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Roles of Receptive and Productive Vocabulary Knowledge in L2 Writing through the Mediation of L2 Reading Ability*

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The present study aims to investigate the direct and indirect contributions of Korean EFL college students' L2 receptive and productive vocabulary knowledge to their L2 writing performances by using a structural equation modeling (SEM) analysis with a goal to explore the pathways of vocabulary knowledge to writing. Data from 178 students were collected through tests of receptive and productive vocabulary breadth and depth, a writing test and a reading test. In testing a hypothesized model on the roles of receptive and productive vocabulary in writing, the results of the SEM analysis reveal the direct role of productive vocabulary in writing. The indirect role of receptive vocabulary on writing was observed through the mediating role of productive vocabulary or reading ability due to the direct contribution of receptive vocabulary to both productive vocabulary and reading and that of productive vocabulary and reading to writing. Findings from the study shed light on the relations of L2 receptive and productive vocabulary knowledge with L2 writing abilities, suggesting potential benefits of both receptive and productive vocabulary learning for L2 writing.

Key words: L2 vocabulary knowledge, receptive vocabulary, productive vocabulary, L2 writing, EFL writing, L2 reading, EFL reading

1. INTRODUCTION

L2 vocabulary knowledge is generally recognized as a strong predictor for L2 language ability, including writing (Laufer & Nation, 1995; Nation, 2001; Read & Chapelle, 2001).

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This knowledge is defined as being composed of receptive and productive knowledge (Laufer, 1998; Nation, 2001; Read, 2000). Receptive vocabulary knowledge is the ability to recognize words while listening or reading; productive vocabulary knowledge refers to the ability to produce words orally or in a written format (Nation, 1990, 2001). Previous studies on vocabulary knowledge have reported that receptive vocabulary knowledge is developed prior to productive vocabulary knowledge (Fan, 2000; Henriksen, 1999; Laufer, 1998; Makarchuk, 2013; Meara, 1997; Shin, Chon & Kim, 2011; Webb, 2008). Furthermore, it is suggested that receptive vocabulary knowledge may be an index of productive vocabulary knowledge (Webb, 2008; Zhong, 2016).

If L2 vocabulary knowledge does have a predictive power for L2 writing, a question is raised whether receptive or productive vocabulary knowledge is directly related to writing or has indirect effects on writing through the mediation of other constructs such as reading ability. Previous studies on vocabulary knowledge and writing ability have revealed the effect of vocabulary richness on writing scoring (Engber, 1995; Laufer & Nation, 1995; Yu, 2009) or have illustrated statistically significant relationships between vocabulary test scores and writing scores by using correlation and multiple regression analyses (Kang, 2011; Lee, 2014, 2015; Oh, Lee, & Moon, 2015; Stæhr, 2008). The majority of the studies have stated that L2 students' productive vocabulary is a significant predictor of their writings rather than their receptive vocabulary, except for a few studies including Stæhr (2008) and Chon and Lee (2015). Schoonen, van Gelderen, Stoel, Hulstijn and de Glopper (2011) and Oh et al. (2015) have found that receptive vocabulary size does not have a significant predictive power for L2 writing proficiency; on the other hand, Chon and Lee (2015) have indicated that productive collocation knowledge is a predictive factor, but not receptive and productive vocabulary size. No clear picture on the relationship of receptive vocabulary with writing has thus been provided. Nonetheless, it can be assumed that receptive vocabulary has an indirect contribution to writing through productive vocabulary, since previous research has demonstrated a strong relationship between productive vocabulary and receptive vocabulary (Fan, 2000; Henriksen, 1999; Laufer, 1998; Makarchuk, 2013; Meara, 1997; Shin et al., 2011; Webb, 2008; Zhong, 2016). Moreover, it can be further hypothesized that receptive vocabulary has an indirect effect on writing through reading because empirical evidence on a significant relationship between reading and writing, as well as between receptive vocabulary and reading, has been provided in previous studies (Horiba, 2012; Ito, 2011; Kim, 2015; Laufer, 1997; Nassaji, 2003; Qian, 1999, 2002).

More comprehensive research is thus needed to investigate whether receptive or productive vocabulary has a contribution to writing and whether the contribution is direct or indirect. This motivates the present study, which aims to examine the pathways of L2 receptive and productive vocabulary knowledge to L2 writing. The study specifically

explores whether receptive and productive vocabulary have direct or indirect effects on writing and whether such effects are mediated by reading ability.

