The Role of L2 Vocabulary Knowledge in Writing Proficiency from the Perspective of Mediating Effect of Fluency

Yanli Tong
Language and Literacy Education Department, Faculty of Education, University of Malaya, 50603 Kuala Lumpur, Malaysia
&
School of Language and Culture, Ningde Normal University, 352100 Ningde, China

Zuwati Hasim
Language and Literacy Education Department, Faculty of Education, University of Malaya, 50603 Kuala Lumpur, Malaysia
Corresponding Author: zuwati_hasim@um.edu.my

Huzaina Abdul Halim
Language and Literacy Education Department, Faculty of Education, University of Malaya, 50603 Kuala Lumpur, Malaysia

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Abstract
The current study aims to probe the effectiveness and predictability of four aspects of lexical knowledge in writing proficiency of 312 Chinese university students of English as an ESL/EFL by pathways analysis of structure equation modeling. Furthermore, Bootstrapping and Monte Carlo statistical methods were used to analyze the mediation role of vocabulary fluency in the relationship between lexicons and writing proficiency. The results indicated that (a) the tested four aspects of lexicon knowledge (receptive/productive vocabulary breadth/depth) were all found to have a potential effect on writing; however, the effect of productive lexicons on writing proficiency is higher than that of receptive ones, and the effect of depth is better than that of breadth in both reception and production; (b) regression analysis demonstrated that overall lexical knowledge can account for 50 percent of the variance in writing; (c) vocabulary fluency plays a partial mediation role between vocabulary knowledge and writing ability; and (d) given the mediation role of lexicon fluency, the regression coefficient of both receptive vocabulary breadth and receptive vocabulary depth raised by 3 percent respectively; however, the regression coefficient of productive vocabulary has no changes. These findings suggest that vocabulary fluency can help language learners perform better in writing ability if only they have high vocabulary levels, especially productive vocabulary knowledge.

Keywords: mediating effect, structure equation modeling, L2 vocabulary fluency, vocabulary knowledge, writing proficiency

Introduction

It has been proved that lexicon knowledge makes a significant contribution to the process of language development and can effectively predict language proficiency in both ESL and EFL. Many scholars argue that good command of the lexicon is an essential prerequisite for successful language learning (Nation, 2013; Qian & Lin, 2020; Schmitt, 2010). The association between lexicon knowledge and different language proficiency has attracted much research attention, for example, the studies on vocabulary and reading (Cheng & Matthews, 2018; Ibrahim et al., 2016; Karakoç & Köse, 2017; Nouri & Zerhouni, 2016; Qian, 2002; Stæhr, 2008b; Zhang & Zhang, 2020); the studies on vocabulary and listening (Cheng & Matthews, 2018; Dabbagh, 2016; Farvardin & Valipouri, 2017; Stæhr, 2009; Teng, 2016); the studies on vocabulary and speaking (Alharthi, 2020; Uchihara & Saito, 2016, 2019); and the reflections on vocabulary and writing (Dabbagh & Enayat, 2019; Flora, 2021; Karakoç & Köse, 2017; Zaytseva et al., 2022; Zhang & Zhang, 2020). Of the four language skills covering reading, listening, speaking, and writing, the researchers mainly focused on the correlation between word knowledge and receptive language skills, including listening and reading, instead of productive language skills, including speaking and writing, probably because reading and listening are easier to be assessed and scored than speaking and writing.

Nation (2013) shows that lexical knowledge is crucial in writing skills. Of all the four skills of language, however, a few researchers focused on the role of vocabulary knowledge in writing skills. In research on the association between lexicons and writing performance, some studies only gave special attention to the effect of receptive lexicon breadth and depth in predicting L2 writing proficiency (Dabbagh & Enayat, 2019; Kilic, 2019). Miralpeix and Muñoz (2018) explored the relationship between one-dimension (receptive vocabulary breadth) and multi-dimension language skills (listening, reading, speaking, and writing). Atai and Dabbagh (2010) examined the correlation between receptive lexical depth and writing performance. Tong et al. (2022) investigated the relationship between the four dimensions of linguistic knowledge and L2 listening.

Although researchers showed an increasing interest in the link between receptive/productive vocabulary breadth/depth and different language skills, the studies in L2 writing performance attracted less attention, especially when considering vocabulary fluency as a mediation variable concurrently. Therefore, there is little empirical research data to shed light upon the relative significance that these aspects of vocabulary knowledge have on L2 writing.

In addition, it is challenging for most Chinese university students to develop both their writing skills and vocabulary knowledge, perhaps because Chinese is different from English. Although they recite many words in the book list, it is tough for Chinese university students to use the appropriate words when they are writing. The main reason is that when learning vocabulary, they do not know the conceptual framework of vocabulary knowledge, and do not understand which dimensions of vocabulary are more conducive to improving their writing skill. In other words, they do not understand the actual relationship between vocabulary knowledge and writing ability, so they cannot apply the learned vocabulary to write in a targeted manner. Therefore, the purpose of the current study is to help Chinese English learners and other non-native English learners elsewhere effectively to develop their vocabulary knowledge and improve their writing ability by ascertaining the relationship between four aspects of lexical knowledge and writing proficiency.

The research has multiple significances. Firstly, it is expected to make a substantial contribution to L2 vocabulary acquisition in China and other places. Additionally, the study
provides a structural equation model of the relationship between four dimensions of L2 vocabulary knowledge and four language skill development. This will help ESL/EFL researchers and learners disentangle their complicated interrelationships.

