing. I really enjoyed the seamless Chinese learning, enjoyed the use of DingTalk in motivating me to do many activities. Seamless learning is very beneficial to my learning skills and writing skills. My level improved a lot after I took HSK Level 4 course, especially with Mr. Zhou because he simplified the information for us and I understood a lot from him, and he encouraged and supported us, at first I could not write sentences and then the teacher trained me to write sentences, and then I started writing sentences and paragraph, I am very thankful to my teacher. Thank you teacher.
L10 Low	F	Week 2: This is my first time participating in seamless Chinese vocabulary learning, and I am so excited. The Learning Circle is very fun to post Chinese artifact. Week 4: Due to the COVID-19 prevention and control policies, it is not easy for me to find suitable places to take photos and post them. Also, I am unable to share my posted artifacts on any other social media platforms. Week 8: The Ding Drive is particularly useful and helps me to remember the Chinese vocabulary and sentences I have learnt, also, the "Reminder" tool is very helpful. Week 15: Seamless Chinese vocabulary learning is truly amazing. I love this learning method so much. It has many benefits that allow me to learn new knowledge and vocabulary constantly, anytime and anywhere.
	I	Week 12: It is very easy to post Chinese artifacts in the HSK Level 4 Learning Circle on the DingTalk platform. Week 14: First time encountering seamless learning, I was curious but not very adapted to it. However, after studying for a month, I found it very interesting. I posted many artifacts that allowed me to learn anytime and anywhere.

		Week 16: I feel like I can write more easily than before, and I'm really happy. I feel like I'm getting more and more confident without having to worry about how to use words in my sentences because of the seamless Chinese learning activities. I've practised many, many times! Ha ha!
	OQ	In the past, my Chinese learning situation was really bad. There were many mistakes in sentences making and writing, and even spoken Chinese. Now the situation has greatly improved, I become more and more confident to learn Chinese after participating the seamless learning study. Also, my writing ability got better by doing lots of seamless learning activities and writing skills and pronunciation have also been greatly improved. It's very helpful for me to get teachers and classmates comments in the platform. I found the platform is much motivating and very user friendly. Notably, the functions of Reminder and Ranking are very useful and motivated!
L11T Medium	F	Week 2: This is my first time posting Chinese on the DingTalk platform, but I can't enter the HSK Level 4 Learning Circle because I don't have permission. Week 4: Why can't I edit my posted artifacts from the Learning Circle of DingTalk platform? I have to delete it and redo one. Week 8: I found that I adapt quickly to seamless learning. Although it's nerve-wracking, this stage of activity is particularly interesting. I like buying things, but because of COVID-19, I can't go to a shopping mall that's too far away. Week 14: I really thanks for the function of "Reminder", it's very helpful and often motivates me to continue to post artifacts and learn Chinese.
	I	Week 4: From my point of view, the HSK Level 4 Learning Circle is limited to people in this circle who can comment. I think it's safe to protect our privacy because the Chinese artifacts posted by some learners are not very good, and they do not want unknown people to review their mistake. Week 8: To be honest, I didn't like the activity, we are all learners from different countries, it's embarrassing and hurts our self-esteem. Week 10: I already master them during in-class learning and then keep the vocabulary in mind. There is nothing that attracts me to practise them additionally. Except the HSK Level 4 test. Week 12: I think it's okay, and it can help me improve my Chinese level. It has an impact because I can't go outside to places like shopping

	malls and go shopping. I feel sad that I can't buy clothes, but I will download pictures online and post them. Post: I am very satisfied with the seamless Chinese learning environment. And, I really enjoy and happy with some functions of DingTalk platform. For example, "Reminder" and "Learning Circle" are quite helpful, "Ranking" is very motivated, etc. Although I wasn't used to it at first, I got used to it day by day and found this method very useful. It not only helps us avoid the coronavirus but also other diseases, but also helps us improve our Chinese language skills. In the first week, my classmates and I were not familiar with each other, and we were not used to creating artifacts in Chinese and posting them to the Learning Circle. However, we became more familiar with it day by day, and our teacher often encouraged and helped us, to keep going, and not to be afraid of writing. In the second stage, I became more adept at the process. I started to find my own photos and look for suitable settings, and began to practise writing on my own. Our level improved as a result, but due to the COVID-19 pandemic, I couldn't go to many places. It's really frustrating. In the third stage, because I felt that my level was improving and more and more confident, I started to give more comments to others. However, sometimes my comments were not good, which made my classmates disappointed and upset. The adjustments made in the final stage were very good. I think the main reason is that our level has improved, and now we need to rely on ourselves to learn more HSK Level 4 vocabulary and use the knowledge we have learned in our daily lives to better master them. If we have any questions, we can ask the teacher, and the teacher will also help and encourage us. I am happy to receive comments and likes from both my teacher and classmates, especially those likes given to me which give me confidence. The most important thing is that their comments can point out my mistakes, which can help me avoid making the same mistakes in the future. The seamless Chinese vocabulary learning is incredible; I think I can correctly describe different scenes with appropriate Chinese words. In addition, I feel like I've improved my social skills, and I can learn Chinese in a variety of scenes, taking pictures, making sentences, and
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		posting Chinese artifacts. Most importantly, from online peer discussion, I can find out how good or bad my artifact is. If it is good I will be happy, and if it is not good I try to revise it and I am sure I would be much happier after that, because I know I have learned something new, in parallel, I have lessened my mistakes. Also, the teacher Zhou and classmates often comment my artifacts and give me more likes. I am so proud of myself.
	OQ	After participating in this seamless learning study, I found that my Chinese writing has improved a lot, and I have posted a lot of sentences. Thanks to the encouragement of the teacher and the teacher who let us take the initiative to practice and learn in life, in doing so, I practiced the Chinese I learned in class. However, the COVID-19 pandemic often prevents me from creating Chinese artifacts! So, sometimes I feel very lonely when posting. On the other hand, the HSK Level 4 Learning Circle is limited to people in this circle who can comment. I think it's safe to protect our privacy because the Chinese artifacts posted by some learners are not very good, and they do not want unknown people to review their mistakes. Finally, it should be noted that the use of DingTalk platform is very motivating and fun.
L12 Medium	I	Week 2: I experienced difficulties with internet connection. Also, I'm not used to using DingTalk, last time I didn't know how to post and turn on my microphone. Week 4: From the beginning, I disliked posting Chinese artifacts on the DingTalk platform because I was used to the platform my university used. And this learning mode is also online learning, I think it is similar to my university. However, after one month of learning Chinese, I found that the seamless learning activities arranged by the teacher are particularly like a Great adventure. Whenever after class, we were encouraged to take pictures outside with our mobile phones, look for the scene, and then think about how to create an artifact and post it onto DingTalk, which is very interesting. I'm so proud of myself. Week 8: This Learning Circle helps create opportunities for practice. Whenever I want to make sentences using target vocabulary, I will quickly click the button to post a perfect artifact onto DingTalk platform. It's very helpful to learn Chinese. But, it came to my attention that I cannot withdraw or modify my posted artifacts.
	F	Week 6: I gotta say, the ranking function is such a cool feature. It really drives me to create and post more Chinese artifacts so I can see how