2. REVIEW OF PREVIOUS STUDIES

In L2 learning, vocabulary knowledge is found to be strongly related with writing and considered as a prerequisite for literacy skills (Laufer & Nation, 1995; Lee, 2014, 2015; Nation, 2001; Stæhr, 2008; Yu, 2009). The knowledge includes receptive and productive knowledge, which can be further classified into breadth and depth knowledge. Vocabulary knowledge breadth is a language user's vocabulary size, that is, how many words he or she understands or produces, while vocabulary knowledge depth refers to the knowledge of synonyms and collocation of words, as in how deep his or her knowledge of words is (Anderson & Freebody, 1981; Nation, 2001; Read, 2000).

Preceding studies on L2 vocabulary knowledge have reported that the development of receptive vocabulary knowledge antecedes that of productive vocabulary knowledge (Fan, 2000; Henriksen, 1999; Laufer, 1998; Makarchuk, 2013; Meara, 1997; Shin et al., 2011; Webb, 2008). Shin et al. (2011), which examined the inter-relationship between receptive and productive vocabulary size of Korean EFL high school students, found that the size of productive vocabulary is less than two fifths of the receptive vocabulary size. The results indicated that acquisition of receptive vocabulary preceded that of productive vocabulary and a gap appeared between the two types of vocabulary size. Furthermore, in Webb (2008) and Zhong (2016), receptive vocabulary knowledge has been recognized as an indicator of productive vocabulary knowledge. Webb's (2008) study illustrated that receptive vocabulary size was larger than productive vocabulary size and the difference between them increased as the level of vocabulary ascended.

L2 vocabulary knowledge has further been researched on its relationship with L2 writing ability (Chon & Lee, 2015; Kang, 2011; Schoonen et al., 2011; Stæhr, 2008; Yi & Luo, 2013; Yu, 2009). Several studies were carried out by exploring the relation of lexical diversity or richness with writing quality (Daller & Phelan, 2007; Engber, 1995; Laufer & Nation, 1995; Yu, 2009). Engber (1995) investigated the effect of ESL adult learners' vocabulary knowledge on holistic scores of their L2 writing. Higher scores were given to writings with more lexical variations, which indicated that L2 students with larger vocabulary knowledge perform better on writing. More recently, Daller and Phelan (2007) provided more evidence that lexical richness in writing affects writing scores. Levels of lexical diversity and lexical density also appeared to influence writing scoring and they were found to be an index of writing quality (Laufer & Nation, 1995; Yu, 2009).

The relationship between vocabulary and writing in L2 has also been explored by

analyzing vocabulary test scores and writing scores (Chon & Lee, 2015; Kang, 2011; Lee, 2014, 2015; Oh et al., 2015; Schoonen et al., 2003; Schoonen et al., 2011; Stæhr, 2008). Stæhr's (2008) regression analysis illustrated that receptive vocabulary size explained 52% of writing. Schoonen et al. (2011) also found Dutch EFL secondary school students' writings were correlated with their receptive vocabulary size; however, they concluded that receptive vocabulary size is not a significant predictor for L2 writing proficiency, compared with other variables including metacognitive knowledge of writing, grammatical knowledge and typing fluency. Unlike these studies, the majority of studies on vocabulary and writing have mainly dealt with productive vocabulary knowledge. Lee (2014, 2015) investigated the relationship between Korean EFL university students' productive vocabulary scores and writing scores. The results of his first study displayed that productive vocabulary size had a moderate, but significant correlation with writing scores. In his second study, Lee found a slightly more predictive power of productive collocation knowledge for writing than productive vocabulary size. Moreover, Oh et al. (2015) investigated predictors of Korean EFL university students' writing quality including receptive and productive vocabulary size. The results of a regression analysis presented only productive vocabulary size as a significant indicator of writing ability.