To help Chinese university students comprehensively understand the extent of lexical knowledge affecting the quality of writing and have a good command of English, the present study thus is administered to ascertain the relationship between four aspects of linguistic knowledge and writing proficiency based on the mediating effect of vocabulary fluency, to clarify how much these aspects of linguistic knowledge affects writing quality and whether these aspects of linguistic knowledge can predict writing proficiency and whether the impact effect of these aspects of linguistic knowledge on writing will change under the mediation of vocabulary fluency.

Based on the research aims identified, we proposed three research questions:

RQ1. How important are the four aspects of L2 vocabulary knowledge for writing?
RQ2. To what extent can writing proficiency be predicted by the four aspects of L2 vocabulary knowledge?
RQ3. How does L2 vocabulary fluency play a role in the association between the four aspects of L2 vocabulary knowledge and writing proficiency?

Literature Review

Breadth and Depth

Schmitt (2014) shows that vocabulary knowledge is not only complex but also multi-faceted, and this complicated phenomenon always perplexes researchers and ESL/EFL teachers to clarify the exact nature of vocabulary knowledge. To handle the complex issue, researchers have tried different vocabulary frameworks, among which two lexical dimensions have been widely accepted by researchers, that is, lexical breadth and depth (Henriksen, 1999; Meara, 1996; Read, 2000). Lexical breadth means the number of words which language learners know, while lexical depth implies the degree of vocabulary knowledge language learners understand (Nation, 2013; Schmitt, 2014).

Receptive and Productive

Vocabulary knowledge is divided into two facets: receptivity and productivity (Henriksen, 1999; Nation, 2013). Nation (2013) thinks that the concept of receptive knowledge is that language input is accepted by other people by listening and reading and trying to make it clear, while the idea of productive knowledge is that language forms are produced by speaking and writing to inform other people of information. Essentially, receptive vocabulary application is perceiving the word’s form and retrieving the word’s meaning while listening or reading. Productive vocabulary application is trying to express meaning in spoken or written word form (Nation, 2013).

Four Aspects of L2 Lexical Knowledge

Based on two dimensions and two facets of L2 vocabulary knowledge, four elements of vocabulary knowledge constitute the essential components of vocabulary acquisition. Thus, by synthetically analyzing these researchers’ lexical framework concept, four aspects of vocabulary knowledge come into being: receptive vocabulary breadth/size (Dabbagh & Enayat, 2019; Henriksen, 1999; Nation, 2013; Qian, 2002); receptive vocabulary depth (Dabbagh & Enayat, 2019; Henriksen, 1999; Meara, 1996; Nation, 2013; Qian, 2002); productive vocabulary breadth (Cheng & Matthews, 2018); and productive vocabulary depth (Alireza, 2017). Although many
researchers have explored the association between these aspects of lexical knowledge and different language skills, however, they focused on the correlation between part of aspects of vocabulary knowledge and receptive language skills, especially reading proficiency. Thus, it is essential to ascertain the contribution of these four aspects of lexical knowledge to productive skills, e.g., writing.

**Lexical Knowledge and Writing**

It has been acknowledged that lexical knowledge plays a crucial role in developing L2 learners’ writing skills. The significance of lexicon knowledge in evaluating writing proficiency has motivated some scholars and researchers to investigate the association between lexicons and writing. Santos (1988) identifies the crucial role of lexicons in EFL students’ writing based on the lexical errors made by learners. Nation (2013) notes that it is essential to develop lexical knowledge for reading and writing. Laufer (2013) shows that focusing on different aspects of vocabulary can strengthen lexicon use in writing. The researchers highlight the significance of vocabulary knowledge for writing; however, various researchers have a different focus on other aspects of vocabulary knowledge in writing.

Taking lexical dimension as the distinguishing point, we will categorize and analyze the literature on the association between L2 lexicon knowledge and writing capability in the following section.

Firstly, we carefully checked the studies on the association between one aspect of L2 lexical knowledge, receptive vocabulary breadth, and writing. On 88 Denmark EFLL participants, Stehr (2008a) conducts an analysis exploring the correlation between receptive vocabulary breadth and three language skills covering writing, listening, and reading comprehension and finds that receptive vocabulary breadth moderately correlated with listening capability ($r = .69$) and strongly linked with their reading ability ($r = .83$) and writing ability ($r = .73$), although writing belongs to productive language skill. Miralpeix and Muñoz (2018) investigated the correlation between receptive vocabulary breadth and EFL language skills of listening, reading, speaking, and writing based on 42 participants. The authors find that at an advanced level, receptive vocabulary breadth is closely related to writing ($r = .57$) and is moderately linked with reading ($r = .52$), speaking ($r = .49$), and listening ($r = .42$). The two studies show that highlighting receptive vocabulary breadth would be very helpful in developing writing skill.

Secondly, we analyzed the studies on the association between one aspect of L2 lexical knowledge, receptive vocabulary depth, and writing. Atai and Dabbagh (2010) examined the role of receptive vocabulary depth in the writing of 70 lower-intermediate level and upper-intermediate level EFL learners and found that receptive vocabulary depth plays a fundamental role among lower-intermediate learners but not among upper-intermediate learners as well as found that receptive vocabulary depth has an essential role in overall writing proficiency only upper-intermediate learners by t-test. Although this study does not offer data on the correlation between these two variables, it highlights the importance of receptive vocabulary depth in developing L2 writing skills.