		well they perform. Week 12: Make It Happen! I like this word. Every time I open my DingTalk platform, there are different words of encouragement that keep me motivated to learn! Week 16: In fact, I believe this method will assist us in improving my writing by informing me about common writing flows. Some things, such as writing, cannot be learned through reading because they come from our minds, so we must think about how to create an artifact and practise the learned vocabulary. So, seamless learning is a good way to improve our writing performance. It offers a variety of seamless learning activities to help us gradually improve our Chinese writing. It's a wonderful experience and make me more and more confident to learn Chinese.
	OQ	I can make longer sentences and make fewer mistakes. Seamless Chinese vocabulary learning makes me become more confident. It's an interesting and comfortable online course. Also, seamless learning was also useful to interact with my classmates and teachers through the use of DingTalk. I like the seamless styles and the motivating platform. Especially, the ranking function is simply amazing! Every time I receive positive feedback on one of my Chinese artifacts, it fuels me to create even more and climb up the ranks.
L13 Medium	I	Week 2: Yes, it is my first time. It feels like posting on Facebook in Chinese, which is very interesting. Week 2: I feel that there are too many people and the classroom is very noisy. Week 4: When I was writing a composition within the one-hour time limit, I was very nervous. There was a feeling of starting an exam, which made me stressed. Week 8: This platform allows us to learn independently as well as engage in group discussions, which gives us a lot of freedom and flexibility. It's a wonderful experience. I feel very comfortable posting Chinese in the HSK Level 4 Learning Circle and interacting with my classmates. I really enjoy it. Week 12: There are so many seamless learning activities, I finished writing the sentence artifacts, then posted the paragraph artifacts, and then I have to write the essay, I am too tired. And I have a lot of exams and homework lately. Week 16: I find online peer discussion to be very useful because it can

		help me notice my mistakes and benefit from the comments from classmates, learn something new, and then go on to create Chinese artifacts and make my Chinese better and better. Week 16: By engaging in seamless learning activities, I have been able to develop my self-directed learning skills, such as goal-setting, planning, and reflection. This has allowed me to become a more effective and efficient learner.
	OQ	I think seamless Chinese learning method is a perfect way to thrive our ability to write better, because we have to think and create how to make posts. Honestly, it lets me confidently learn Chinese and writing. My Chinese proficiency really improved a lot after I took the HSK 4 class with Mr. Zhou, because he simplified the information for us and I understood a lot from him, and he encouraged and supported us, at first I could not write sentences and then the teacher trained me to write sentences, and then I started writing sentences and paragraph, it's very benefited. I am very thankful to my teacher.
L14 Medium	I	Week 2: It was the first time I posted Chinese artifacts on the platform yesterday. I feel very comfortable to post Chinese artifacts. But, I found the artifacts I posted cannot be edited. Week 4: I am feeling tense and stressed out about the writing task with a time limit in the first stage. I don't think I am fully ready for it yet. Week 8: I'm very content with the seamless online learning experience, which is filled with interactive sessions and exercises, providing me with ample opportunities to learn and practice. Week 8: I have no problems, and I find this seamless learning platform to be especially good. It's very safe, as only teachers and classmates can see my artifact. They also give me likes and comments, which makes me feel appreciated and encouraged. I can also easily browse and learn from my own work at any time that's convenient for me. Week 16: Thanks to online peer discussion, I can now notice my faults and try to avoid them. it has become a habit to reread my writings and I am so glad and confident I have made it this far. Also, I think that I could gain new knowledge for self-revising with attending to this class; however, I can improve it by doing more exercises.
L15T Medium	OQ	Seamless learning is a flexible and fast scaffolding approach for my Chinese writing. As I need to create sentence-paragraph-essay artifacts persistently, the DingTalk platform provides a seamless learning space named Learning Circle, which has made me more motivated and