Prior research has presented inconsistent findings on the relation of receptive and productive vocabulary knowledge with writing, due to methodological variations regarding which aspects of vocabulary knowledge were measured; only a small number of studies measured both receptive and productive vocabulary to examine their relation to writing ability. As for receptive vocabulary, nevertheless, its indirect contribution to L2 writing ability through productive vocabulary knowledge can be hypothesized, since productive vocabulary is generally considered as an explanatory factor of writing ability (Engber, 1995; Laufer & Nation, 1995; Oh et al., 2015) and receptive vocabulary is found to predict productive vocabulary (Webb, 2008; Zhong, 2016). However, few studies on the relation of vocabulary knowledge with writing have been conducted to explore such an indirect contribution. They mainly employed correlation and multiple regression analyses, which can provide information on their relations in terms of correlation, but not on the direct or indirect role of vocabulary in writing, unlike structural equation modeling (henceforth, SEM). Further comprehensive research on both receptive and productive vocabulary is thus needed to specify the pathways of vocabulary knowledge to writing in a model using SEM.

The indirect effects of receptive vocabulary knowledge on L2 writing can also be hypothesized through reading ability due to the close relation of receptive vocabulary with reading and that of reading with writing noted in previous studies. In other words, receptive vocabulary is found to be directly linked to reading (Alavi & Akbarian, 2012; Horiba, 2012; Huh, 2014; Kim & Kang, 2014; Koda, 1989; Laufer, 1997; Li & Kirby,

2015; Qian, 1999; Zhang, 2012) and reading appears to be related with writing (Eisterhold, 1990; Ito, 2011; Kroll, 1993; Shim, 2004); thus, receptive vocabulary can be assumed to have indirect effects on writing through reading. For example, Stæhr (2008) investigated the receptive vocabulary size of Danish EFL middle school learners and reported that receptive vocabulary size is a powerful indicator of reading with explaining 72% of reading comprehension ability. The results of Kim and Kang (2014) indicated that Korean EFL high school students' depth knowledge of receptive vocabulary is a significant indicator of reading comprehension ability compared with decoding skills and oral communication. Additionally, L2 writing ability has been investigated to examine its correlations with L2 reading ability, because of the influence of L1 studies which illustrate a strong correlation between reading and writing (Belanger, 1987; Petrosky, 1982; Shanahan & Lomax, 1986; Stotsky, 1983). Ito (2011), for example, found that Japanese EFL learners' reading skills have an effect on quality of their L2 writings.

The majority of studies on the relationship of L2 receptive or productive vocabulary knowledge and L2 writing ability illustrate productive vocabulary knowledge as a predictor for writing (Engber, 1995; Oh et al., 2015; Yu, 2009). However, no clear pictures have been given on the relation of receptive and productive vocabulary with writing because of inconsistent findings depending on which dimension of vocabulary knowledge, such as the knowledge breadth or depth, was assessed. Furthermore, the contribution of receptive vocabulary to writing ability is relatively underexplored. In order to compensate for the dearth of research on the comprehensive relationship of receptive and productive vocabulary with writing, the present study aims to examine the direct and indirect contribution of both receptive and productive vocabulary knowledge to writing with an SEM analysis. In the study, receptive and productive vocabulary knowledge entail both breadth and depth knowledge, respectively. As for the indirect contribution, it could be assumed that receptive and productive vocabulary can play an indirect role in L2 writing through the mediation of L2 reading ability, and receptive vocabulary can have indirect effects on L2 writing through productive vocabulary. The study addresses the following questions.

1. Do Korean EFL university students' L2 receptive and productive vocabulary knowledge make a direct contribution to L2 writing?
2. Do Korean EFL university students' L2 receptive and productive vocabulary knowledge make an indirect contribution to L2 writing?
    1) Do they have an indirect contribution to writing through the mediation of reading?
    2) Does receptive vocabulary knowledge have an indirect contribution to writing through the mediation of productive vocabulary knowledge?

3. RESEARCH METHOD

3.1. Participants

The participants of the study consisted of 178 Korean EFL university students (41 male and 137 female students) recruited from 24 universities in Seoul and Gyeonggi Province. They included 85 first-year, 50 second-year, 22 third-year, and 21 fourth-year students. Their majors were diverse: humanities (28), social science (33), business (12), education (37), science (29), engineering (30), medical science (5) and art (4). The participants' English proficiency levels and educational backgrounds were not controlled.

3.2. Measures

Four types of L2 vocabulary measures were constructed to assess breadth and depth of receptive knowledge and breadth and depth of productive knowledge. A writing test and a reading comprehension test were also developed.

3.2.1. Measures of L2 receptive and productive vocabulary knowledge

In order to measure L2 vocabulary knowledge, four different types of test were developed: receptive vocabulary tests for breadth and depth knowledge and productive vocabulary tests for breadth and depth knowledge. Each test consisted of 100 items; in each test, 100 words were selected from the first 1,000 (1K) to the tenth 1,000 (10K) word families of English based on British National Corpus (BNC) words list (Nation & Beglar, 2007); and 10 items were included for each 1,000 word families.