Thirdly, we searched the literature on the association between two aspects of L2 lexical knowledge, covering receptive vocabulary breadth and depth, and writing proficiency. Dabbagh and Enayat (2019) ascertained the association between receptive vocabulary breadth/depth and L2 descriptive writing based on 67 English learners. Based on their research results of multiple regression and correlation analyses, the correlation coefficient between receptive vocabulary...
breadth/depth and writing is the same with $r = .43$. Wu et al. (2019) investigate the role of receptive vocabulary covering breadth and depth and Chinese English beginners’ writing development based on 267 secondary students (120 Grade 8 students and 147 Grade 9 students), and find that receptive vocabulary breadth ($\beta = .28$ for Grade 8; $\beta = .41$ for Grade 9) contributes to writing ability greater than receptive vocabulary depth ($\beta = .22$ for Grade 8; $\beta = .14$ for Grade 9). Therefore, the average value of the two groups is $\beta = .35$ for breadth and $\beta = .18$ for depth. Thus, receptive vocabulary breadth plays a more critical role than receptive vocabulary depth in developing writing skills.

Fourthly, we explored the studies on the association between receptive and productive vocabulary breadth and writing. Karakoç and Köse (2017) examine the role of these two vocabulary dimensions on reading, writing, and general language capability based on 175 EFL learners. The authors find that the correlation between receptive lexicon breadth and reading is $r = .43$. The correlation between productive lexicon depth and writing is $r = .43$ too. They also show a moderate correlation ($r = .65$) between receptive lexicon breadth and general language proficiency and a strong correlation ($r = .83$) between productive lexicon breadth and general language proficiency. Nasir et al. (2017) ascertained the correlation between receptive lexicon breadth and productive lexicon breadth, and general language proficiency based on 136 Malaysia university students and found that receptive vocabulary breadth has a higher correlation with language proficiency than productive vocabulary breadth, such as $r = .52$ for 3000-word frequency level of receptive vocabulary breadth and $r = .43$ for productive vocabulary breadth.

Additionally, we examined the studies on the association between three dimensions of L2 lexical knowledge, including receptive lexicon breadth and depth, productive lexicon breadth, and writing. Kilic (2019) ascertained the association between three dimensions of L2 lexical knowledge, including receptive lexicon breadth and depth, productive lexicon breadth, and writing on 54 Turkish English learners. He found that the correlation between three dimensions and writing is $r = .49$, $r = .39$, and $r = .48$, which indicates both receptive vocabulary breadth and productive vocabulary breadth have a nearly equal effect in writing, while receptive vocabulary depth has a lower impact in writing.

Finally, we examined the studies on the relationship between four dimensions of L2 lexical knowledge: the three aspects mentioned above and productive vocabulary depth, and writing. Choi (2017) investigates the roles of four aspects of lexical knowledge in writing by the mediation of L2 reading of 178 Korean university students and finds that productive lexical knowledge tested by breadth and depth knowledge had a direct role ($\beta = .35$) on writing. Receptive lexical knowledge tested by breadth and depth knowledge was not discovered to have a direct role in writing ($\beta = .13$). In this study, Choi only analyzes the role of both overall receptive lexical knowledge and overall productive lexical knowledge in writing, which is unilateral. Since the four aspects of lexical knowledge have been measured, it is necessary to analyze the correlation of each element with writing.

By checking the related literature above, it is obvious to see that most researchers focus on the effect of one or two aspects of L2 vocabulary knowledge in writing, and few studies concentrate on the role of the four aspects of L2 vocabulary knowledge in writing. Although Choi considered four dimensions of vocabulary in 2016, the respective impact of the four dimensions on writing was not analyzed. Therefore, it is essential to ascertain the relationship between four aspects of L2 lexical knowledge in writing proficiency.
**Vocabulary Fluency**

Vocabulary fluency is also one dimension of lexical knowledge. Daller et al. (2007) think that vocabulary fluency should belong to the quality of vocabulary knowledge. This leads to a new three-dimension perspective to thinking in language learners’ vocabulary knowledge, which consists of breadth, depth, and fluency. Schmitt (2014) notes the importance of the three-dimensional view because the conceptualization of vocabulary competence has been changed to performance ability which should be language learners’ ultimate goal. Segalowitz and Hulstijn (2005) stress the vital role of vocabulary fluency in different language skills. Thus, it makes sense to study vocabulary dimensions together with vocabulary fluency.

Vocabulary fluency is a crucial factor influencing L2 learners' performance in various language skills. It is sensible to know that if the speed of word recognition rises, learners can focus their attention on handling higher levels of communication. van Gelderen et al. (2004) show that a positive correlation is found between word recognition speed and reading performance. Schmitt (2010) believes that to communicate smoothly, there is an urgent need to process words quickly enough. Therefore, vocabulary fluency is defined as proficiency in recognizing and retrieving a target word in language use.

When we mention vocabulary learning, the core concept is to command vocabulary size/breadth and depth. However, if learners want to be proficient in language use, vocabulary fluency must play a key role. In other words, lexical fluency acts as a booster in language development. Therefore, it is reasonable in this study that vocabulary fluency is regarded as a mediation variable to affect the relationship between lexical knowledge and writing quality.