		confident than before. I am very happy with the method to learn Chinese. DingTalk is the best free social media platform for me to learn Chinese, I really like it.
I		Week 2: It's a very innovative and a new idea of learning. But I had poor internet connection at the beginning. Week 8: I think seamless Chinese learning method is a perfect way to thrive our ability to write better, because we have to think and create how to make posts. Also, I enjoy interacting with my classmates in the Learning Circle, I enjoy it because not only do I get a lot of likes and good comments, I also get a lot of help from my classmates to edit my artifact, which makes me proud! Week 12: I think it's pretty good. When my teacher pointed out my mistakes indirectly, I had to think deeply before replying to the teachers comments, and other classmates also helped me notice my mistakes of posted artifacts. That way, I hardly forget the mistakes I made in the past. Week 16: I am highly inspired, as I can compare my previous written texts with newest one each time, I saw a good achievement and am proud of myself. To note, the seamless Chinese learning has allowed me to effortlessly expand my vocabulary in everyday situations, learn new words, and has propelled me towards the realisation of my language learning goals. Post: The later stages were better, in the first stage we were all quite shy, and there were many unfamiliar classmates. Moreover, the DingTalk platform was different from our university platform, so I needed to learn how to use it, but I quickly understood. In the later two stages, I felt particularly good. Classmates and teachers often interacted and communicated, and my Chinese language proficiency improved greatly. At first, I began to understand more and more vocabulary, and then I discovered that I could use the learned words in my daily life. Whenever I saw a scene related to the Chinese language I had learned, I felt benefited, and so I learned more and more. Another thing is that the topics and activities posted by our teachers are closely related to the lives of international students, such as "friendship," "the joys and sorrows of learning Chinese," and "studying abroad in China." I think they are especially good. However, sometimes I am a bit busy, and another reason is that I participate in competitions and review

		for exams. Moreover, due to the COVID-19 pandemic, we often need to undergo nucleic acid testing every day. I have no issues with the final stage. Having one class per week allowed me to relax and enjoy the process of creating and submitting my artifact. It felt very appropriate and manageable to me.
	F	Week 8: At this stage, I feel much better. We can study by ourselves or discuss in the Learning Circle, which is very relaxed and casual. To note, online discussions have some interesting tools that motivate me to go further and increase my interest in learning Chinese vocabulary. Week 10: Posting so many works, I feel a bit tired. Also, I have a lot of assignments in my university. Week 11: Hi Teacher, I really enjoy the peer review feature on DingTalk platform, which has taught me a lot of knowledge. Good comments can boost my confidence and make me more interested in Chinese. This seamless learning has been of great help to me! Week 14: I have realized that I am achieving my vocabulary learning goals. I am able to write more and more sentences and my writing skills have also improved. This seamless Chinese vocabulary learning is really awesome!
L16 Medium	I	Week 2: I like to study Chinese on the DingTalk platform, it allows me to work at my own pace to take photos, post artifacts anytime, anywhere. Week 4: The Ding Drive proves to be incredibly useful in reinforcing my knowledge of Chinese vocabulary and sentences. Week 8: The seamless online learning classroom has exceeded my expectations, providing a lot of opportunities for interaction and practice, which I am extremely pleased about. Week 12: I am becoming more and more satisfied with seamless Chinese vocabulary learning, and I am really enjoying it. Week 12: Peer feedback is great and very helpful for learning, and I really enjoy it. If I go a week without any feedback from others, I feel discouraged and begin to doubt my writing abilities. However, the teachers are always friendly and provide me with feedback and likes, which makes me happy. Their guidance has helped me improve my writing skills and expand my vocabulary. Week 16: I think I am quite good at correcting my mistakes. And I really feel that I can revise my artifact better and post a correct artifact in the Learning Circle. For example, I try to review my artifacts before posting

		it onto DingTalk platform and I find several mistakes from different sorts. Some of them are very childish and some others belong to upper levels. I have realised the more I review my artifacts online, the more abilities I gain for revising my writing texts.
	F	Week 4: I can't get enough of the ranking function! It's such a fun and motivating tool that encourages me to keep creating and sharing my Chinese artifacts with others. Week 12: Hi teacher, online peer discussion had a lot of good effects on my writing by means of showing me my mistakes. Therefore, now I know in which part of my weakness I should self-revise and practice.
	OQ	It's quite different from the previous courses in my college, my lecturer taught very quickly and I felt bored. Taking part in the seamless learning makes me extraverted and confident. And the seamless learning platform DingTalk is very motivating. Also, I have made a great progress in making many friends and opening up my social circle. I become more confident. The COVID-19 pandemic makes us have to stay at home and rarely communicate with others. But this learning makes us seamlessly and continually study Chinese, and we comment on each other and praise each other. I'm very happy. BTW, I don't like the COVID-19 pandemic, it affects my posting artifact.
L17 Medium	F	Week 4: I like this word: Make It Happen!, it always motivates me to learn Chinese. That's very helpful! But, I am unable to distribute my posted artifacts to other social media platforms. Week 10: I was annoyed by some incorrect comments made by other classmates and refrained from posting Chinese artifacts because I believed it would disrupt my learning pace. Week 12: My classmates and I often meet and chat at university, so we rarely interact with each other on social media because we meet in person frequently. Week 16: Seamless Chinese vocabulary learning were very useful and helpful, and great especially allow me to create artifacts across different learning contexts and give me more time to think and it did not kill my hope of getting better.