**Conceptual Framework**

Based on the literature mentioned above and our research objective, a research concept framework has been designed (Figure one).

![Conceptual framework](image)

**Figure 1.** Conceptual framework

Note: VK=vocabulary knowledge; LP=language proficiency; WP=writing proficiency; Rec=receptive; Pro=productive

In Figure one, the double arrow between Vocabulary Knowledge (VK) and Language Proficiency (LP) indicates the relationship between these two variables. On the left of vocabulary knowledge, it has two dimensions: breadth and depth, and it also has two aspects: receptivity and productivity. Thus, these four aspects, including receptive vocabulary breadth, receptive vocabulary depth, productive vocabulary breadth, and productive vocabulary depth, are used as independent variables. The dependent variable is writing proficiency on the right of language proficiency. This concept framework is the theoretical basis adopted to establish a structure equation model.
Method

A quantitative research method was used to recruit the participants, collect data, design the research model, and analyze data.

Participants

The participants of the study are 312 sophomore students coming from one Chinese tertiary university in 2022, all of whom were 20 years old and had studied English for at least ten years. Most of the students had a CET4 certificate, which measures the English proficiency of non-English major Chinese university students. The study also included four experienced EFL teachers: one professor, one associate professor, and two lecturers, who served as raters for the vocabulary and writing tests. Two of the teachers had overseas learning experience, and all had almost twenty years of English teaching experience.

Instruments

For this research, five vocabulary measurement instruments were used, and a writing test was conducted to yield relevant research data. All the research instruments were provided in an English version because the participants had a level of English capability sufficient to enable them to understand the measurement instruments. A detailed description of each device is provided below.

Receptive Vocabulary Breadth Measurement Instrument

Based on McLean et al. (2020), meaning-recall can better provide an explanation or justification for language proficiency scores than meaning recognition; therefore, in this research, VLT (meaning recognition test) developed by Schmitt et al. (2001) is adapted to the meaning-recall format. It still includes two thousand, three thousand, five thousand, ten thousand, and academic vocabulary. Each level has 30 items. The target word is addressed in an English sentence, and test takers translate the target word into Chinese. An example is presented below:

The **motor** can move a car. ____________.
(Please translate the bold and underlined word into Chinese)

Receptive Vocabulary Depth Measurement Instrument

The Receptive Vocabulary Depth Test (VDT) was conducted by using the Word Associate Test (WAT) developed by Read (1998). Generally speaking, it has been regarded by researchers as a proxy of receptive lexicon depth testing instruments. The synonym of calm should be chosen from words on the left side, and the collocation of calm should be found from words on the right side. One example is presented below:

calm

[(A)open (B)quiet (C)smooth (D)tired] [(E)cloth (F)day (G)light (H)person]

Productive Vocabulary Breadth Measurement Instrument

According to Laufer and Goldstein (2004), the form-recall test can better explain the productive language proficiency scores than meaning recognition; therefore, in this research, PLT (meaning recognition test) developed by Laufer and Nation (1999) is adapted to form recall format. It still includes two thousand, three thousand, five thousand, ten thousand, and academic
vocabulary. Each level has 18 items. The target word is presented in Chinese sentences, and test takers translate the target word into English. An example is shown below.

很高我们有机会交谈。opp ________
(Please write one word according to the bold and underlined Chinese phrase, the first three letters have been provided)

Productive Vocabulary Depth Measurement Instrument
Since multi-dimension features of vocabulary depth, it is impossible to check all its aspects. The test instrument, Productive Vocabulary Depth Test (PVDT), was used based on the “A Definition Completion Test (DCT)” suggested by Read (1995). The test takers are required to define the target word and make a sentence, a conscious metalinguistic representation used to search for terms in the semantic space of the subject's brain, and test the vocabulary capability of the participants, including word parts, association, collocation, and structure. As addressed in the examples below:

Communication
Definition:
Example:

Vocabulary Fluency Measurement Instrument
The Vocabulary fluency measurement instrument (VFT) used in this study was a dictation test about elements of phonetics, morphology, semantics, and pragmatics of lexical knowledge. This instrument was designed based on training methods for retrieving individual words proposed by Snellings et al. (2002), in which the participants need to write the required word or phrase by making use of known vocabulary knowledge with time pressure, resulting in faster vocabulary decision time.

In this dictation testing, participants must listen to a long passage with 80 missing words and write down these missing words when listening.
And there are 80 missing words in one passage, which should be completed in a limited time while listening. The fleeting features of listening reflect the speed of retrieving vocabulary, indicating their vocabulary fluency proficiency is better. For example:

“Welcome to all of you...can everybody see and hear me?...Good...I am Sally, your _____ for this _____ of the Bicentennial Park...I hope that you are all _____ your most _____ _____ and that you can keep up the ______. So, let’s _____ under _____ on our tour around this ______.”

Writing Proficiency Test
The writing proficiency test was based on the writing model of IELTS, but we applied only the argument composition to check the participants’ writing ability. The writing ability test selects the second part of academic writing, where the participants must complete an article with at least 250 words in 40 minutes. The topic pattern is the following.

The following topic should be finished in 40 minutes with at least 250 words:

Some experts believe that children should begin learning a foreign language at primary school rather than secondary school.
Do the advantages of this outweigh the disadvantages?
Research Procedures

It took nearly a year to conduct this study, from designing research, selecting participants, training examiners, and organizing examinations to data collection, scoring, data analysis, and essay writing.

Data collection

All the tests were arranged to conduct in the lecture halls. The participants had 35 minutes to complete the first and the third vocabulary tests, respectively (receptive and productive lexicon breadth), 30 minutes to finish the second and the fourth (receptive and productive lexicon depth), respectively, and 25 minutes to finish the vocabulary fluency test. Finally, one writing task was completed in 40 minutes.

Scoring

Based on one point per correct word, receptive vocabulary breadth (VLT) has a maximum score of 150 points, including five levels two, three, five, and ten thousand, and academic vocabulary, respectively, with 30 points for each level. Receptive Vocabulary Depth (VDT) has a maximum score of 160 points, including 40 target words, with four points for each target word. Productive Vocabulary Breadth (PLT) has a top score of 90 points, also including five levels like VLT, with 18 points for each level. Vocabulary Fluency (VFT) has a maximum score of 80 points, using four paragraphs with 20 missing words for each paragraph.

The Productive Vocabulary Depth test (PVDT) involved 20 words where the participants must provide a definition and produce a sentence for each word. Each target word has a total of four points, with two points for a definition, and for a sentence respectively. Thus, the total score of PVDT is 80 points. On writing ranking, the total points for the composition are 100 with four categories which are used as holistic scores of the writing tasks: Lexical resource (25%), Task response (25%), Coherence and cohesion (25%), Grammar and accuracy (25%).

Data Analysis

In this study, these four aspects of L2 lexical knowledge are used as exogenous variables, argumentative writing is the endogenous variable, and vocabulary fluency is a mediating variable. The data collected were analyzed by using AMOS 24.0.

Results

Variable Reliability and Validity Test

Variable reliability and validity were checked by Confirmatory Factor Analysis (CFA). In Table One, all un-standard estimated values are shown as positive numbers. Z-values are higher than 1.96 and $P < 0.001$, indicating the research hypotheses are established. All standard estimated values stand for factor loadings which are higher than 0.7, except for two items with almost 0.6; composite reliability is higher than 0.7, and convergence validity is higher than 0.5, except for the writing variable with 0.493, indicating good reliability and validity of all variables.

Table 1: Convergence validity

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Items</th>
<th>Significance of Estimated Parameter</th>
<th>Std.</th>
<th>Item Reliability</th>
<th>Composite Reliability</th>
<th>Convergence Validity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Unstd.</td>
<td>S.E.</td>
<td>Z-value</td>
<td>P</td>
<td>SMC</td>
</tr>
</tbody>
</table>

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In Table two, the discriminant validity is the square root calculations of the average variance extraction AVE and AVE square root in bold are higher than all Pearson Correlation Coefficients, indicating that the study has good discriminating validity.

Table 2: Discriminant validity

<table>
<thead>
<tr>
<th>CONSTRUCTS</th>
<th>AVE</th>
<th>WP</th>
<th>PVDT</th>
<th>VFT</th>
<th>VDT</th>
<th>PLT</th>
<th>VLT</th>
</tr>
</thead>
<tbody>
<tr>
<td>WP</td>
<td>.493</td>
<td>.702</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PVDT</td>
<td>.602</td>
<td>.513</td>
<td>.776</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VFT</td>
<td>.596</td>
<td>.573</td>
<td>.329</td>
<td>.772</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VDT</td>
<td>.658</td>
<td>.385</td>
<td>.179</td>
<td>.215</td>
<td>.811</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLT</td>
<td>.626</td>
<td>.470</td>
<td>.243</td>
<td>.321</td>
<td>.146</td>
<td>.791</td>
<td></td>
</tr>
<tr>
<td>VLT</td>
<td>.666</td>
<td>.357</td>
<td>.182</td>
<td>.263</td>
<td>.205</td>
<td>.182</td>
<td>.816</td>
</tr>
</tbody>
</table>

Note: *** stand for \( p < 0.001 \)

After finishing data checking, three research questions are answered by establishing structural equation modeling in the following.
Structural Equation Modeling

Based on the concept framework, a research model is established in Figure Two.

Figure 2: Research model

The research model is one of the associations between the four aspects of lexicon knowledge and writing capability. In Figure two, productive vocabulary depth has the most substantial effect on writing performance with $\beta = .36$, and productive vocabulary breadth’s effect on writing ranks is second with $\beta = .32$. The contribution of receptive vocabulary depth and breadth to writing proficiency is $\beta = .24$ and $\beta = .19$ respectively. $R^2 = .50$. The meaning of these analysis results will be discussed in the discussion section. In Table Three, the model fit index meets the criteria proposed by scholars ultimately, showing that the SEM hypothesis is reasonable.