	OQ	I like to study in the classroom or library with my good friends. Before attending the seamless study, I also have online classes. I am alone in the dormitory, and I feel very boring and less enthusiastic. But after taking part in seamless Chinese learning, I was very happy, because my teacher didn't give me much chance to practice and learn the words. After class, when I do tasks, I will ask my friends to take photos and post the artifacts in seamless Chinese Learning Circle. And my good friends are very envious of my seamless learning, and I am very proud of it. For my Chinese learning progress, at first, I had a lot of mistakes but as the time past I'm gradually realising the mistakes and reducing them in my created artifacts. Most importantly, the use of the DingTalk platform is extremely motivating and enjoyable and I'm more and more interested in Chinese. but Dr Zhou said that he wouldn't teach us this semester. I'm sad, but I'll continue to post my artifacts on the DingTalk platform. This platform is very convenient, and you can log in anytime and anywhere.
	I	Week 12: The seamless learning method has enabled me to take charge of my own learning by providing me with the flexibility to choose the learning activities that suit my individual needs and interests. Week 16: The seamless learning method has been instrumental in helping me achieve my Chinese learning goals, as it provides a consistent and immersive learning experience that allows me to continuously practice and improve my language skills. Week 16: I feel like my self-confidence has improved a lot since I started the program. I used to doubt my abilities, but now I feel more capable and confident in what I can accomplish. I also feel that I have significantly improved my Chinese writing skills, as I am now able to construct longer sentences and learn independently.
L18 Medium	OQ	It should be observed that incorporating the DingTalk platform can be incredibly motivating and enjoyable. I love the way of seamless learning using the platform. It's very helpful. I can know whether my Chinese sentence is good or bad, if it is good, I will be very happy, if it is not good, I will try to revise it, and the teachers and classmates are also very enthusiastic to help me. I'm sure I'll be happier afterwards because I know I've learned something new and at the same time, I've made fewer mistakes. But I found that participating in this study made progress. it has made me more powerful than before. This platform is

		particularly convenient, and you can log in to practise the target vocabulary anytime, anywhere.
	I	Week 4: The “ranking” feature in DingTalk always motivates me to keep practicing and posting Chinese artifacts. I am delighted with the seamless learning activities and enjoy posting them on DingTalk. Week 12: Through seamless learning, I have been able to become more self-directed in my learning approach, as it encourages me to take responsibility for my learning and identify areas where I need to improve. Week 16: With the help of the seamless learning method, I have been able to make significant progress in my Chinese language learning journey. The continuous engagement with language content and the ability to practice in real-life situations has been incredibly beneficial. Week 16: Honestly, I felt a bit uncertain about it at first, but as I got more involved, my confidence started to grow. By the end of it, I felt like I had learned a lot, and my self-esteem had improved significantly. It was a really positive experience overall.
L19 Medium	F	Week 6: I am so motivated by the word of “Make It Happen”. Week 8: I don’t like to see my artifacts compared with other classmates artifacts because I think it make confusing people and everybody have their own idea and thoughts to create the artifacts. This is not a satisfactory activity. Week 11: if I saw my friend has a higher score than me, I think it would motivate me to compete with him and surpass him. Week 14: The comments from some of the less proficient students made me feel embarrassed. Although I know they were well-intentioned in trying to help me, their comments were often incorrect. Week 16: Hi teacher, I really feel that I am able to use vocabulary accurately to write a good paragraph in Chinese, Thank you! Regarding seamless Chinese learning, I have to say that I really like it, because you can see the mistakes and likes of your teachers and classmates in the study circle for the first time, and you can think about them. I think this is the most important advantage of seamless learning. It’s very helpful and beneficial.

	OQ	It's very helpful for me to improve my writing. I can feel confident that I have written a lot of sentences, but I have never noticed that my Chinese learning skills has become better. Although I have a lot of questions and I am not perfect, the teachers and students encouraged me, commented on me. Seamless learning also improved my social skills and I make many friends here. They are kind to help correct my artifacts in Chinese. This is a wonderful seamless learning experience. BTW, the employment of the DingTalk platform can be considered very engaging and enjoyable. Although sometimes studying is very tiring, when I see the teacher and other classmates compliment my artifact, I become very happy, very confident and motivated.
	I	Week 16: Well, I felt like I gained a lot of knowledge and skills, but what was more surprising was how much my confidence level improved. As I went through the course, I felt more and more capable of understanding the concepts, and it gave me the courage to apply what I learned in class. By the end of it, I felt like a completely different person, and I was more confident in myself and my abilities. Week 16: Seamless learning has given me the opportunity to integrate Chinese language learning into my daily life seamlessly. As a result, I have been able to stay motivated and focused on achieving my learning goals.
L20 Medium	I	Week 2: Posting Chinese artifacts in Learning Circle is very fast and helpful, and DingTalk's quick access took me by surprise! Week 4: As the time was running out, I had just finished my writing and at the moment I clicked "submit", I felt an intense surge of excitement. I had succeeded! Week 12: Over time, I noticed that I had become more proactive in exploring lives many facets. As ideas for written pieces came to mind, I would then strive to convey them in Chinese and share them with the Learning Circle. Week 16: I gained confidence to learn Chinese through the way of seamless learning. Also, through the seamless learning method, I have been able to create a consistent and sustainable Chinese language learning routine that has helped me reach my learning goals. The continuous exposure to language content and the ability to apply my learning in real-life situations has been invaluable.
L21	F	Week 4: The Learning Circle is safe and helpful, only people we know well can see and comment. But, the artifacts cannot be shared on other