Table 3: Model fit

<table>
<thead>
<tr>
<th>Index</th>
<th>Criteria</th>
<th>Model fit</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>$X^2$</td>
<td>lower, better</td>
<td>569.930</td>
<td></td>
</tr>
<tr>
<td>DF</td>
<td>higher, better</td>
<td>199</td>
<td></td>
</tr>
<tr>
<td>$X^2$/DF</td>
<td>lower 5</td>
<td>2.864</td>
<td>excellent</td>
</tr>
<tr>
<td>GFI</td>
<td>higher 0.9</td>
<td>0.849</td>
<td>accept</td>
</tr>
<tr>
<td>AGFI</td>
<td>higher 0.9</td>
<td>0.808</td>
<td>accept</td>
</tr>
<tr>
<td>RMSEA</td>
<td>lower 0.08</td>
<td>0.077</td>
<td>excellent</td>
</tr>
<tr>
<td>SRMR</td>
<td>lower 0.08</td>
<td>0.049</td>
<td>excellent</td>
</tr>
<tr>
<td>CFI</td>
<td>higher 0.9</td>
<td>0.909</td>
<td>excellent</td>
</tr>
<tr>
<td>TLI</td>
<td>higher 0.9</td>
<td>0.895</td>
<td>accept</td>
</tr>
</tbody>
</table>

Note: model fit criterion is proposed by scholars like MacCallum et al. (1996) and Doll et al. (1994).

Mediation Effect

Bootstrapping and Monte Carlo, the most advanced statistical methods in the twenty-first century for checking the indirect effect of the mediation variable, are used to check the mediating impact of vocabulary fluency on the association between four aspects of lexicons, and writing proficiency. In the mediating relationship figures below, four aspects of vocabulary knowledge are
independent variables, Writing Proficiency (WP) is the dependent variable, and Vocabulary Fluency (VFT) is the mediation variable.

**Verifying the Mediation Role of Vocabulary Fluency (VLT vs. WP)**

Based on the non-standard mediation role in Figure three, total effect, direct effect, and indirect effect are calculated by Bootstrapping shown in Table four where the point estimated value of total effect is the sum of that of direct effect with indirect effect, z-value is higher than 1.96, and no zero is included in the confidence interval of Bias-Corrected and Percentile. Therefore, it can be concluded that the mediation role of vocabulary fluency existed when pointing at the relationship between receptive lexicon breadth and writing proficiency.

![Figure 3](image)

**Figure 3** (non-standard) Mediation role of vocabulary fluency (VLT vs. WP)

<table>
<thead>
<tr>
<th>Relationship</th>
<th>Points Estimate</th>
<th>Product of Coefficients</th>
<th>Bootstrapping</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Bias-Corrected</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>95% CI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SE</td>
<td>Z</td>
</tr>
<tr>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VLT→WP</td>
<td>.126</td>
<td>.038</td>
<td>3.316</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: 5000 bootstrapping samples

Figure four shows the standard mediation role of vocabulary fluency; based on the pathway coefficient calculated, the effect of receptive vocabulary breadth on writing has increased from .19 to .22.

![Figure 4](image)

**Figure 4:** (Standard) Mediation role of vocabulary fluency (VLT vs. WP)
Verifying the Mediation Role of Vocabulary Fluency (VDT vs. WP)

Based on the non-standard mediation role in Figure five, total, direct, and indirect effects shown in Table five are calculated by Bootstrapping in which direct effect plus indirect effect is equal to total effect, z-value is higher than 1.96, and no zero is included in 95 percent confidence interval of Bias-Corrected and Percentile. So, the mediation role of lexicon fluency exists for the relationship between receptive vocabulary depth and writing proficiency.

Figure 5: (non-standard) Mediation role of vocabulary fluency (VDT vs. WP)

Table 5: Mediation effect on the relationship between VDT and WP

<table>
<thead>
<tr>
<th>Relationship</th>
<th>Points Estimate</th>
<th>Product of Coefficients</th>
<th>Bias-Corrected 95 percent CI</th>
<th>Percentile 95 percent CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDT → WP</td>
<td>.302</td>
<td>.054</td>
<td>.198</td>
<td>.411</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.593</td>
<td>.127</td>
<td>.307</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.046</td>
<td>.127</td>
<td>.307</td>
</tr>
<tr>
<td>VDT → WP</td>
<td>.088</td>
<td>.030</td>
<td>.036</td>
<td>.156</td>
</tr>
</tbody>
</table>

Note: 5000 bootstrapping samples

Figure six is the standard mediation role of vocabulary fluency, based on the calculated pathway coefficient: the effect of receptive vocabulary depth on writing has risen from .24 to .27.

Figure 6: (Standard) Mediation role of vocabulary fluency (VDT vs. WP)
Verifying the Mediation Role of Vocabulary Fluency (PLT vs. WP)

Monte Carlo is used to calculate whether or not an indirect effect does exist by using the internet website http://quantpsy.org/medmc/medmc.htm to calculate the confidence interval, as shown in Figure seven, the lower bound is 0.09118, and the upper bound is 0.2459, that is, no “0” is included between the two bounds, indicating that indirect effect exists.

![Figure 7: The mediation role of vocabulary fluency (PLT vs. WP)](image)

Based on the standard mediation role in Figure eight, the pathway coefficient of productive vocabulary breadth to writing proficiency is decreased from .32 to .31.

![Figure 8: (Standard) Mediation role of vocabulary fluency (PLT vs. WP)](image)

Verifying the Mediation Role of Vocabulary Fluency (PVDT vs. WP)

Monte Carlo is used to calculate whether or not an indirect effect exists. We used http://quantpsy.org/medmc/medmc.htm to calculate the confidence interval as shown in Figure nine, the LL is 0.08579, and the UL is 0.2184, that is, no “0” is included between two bounds, indicating that an indirect effect exists.

![Figure 9: The mediation role of vocabulary fluency (PVDT vs. WP)](image)
Based on the standard mediation role in Figure ten, the pathway coefficient of productive vocabulary depth to writing proficiency is still .36.