Medium		social media platforms. Week 7: The feedback provided by less proficient students left me feeling embarrassed. Despite their good intentions, their comments were frequently inaccurate. Week 8: In the event of my absence from class, the teacher sends a recording of the lecture, which I watch in my dormitory the following day.
	OQ	This is different from my online class at my university. My university online class is very boring and the teacher has no interaction. I think this seamless learning is very fulfilling and fun and interesting and helpful. I keep studying. Additionally, this ability that I can correct others mistakes would increase my self-confidence a lot. Although it is very tiring, my Chinese has improved. I am going to take the HSK Level 4 test after the course. One should take note that utilising the DingTalk platform can be highly stimulating. DingTalk's Learning Circle function offers a space to practise and learn Chinese vocabulary. It's very helpful and benefited. But, there are too many topics to write, and sometimes I forget, it can be once a week.
	I	Week 4: Although the Learning Circle is safe, one problem is that once an artifact is posted, it cannot be withdrawn or modified. Similar to other social media platforms, the artifact must be deleted and re-posted in order to make changes. Week 12: Whats really interesting to me are the comments and likes! I can see other learners mistakes and others can see mine. This is a good approach for me to amend my Chinese artifacts because I can pay attention to my mistakes in the next writing Week 16: My writing skills have improved a lot, I can write a lot of sentences and create more Chinese artifacts, and I am more and more interested and confident in learning Chinese. This method is very good and helpful. It's very interesting. My Chinese has improved, and my vocabulary mistakes have been reduced, and I have also learned a lot of HSK 5 words, but I have to pass the HSK 4 test.
L22 High	I	Week 8: If I happen to miss a class, the teacher ensures that I receive a replay of the lecture, which I can then view in the comfort of my dormitory the next day. And sometimes the class is too noisy. Week 12: I think comments are very helpful for me to learn and improve my Chinese, and I can learn new knowledge from the opportunity of repeatedly revising my artifact, and then continue to create the content

		of my article to make my Chinese better and better. I like the comments that the teacher and classmates give me, and I like to give others comments even more! We are all classmates, learning from each other and making progress together. Week 16: Seamless Chinese learning has really helped me make progress. In Learning Circle, the teacher and my classmates kindly corrected my artifacts, and then I was also able to identify some mistakes in my artifacts (not posted yet). After revising, I posted new, correct sentences, which made me learn a lot. This is a very useful method, and it makes me more confident in learning Chinese.
	OQ	When studying in class, the screen of the mobile phone is too small, it can't be enlarged, I can't see clearly, sometimes the network is not good, there are too many students in class, I can't answer the question. But, after taking part in this seamless Chinese study, I often thought of the Chinese idioms I had learned in my daily life and couldn't help but connect them and speak them out.
L23 High	I	Week 8: For me, what's really interesting is the comments and likes from everyone! I can see other peoples mistakes, and they can see mine. This is a great method for me, because I can pay attention to my own mistakes in the next writing. Week 12: This is my first time participating in a seamless learning study, and the amount of improvement through seamless Chinese vocabulary learning is incredible, even starting from scratch. Of course, practise makes perfect and the more you engage through this method, the more knowledge you will gain. Week 16: I like this way of learning very much. It's very interesting, although I was very suspicious and confused at the beginning. But during the learning process, I found that I quickly posted my Chinese on the platform. My Chinese writing has improved a lot. It's a good experience to learn without any cracks. Besides, many students and teachers gave me likes and comments and let me know my mistakes. Then I corrected my mistakes and made progress in my Chinese! I really enjoy their comments and likes.
	F	Week2: A class of more than 30 people is too noisy, I can't speak and participate in discussions, and students from other universities do not know. Week 4: I'm going to pass the HSK Level 4 test, and I will definitely study hard.

		Week 10: Hi teacher, I found myself feeling uncomfortable when reading comments from less proficient students. While I appreciate their good intentions, their comments were often incorrect. Week 11: The COVID-19 pandemic is too serious, I can't go to many places to create Chinese artifacts, I'm too tired to post a lot of artifacts, I'm sorry teacher.
	OQ	I'm surprised at my progress, and my Chinese adaptability is unparalleled in any other times. Seamless learning undoubtedly improved my ability. It is worth highlighting that employing the DingTalk platform is exceptionally engaging and enjoyable. Relying on its consistent seamless activity mode, it encouraged me to write more and track my development in Chinese writing. Most importantly, it allowed me to do all this at my convenience. However, there are times when I am unable to post due to the COVID-19 pandemic requiring daily nucleic acid testing and the university's mid-term exams, which affects the quality of my posts.
L24 High	I	Week 2: My internet constantly disconnect. Week 4: While the Learning Circle offers a secure platform, a drawback is that any posted artifacts cannot be edited or withdrawn, similar to other social media platforms. In such cases, users have to delete the artifact and re-post it once again. Week 8: I am extremely satisfied with the online learning environment, which is seamless and offers plenty of interactive sessions and exercises. Also, I am very happy with the free use of DingTalk platform. I really enjoyed the ranking function, it often motivates me to post more Chinese artifacts. Week 12: I think comments are very important because teachers and classmates pay attention to me and give me likes. They also help me correct my Chinese sentences, which allows me to improve my Chinese and not make the same mistakes next time. Week 16: I'm amazed at my progress, and I'm now more comfortable with Chinese than at any other time. Seamless learning has definitely improved my Chinese writing. With its consistent pattern of seamless activities, it motivates me to write more, track my development in Chinese writing, and more importantly, do all of this at my convenience.
	OQ	I majored in management at University, but my Chinese was not good. My teacher suggested me to take part in this seamless study. After taking part in the seamless Chinese vocabulary learning study, I found