Figure 10: (Standard) Mediation role of vocabulary fluency (PVDT vs. WP)

The mediation role of vocabulary fluency on the association between four aspects of lexicon knowledge and writing ability is verified using Bootstrapping and Monte Carlo methods. The findings indicate that the mediation role of vocabulary fluency occurs. Thus, the answer to RQ3 is achieved.

Discussion

This study ascertained the relationship between four aspects of lexical knowledge, as tested by the VLT, VDT, PLT, and PVDT, respectively, with analytic evaluation grades of Chinese University learners’ argument composition, and the mediating role of vocabulary fluency. The predictive effect of overall lexical knowledge on writing proficiency was also examined, as was the individual aspect of lexicon knowledge on writing.

Relating to the first research question, four aspects of lexical knowledge had a varying effect on writing proficiency. The contribution effect of productive vocabulary depth (PVDT) ($\beta = .36, p < .001$) and productive vocabulary breadth (PLT) ($\beta = .32, p < .001$) on writing proficiency was more robust than that of receptive vocabulary depth (VDT) ($\beta = .24, p < .001$) and receptive vocabulary breadth (VLT) ($\beta = .19, p < .001$) on writing, which is consistent with the results of Pearson correlation with $r = .51$ for PVDT and writing, $r = .47$ for PLT and writing, $r = .39$ for VDT and writing, $r = .36$ for VLT and writing, and the highest correlation is $r = .57$ for VFT and writing.

From the viewpoint of the importance of vocabulary knowledge in writing, our findings are nearly in line with Choi’s research results in 2017, with ($\beta = .35$) for productive vocabulary knowledge in writing, and ($\beta = .13$) for receptive vocabulary knowledge in writing. However, Choi only analyzes the role of both overall receptive lexical knowledge and overall productive lexical knowledge in writing. However, now that four aspects of vocabulary knowledge are measured, it is necessary to analyze each correlation with writing. Our findings are close to those of Wu et al. (2019), with ($\beta = .28$) for receptive vocabulary breadth in writing in Grade 8 and ($\beta = .41$) for receptive vocabulary breadth in Grade 9, and ($\beta = .22$) for receptive vocabulary depth in writing of Grade 8) and ($\beta = .14$) for receptive vocabulary depth in writing of Grade 9).

From the correlation perspective of vocabulary knowledge and writing, our findings ($r = .47$) on the correlation coefficient between productive vocabulary breadth and writing are close to the results of both Karakoç and Köse (2017), and Nasir et al. (2017) with $r = .43$, and Kilic (2019) with $r = .48$. On the correlation coefficient of receptive vocabulary depth and writing, our finding is $r = .39$ is similar to Kilic’s result (2019) but lower than that of Dabbagh and Enayat (2019) with
r = 43. As for the most popular receptive vocabulary breadth, our finding is lower than that of Dabbagh and Enayat (2019) with \( r = .43 \) and Kilic (2019) with \( r = .49 \), and Miralpeix and Muñoz (2018) with \( r = .57 \), but far from that of Stæhr (2008a) with \( r = .73 \).

Additionally, whether receptive or productive, we discovered that the contribution of vocabulary depth to writing is significantly more substantial than that of vocabulary breadth. These research results are partially in line with Varnaseri and Farvardin (2016), who found that the Beta value of vocabulary depth on writing with a high rate (\( \beta = .48^{**} \)) in comparison to the Beta value of vocabulary breadth (\( \beta = .25^{**} \)) and partially in line with Choi (2017) who found productive lexical breadth and depth had a direct effect (\( \beta = .35^{*} \)) on writing and receptive vocabulary breadth and depth was found to have a direct effect on writing (\( \beta = .13, p > .05 \)). The results of the current study confirmed that vocabulary depth as the exogenous variable had a more vital contribution to the endogenous variable, writing proficiency, suggesting that lexicon depth might be the fundamental element of lexical knowledge in writing.

Of course, different research results also existed. Some researchers stressed the importance of vocabulary breadth in writing. For example, Dabbagh and Enayat (2019) found the \( \beta \) values of vocabulary breadth and depth on writing tasks were \( \beta = .287^{*} \) and \( \beta = .281^{*} \), respectively. Although Dabbagh and Enayat themselves declared that lexicon breadth predicted overall scores on the L2 writing more strongly than lexicon depth, the two values differ by only .006, and the gap of .006 is entirely negligible. That is to say, according to Dabbagh and Enayat’s findings, both lexicon breadth and lexicon depth are almost equally → crucial for descriptive writing. Stæhr (2008a) emphasized the importance of vocabulary breadth in writing performance. Miralpeix and Muñoz (2018) showed that vocabulary breadth is closely linked to writing (\( \beta = .57 \)) and is moderately correlated with reading (\( \beta = .52 \)), speaking (\( \beta = .49 \)), and listening (\( \beta = .42 \)), revealing that vocabulary breadth could explain language proficiency to a large extent. In their studies, only one or two aspects of lexical knowledge, such as breadth, or breadth and depth were involved in the measurement of the relationship between lexicon and writing.

A comparison of different researchers’ findings shows that our findings align with the essential features of language, that is, writing is a productive language skill. Therefore, the RQ1 is well answered. Given the findings related to the first research question and subsequent discussion, the conclusion is that all aspects of vocabulary knowledge should be tested concurrently for a comprehensive understanding of the contribution effect of a lexicon in writing. The current study provides empirical support for assessing the impact of four aspects of lexical knowledge on writing as well as generalizing the finding to vocabulary proficiency.