		this learning method very interesting, and it made me make a lot of progress in Chinese, especially in terms of vocabulary growth, I can remember a lot of words. I can create lots of Chinese artifacts and I definitely improved my Chinese writing well. I am usually too busy with professional courses and rarely have time to study. But because the major I'm studying is more practical, I still hope to have many opportunities to teach students in the classroom. Although we are also taking Chinese teaching skills classes now, I think it's all on paper. In fact, many classes are not suitable for online classes, and we can't learn anything. The school might as well postpone such classes until the winter and summer vacations to make up.
L25 High	I	Week 2: The HSK Level 4 Learning Circle is very fun. Also, I am extremely satisfied with the fact that I can use DingTalk platform without any cost. Week 4: I really like and enjoy the learning method you provide. It allows me to continue learning after class, and as long as there is internet access, I can conveniently enter the Learning Circle and post artifacts to study Chinese. It is quite meaningful. But the timed writing task in the first stage is causing me to experience anxiety and pressure. I don't feel like I am fully prepared for it yet. Week 8: The seamless learning activities are interesting, but due to COVID, I can't go to some malls for shopping. This stage is a great opportunity for interaction with teachers and classmates. Week 12: I think comments are very helpful because they can help me understand my mistakes, benefit from opportunities to revise and learn new knowledge, and then continue to create content for my article, making my Chinese better and better.
	OQ	My Chinese writing has improved a lot. After the online class, students had to take part in the seamless learning. Being on the mobile phone often would damage their eyesight, and class was more likely to be tired. Sometimes I forget to post my artifacts, but I've mastered a lot of HSK4 level words. Although I'm very tired, I've learned a lot. BTW, the Ranking function is quite good! If I noticed that my friend had a better score than me, I would feel motivated to compete with them and try to outperform them.
L26T High	I	Week 2: Wow! I find access to DingTalk platform was faster than access to Chaoxing. I enjoy using the platform. It makes me

	increasingly interested in posting Chinese artifacts on the Learning Circle of DingTalk platform. Week 4: I quickly adapted to posting Chinese artifacts in the Learning Circle and I was happy because my teacher could also comment immediately and he often encouraged us to post our artifact using the vocabulary we were learning, it makes me expand my vocabulary in daily life and achieve my goal. Week 8: I am very satisfied with the seamless online learning environment supported by the DingTalk platform, as it provides ample opportunities for interaction and practice. Also, peer reviews are really great, especially since I got a lot of likes, I want more likes. Week 12: I think it's great. When my teacher indirectly points out my mistakes, I have to think deeply and then respond to the teachers comments, and other classmates also help me learn. In this way, I almost never forget the mistakes I made before. Week 12: My university has been locked down for weeks due to the recurrent outbreak of COVID-19. I have to study at the dorm. Week 16: When I was learning and using HSK Level 4 vocabulary, I also encountered a lot of HSK Level 5 vocabulary, and I learned it by the way. And I also found that when I used Chinese in my life, I also learned some words that I rarely use, such as 幻灭的梦 disillusioned dream, which is a lyric. There are also some Wuhan dialect words, such as 弯管子 and 滴滴答. Ha ha! Week 16: I think if I can see my classmates feedback, I would be learning sooner because I can see other mistakes which is unknown for me before that and maybe I have these mistake but I didn't know these are false. This is good way for me because I can see another writing and thinking about a topic which I write. Also, it is a very good way to learn Chinese seamlessly. It not only gave me new ideas for writing, but also motivated me to learn continuously. I can learn a lot of new vocabulary and create a lot of interesting artifacts in different scenarios. Post: During the first stage, I mainly studied in my dormitory because the COVID-19 situation here was very serious. I didn't post many artifacts and I also didn't adapt well. We were not familiar with each other during the online classes, and some students didn't turn on their cameras and others had microphone problems, which made it very noisy. The teacher taught us HSK Level 4 materials, including listening,
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		vocabulary, speaking discussion, and writing, so there was a lot of content. After class, the teacher would post some activities and topics, such as “Friendship,” and we would seamlessly continue learning. In the second stage, I adapted and started to post a lot. I went from my dormitory to places like the campus, coffee shops, and malls to take photos and post my artifacts. However, due to the COVID-19, we had to wear masks and were not allowed to go too far from the school. During the third stage, I went on a vacation during the Chinese holiday and continued to post while studying in the hotel and taking photos in scenic spots. Some students were absent from class during the third stage, but it was okay because we only had one class per week. Although I was sad about having one less class per week, I learned a lot on my own after class. Although we have one less class per week now, I think this adjustment has had an impact on my Chinese language learning, such as making me more autonomous. I think this adjustment is very good as it gives us more time for self-study, without the pressure and exhaustion from the previous stages. I feel that my Chinese language proficiency has improved a lot, especially in writing. I have been writing better and better, and I really like this way of learning because it is very interesting and there is no pressure, so I can learn anytime, anywhere. Although it has ended now, I will continue to post in Chinese because it gives me a great motivation to improve! In addition, I'd like to say that the Ranking function is so cool! If I saw that my friend had a higher score than me, I would use it as a challenge to push myself and surpass their achievement.
	OQ	To tell you the truth, I wasn't interested in this research at first, but I wanted to pass HSK Level 4. My Chinese teacher arranged this seamless course for me, so I took part in it. At first, I felt boring, but gradually I found that the seamless learning activity was very interesting. The HSK Level 4 Learning Circle were safe and transparent and it has a protective effect, I like it. Also, It was very motivated and kept learning new vocabulary without interruption in the DingTalk platform. This was the most Chinese I learned. Besides, I was at school by myself and took many photos and created Chinese artifacts. I felt that I had made great progress, I think this method is very helpful. Thank you! But the COVID-19 pandemic often prevents me from creating my artifact! Our school rules say not to go too far. But I really

		like the method of learning Chinese. Seamless learning is helpful and beneficial.
	F	Week 2: There are too many students in class, and the classroom is a bit chaotic. Some classmates have very noisy microphones. Week 4: It is not possible for me to distribute the artifacts on other social media platforms. Week 8: Regarding the seamless learning activities, I have to say that I really enjoy doing them on the DingTalk platform, because you can see the comments and likes that your teachers and classmates give you in the Learning Circle immediately and you can think about them. Week 10: Wow, DingTalk's online discussion feature provides me a great opportunity to practise using Chinese vocabulary in context. By participating in discussions with classmates and teachers, I can improve my ability to communicate effectively and express my ideas using Chinese vocabulary; When seeing my friend with a higher score than me would inspire me to strive for better and work harder to surpass them. Week 13: Creating Chinese artifacts costs me lots of data when I am searching for situations outside! It's very pricey to spend money on the internet data plan. I'm a learner who gets minimal pocket money. That makes it hard for me to buy a data plan.
L27T High	OQ	First of all, my Chinese vocabulary learning has really improved a lot. I also become more confident to learn Chinese than before. Every time I take pictures and do seamless learning activities, I will learn new vocabulary unexpectedly. The last time I took the bus to the shopping mall, I used the word traffic jam. In the case of traffic jams, I also learned the word "gag" and the word "helmet" on motorcycles. The teacher praised me for being very clever. Also, I was not interested in writing at the beginning, and participating in this research was just for fun, but in the end, I became interested in Chinese writing. My writing skills has got improvement. And I also improve my social skills and made lots of foreign friends from other universities. Although the course is over, I will continue to study Chinese. I am no longer afraid and afraid of Chinese writing. But, I don't believe learners comments on each others artifacts are reliable because they all have mistakes in their artifacts, and were both learners, and classmates can't fully correct each others mistakes. I think the teachers comments are excellent. BTW, the COVID-19 pandemic doesn't allow us to go to many places,

		and the network signal is sometimes bad. Sometimes I feel lonely.
I		Week 12: Online peer discussion activities of seamless learning had a lot of positive effects on my writing and new vocabulary acquiring by means of my peers comments on my artifact. Then, I have to say their comments are very kind to point out my mistakes, and I will be cautious in what I write in the next posts. Week 16: I think I have improved my Chinese. Especially when I post sentences on the platform, I can create a lot of Chinese artifacts. Seamless learning is very helpful. Post: I think there are too many people in our class. In my university, we usually have 8-10 people in a class, which is different from the classes in China. Language learning requires a lot of interaction and practice, and it's important to participate in discussions with the teacher. With 32 people in this class, it's a bit noisy and crowded. I feel very satisfied and comfortable with the seamless learning environment, and the DingTalk platform is free to use. Sometimes I study in my dormitory, sometimes I study at Starbucks, it's quite flexible. I feel like my Chinese is improving, especially in the third stage, where I have become more proactive and have been posting more and more artifacts. Although I cannot go out and take many photos due to the COVID-19 pandemic, I will download some pictures from the internet to create artifacts. Because the teacher and classmates give me comments and likes, it gives me confidence and makes me more interested in creating artifacts, so I create and post a lot. Moreover, everyone's comments make me aware of my mistakes and correct them. Each stage is different. In the first stage, everyone warms up and gets familiar with each other. In the second stage, the teacher adjusts the teaching method, and everyone starts to interact and slowly posts a lot of artifacts. In the third stage, the teacher begins to encourage us to learn independently, and we also pay attention to safety. In the last stage, we have one class per week, and the teacher summarises all the issues in this class. Actually, I feel it is very good. I feel that the course has become more and more meaningful, and I have gained a lot from it, especially through creating and posting many Chinese sentences. I usually post more when I am in my dormitory or outside, as I like to go out and explore. To be honest, although I used to

		often post Chinese sentences on Facebook or WeChat before, this is my first time posting on DingTalk, and I feel that it's very beneficial. The teacher created a Learning Circle for us, and only students in our class can access and use it, and we can only see and comment, like, etc. on the Chinese artifacts posted by our classmates. I feel a sense of belonging and not alone. When I posting my artifacts, the teacher and classmates will give me comments and likes, which makes me feel happy and proud, and gives me confidence and no longer afraid of writing. I create and post a lot of Chinese artifacts because I feel that this way I can practise my Chinese writing skills and apply Chinese vocabulary to my daily life, and make my Chinese better and better! So I use it more and post more. Because of the COVID-19 pandemic, each of us had to reduce communication and meetings, and we could only chat through the network. Although I have been taking online classes for a long time, the effect was not very good. Since I joined this seamless learning, I found that in addition to online learning, we need to have seamless and uninterrupted learning, which means that learning should continue all the time. I think this is very good, and it has made my Chinese level better and better.
	F	Week 2: Too many people in class, the class is too noisy. Week 2: I am extremely satisfied with the fact that I can use DingTalk platform without any cost. Week 4: Due to COVID-19 prevention and control policies, it is not easy for me to find a suitable place to take photos and post them. Also, sharing the artifacts on other social media platforms is not possible for me.
L28 High	I	Week 2: The Learning Circle of DingTalk is so interesting and safe. But the class is a bot noisy. Week 4: Yes, it's my first time. It's like posting on Facebook, but in Chinese, which makes it quite enjoyable.
	OQ	I've been in the online class for a long time. It is boring. The teacher doesn't have high requirements for us. As long as we pass the exam, everything will be fine. In the past, I really couldn't learn anything in the online class. But after taking part in this seamless learning, I found that I have made great progress in my Chinese, and I have created a lot of Chinese artifacts and gained a lot of knowledge. Thanks to the encouragement of the teachers, and the teachers let us take the