Turning to the RQ2, this study found that four aspects of lexicon knowledge together explained 50 percent of the variance of writing on the one hand, and four individual aspects of lexical knowledge explained respectively the variance of writing on the other hand, namely, VLT (31%), VDT (40%), PLT (42%), and PVDT (44%) after mediating by vocabulary fluency. These findings comply with the results of the first research question, which indicates the predictive power of productive lexicon breadth and depth on participants’ writing performance is more robust than that of receptive lexicon breadth and depth on participants’ writing performance, and the predictive power of vocabulary depth is higher than that of vocabulary breadth. Miralpeix and Muñoz (2018) also revealed that receptive vocabulary size could explain 32 percent of writing proficiency, which was almost consistent with the result of the present study. Also, the research results stressing productive vocabulary knowledge importance in writing are in accordance with Webb (2005),
indicating that productive learning is much more critical than receptive learning in writing tasks. Given the findings, the answer to RQ2 is successfully gained.

The findings of the RQ3 clearly stated that vocabulary fluency had a mediating effect in investigating the association between four aspects of lexical knowledge and writing proficiency on the one hand and multi-regression coefficient $\beta$ values increased after mediating by vocabulary fluency on the other hand. Firstly, based on data shown in Table six and Seven, and Figure seven and nine, no zeros were found in the 95 percent confidence interval between lower and upper bounds. In addition, as shown in Figure four, the regression coefficient increased from $\beta = .19$ to $\beta = .22$, meaning VLT would make a more outstanding contribution to writing based on the mediating of vocabulary fluency. Like VLT, the role of VDT also increased by 3 percent, amounting to $\beta = .27$ (see Figure six). However, for productive vocabulary knowledge, we found no changes in $\beta$ values even though the mediating effect also existed. These findings manifested that training vocabulary fluency plays a booster role in learning lexicons and developing language skills. As Uchihara and Saito (2019) showed, the productive vocabulary grades were moderately correlated with L2 fluency ($r = .34$). Stronger correlations were found (van Gelderen et al., 2004) between predictor variables, including word recognition and lexical retrieval, etc., and writing in L2. Thus, there is no doubt that it is crucial to train vocabulary fluency for developing language proficiency. The answer to RQ3 is affirmative. Since there is no previous literature on the mediation role of vocabulary fluency, no further comparative analysis can be discussed. Therefore, follow-up research will be given consideration.

Compared to previous studies, this research found moderate results. It highlights the importance of different dimensions of L2 vocabulary knowledge on writing ability and suggests that vocabulary knowledge can contribute up to 50% in developing writing proficiency.

**Conclusion**

Firstly, the current study investigated four aspects of vocabulary knowledge that contribute differently to overall L2 writing scores and found that the most contribution to writing is productive vocabulary depth which is followed by productive lexicon breadth, and then receptive lexicon depth, which is higher than receptive vocabulary breadth. Therefore, it can be summarized that productive lexical knowledge relatively plays a relatively more important role in writing proficiency than receptive vocabulary knowledge. It was also found that overall lexical knowledge can explain a considerable ratio of the variance in L2 learners’ writing proficiency, and four aspects of vocabulary knowledge respectively have a moderate explanatory power or so for the variance of writing. Therefore, it can be summarized that lexical knowledge is key to predicting writing proficiency. In addition, the mediation of vocabulary fluency strengthens the effect of vocabulary knowledge on writing capability, especially receptive vocabulary.

**Implications**

Some implications can be drawn based on the conclusions of the present study. First, the implications for both language teachers and learners are that they should dialectically select appropriate words to teach and learn for developing the learners’ writing ability rather than taking all the words in the book list to recite. Second, both teachers and students must pay enough attention to the training and improve vocabulary fluency because it is crucial for developing all language skills. Third, the teachers and learners ought to pay much closer attention to other linguistic knowledge concerning writing and accumulate some native and beautiful sentences by
reading many original English works to improve their corresponding lexicon knowledge, which has, after all, a moderate predictive effect in writing. Lastly, writing is inseparable from reading and effectively promotes improving reading ability in the meanwhile.

Limitations
There are some inevitable limitations to this study. First, no analysis was conducted on different word frequency levels of each dimension of vocabulary knowledge in writing, and it needs consideration in future research. Second, all lexicon testing was conducted in the classrooms by written examination because our students have become accustomed to the written test format used for many years. In future studies, a computerized test could be used to evaluate one's lexical knowledge.

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About the Author:
Yanli Tong: Language and Literacy Education Department, Faculty of Education, University of Malaya, 50603 Kuala Lumpur, Malaysia & School of Language and Culture, Ningde Normal University, 352100 Ningde, China. ORCID: https://orcid.org/0000-0002-3687-7520

Zuwati Hasim: Language and Literacy Education Department, Faculty of Education, University of Malaya, 50603 Kuala Lumpur, Malaysia. ORCID: https://orcid.org/0000-0002-7840-5855

Huzaina Abdul Halim: Language and Literacy Education Department, Faculty of Education, University of Malaya, 50603 Kuala Lumpur, Malaysia ORCID: https://orcid.org/0000-0003-3275-4889

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