		initiative to practice and learn in daily life, so that we can practice the Chinese in class very well. In addition, seamless Chinese learning is creative and very useful, it makes me more and more confident in Chinese writing and it makes me even more powerful to solve any problem I faced. Besides, the HSK Level 4 is very important to me, because I'm going to be a graduate. This learning method makes me interested in Chinese again, but it's over soon. I don't want to go back to the previous Chinese class.
L29 High	I	Week 2: The Learning Circle is very interesting and safe. Week 4: I thought I wouldn't be able to finish within an hour, but after brainstorming and organizing my ideas, I had a lot of thoughts and content in my mind, which allowed me to write quickly. Week 12: I am happy with the seamless learning class. It's been an enjoyable experience so far, with the teacher being very professional and motivating, constantly helping us out. However, my internet connection is often unreliable, making it challenging to hear the teacher properly. But, due to the virus, the situation became increasingly dangerous in my living area. Chinese government is very strict to control it. I have to do test once a day. Week 16: I feel that my vocabulary has really improved and that I have mastered vocabulary in various scenarios through this seamless learning, in addition to the Chinese vocabulary I have studied in my textbooks. For example, the word “蚊帐 mosquito net”. I learned in the supermarket, and when I was a guest at my Chinese friends house, I learnt from them that “上梁不正下梁歪 the upper beam is not correct and the lower beam is not correct”. It's so interesting.
	OQ	In the past, I rarely used Chinese in my daily lives, because I watched TV plays and prefer to order takeout for meals in the dormitory. But now, this seamless learning study makes me immersed in Chinese study every day, because I really want to pass the HSK Level 4 test, but I am too lazy and unable to move. But this teacher encourage me every day to practice Chinese after class. So after class, I found a lot of opportunities to learn Chinese. At the beginning, I was very passive and was forced to learn, so I was forced to complete the teachers homework. But later, I began to learn by myself. I will post Chinese artifacts every day. I like this way of learning. Thank you for your help. But, sometimes the internet is not good, so I can't hear the teacher's speech, and some students don't turn off their microphone in class,

		making it very noisy.
L30 High	I	Week 2: My network is poor because four people in our dorm share one WiFi. Week 4: The Learning Circle is great. I can post lots of artifacts, and I can also comment on others. In my opinion, the best part is the privacy, only my classmates and teachers can see it and comment on it; others can't, so it has a protective effect. Week 8: It's quite fascinating, the teacher is extremely knowledgeable and provides us with great encouragement and support. Nevertheless, I face some difficulties due to my unstable internet connection, which sometimes results in me not being able to hear the teacher clearly. Week 12: That's great to hear! It's always important to reflect on feedback and take the time to learn from it. This will definitely help you improve your writing skills and overall language proficiency. Keep up the good work! Week 12: I find that some words, like 'responsibility,' can be quite abstract, and it's challenging to relate them to real-life situations. However, I do my best by searching for images on the Internet to create my artifacts. Week 16: For me, I think starting one class per week in the previous stage was helpful because I had already understood a lot of the vocabulary and it wasn't difficult for me. I have remembered many words and can use them well in real life. I have achieved my vocabulary learning goal, and my Chinese sentences that I write now have very few errors and are very suitable for the context. My teacher often compliments me on how much better my Chinese writing has become.
	F	Week 4: The seamless Learning Circle is so interesting, a bit like Instagram, you can post photos, short videos....The most important thing is that it is very helpful for Chinese vocabulary learning. Week 16: I think that's so important and so useful to learners like me can understand their own mistakes and correct them, and understand as soon as possible their mistakes.
L31 High	F	Week 1: I feel like there are too many people and it's hard to get to know everyone. It would be best to divide the class into smaller groups for both classes and practice. In my university, we had a class with only 7 people and we quickly became good friends. Week 2: DingTalk has become my new favorite platform for learning and sharing Chinese language content. Unlike Zoom, I can use it to

		post my own artifacts and improve my language skills, no matter where I am. Week 4: Finding a suitable place to take photos and post them has become a challenge for me due to COVID-19 prevention and control policies. And, I found out that I cannot disseminate the artifacts on any other social media platforms. Week 8: I can create artifacts and post it into DingTalk platform whenever I want or not. Everything is on my fingertips. Week 12: Many of the comments given to me by some learners with low Chinese proficiency were incorrect, which made me feel very awkward and uncomfortable.
	I	Week 16: As far as I am concerned, online peer discussion is very helpful in assisting me in identifying my mistakes in artifacts. Because we are discussing the artifact, I can think about their mistakes. It's helpful to reduce my mistakes.
	OQ	Actually, I am not interested in peer discussion in the HSK Level 4 Learning Circle, I prefer face-to-face communication and discussion, so that it will be very helpful to improve my Chinese vocabulary learning. Sometimes the comments some students give me make me upset, and there are too many people in our class, and I don't have a chance to answer the teachers questions, the Internet is sometimes not good, and I can't hear the teacher.
L32 High	OQ	At the beginning, I am very skeptical of this learning method because the formal learning mode is also online learning, I think it is similar to my university. But, it has changed my perspective, I am becoming increasingly satisfied, and I have experienced a new way of writing, which has greatly enhanced my Chinese vocabulary learning.
	F	Week 6: I am not familiar with some people, and I am worried that they will be upset after I comment. Week 8: COVID-19 prevention and control policies have made it difficult for me to find an appropriate place to take photos and share them. Week 11: In my opinion, it is important to interact with teachers and peers because these interactions can enhance our Chinese learning through immediate feedback. And during in-class learning, my Chinese teacher vividly presented Chinese materials in an engaging manner. Sometimes, I can go to his office as soon as I have any questions.
	I	Week 2: I don't think it's interesting to post Chinese artifacts in the Learning Circle, because I can learn Chinese in normal Chinese

		classes, and I think I can improve my Chinese by not posting artifacts. Week 4: It is challenging to get to know everyone with such a large group of people. Dividing the class into smaller groups for classes and practice sessions would be more conducive to building relationships. In my university class of only 7 students, I formed close friendships with my classmates in no time. Week 12: I don't like comments from strange students, it annoys me. Week 12: Because of the COVID-19 prevention and control policies, it's proving to be quite the challenge to locate a fitting spot to take photos and upload them. Week 14: I am very used to posting Chinese in the Learning Circle; it is very comfortable. And I can also see other learners' posts, likes, and comments.
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