To measure receptive vocabulary knowledge breadth (RVKB), the study employed the receptive Vocabulary Size Test (VST) developed in Shin et al. (2011), which was originally adapted from Nation's VST (2010). It was a multiple-choice test designed to assess Korean EFL learners' receptive vocabulary size with five options in Korean, as shown below (The English expressions given in the parentheses for each option were the translation of the Korean options.). It was a 25-minute test of 100 items; the maximum possible score was 100 points. In scoring, one point was given for each correct answer for each item.

2. clean: The room is clean. [answer: ①]
① 깨끗한 (hygienic) ② 큰 (big) ③ 빨간색인 (reddish) ④ 주인이 없는 (stray)
⑤ '잘 모르겠음' ('do not know')
80. smug: He is smug. [answer: ④]
① 배려하는 (considerate) ② 부유한 (wealthy) ③ 부드러운 (soft) ④ 독선적인 (egotistic)
⑤ '잘 모르겠음' ('do not know')

The measure of receptive vocabulary knowledge depth (RVKD) was constructed based on Read's (1993, 1998) Word Associates Test (WAT), which measures two aspects of depth knowledge: word meaning and word collocation. It was a 30-minute test of 100 items. Each item contained one stimulus word (an adjective) with a box of four adjectives from which one to three near synonyms needed to be selected and another box of four nouns from which one to three nouns could collocate with the stimulus adjective, as presented below. The maximum possible answers were four per item; each correct answer was given one point; the maximum score of the test was 400 points.

2. *Dangerous* [answer: ②⑤⑥⑦]
① broad ② harmful ③ thoughtful ④ valuable ⑤ animal ⑥ machine ⑦ moment ⑧ sky
91. *Ardent* [answer: ③④⑤⑧]
① bad ② equal ③ fervent ④ passionate ⑤ admirer ⑥ bag ⑦ bill ⑧ desire

The subtest for synonyms had a total of 172 correct answers and the collocation subtest had 228 correct answers. Directions within the test clearly stated to choose four answers per item. However, a few students selected more than four items and a half point was deducted for each extra answer. For example, if five answers were marked and three were correct, three points were given for the correct answers and a half point was deducted for the surplus answer, adding up to a total of two and a half points.

The measure for productive vocabulary knowledge breadth (PVKB) was the productive VST of Shin et al. (2011), which was modified from Laufer and Nation's (1999) VST of controlled productive ability. In each item, the first letter or syllable was provided depending on the length of the word; missing letters were given as underlines, as shown below. The test was a 25-minute test of 100 items.

3. 그녀의 얼굴은 빨개지고 있다. [answer: face]
☞ Her f__ __ __ is getting red.
83. 그 기업가는 파산에 직면했다. [answer: entrepreneur]
☞ The ent__ __ __ __ __ __ __ __ __ was on the ragged edge.

For scoring the PVKB test, each correct answer was scored one point; the maximum possible score was 100 points. No point was given to incorrect answers, which could not be considered as spelling errors; for example, *empire* for *emperor* was not accepted since it changes meaning and its number of letters is beyond the number of missing letters given in the test item. For spelling errors, deductions were made to varying degrees. One-fifth point was deducted for one-letter mistakes such as *docter* instead of *doctor*; a half point was deducted for two-and-more-letter errors such as *mupple* instead of *muffle*; and four-fifth

point was deducted for changing meaning (e.g., *hair* for *heir*), changing the part of speech (e.g., *advice* for *advise*), or violating English spelling rules seriously (e.g., *disscaragy* for *discourage*).

The measure of productive vocabulary knowledge depth (PVKD) was based upon and modified from Lee's (2015) test, which was developed to measure productive collocation knowledge of verb-noun and adjective-noun. The test included 100 items for adjective-noun collocations; each item provided the initial letter of the target adjective in an English sentence with its L1 translation, as presented below. It was a 25-minute test of 100 items.

1. She is a **b_____ woman**. [answer: beautiful]
   그녀는 아름다운 여인이다.
90. The **s_____ economy** is playing a role, too. [answer: sluggish]
   침체된 경기도 역할을 하고 있다.

In the PVKD test, each correct answer (adjective) was scored by one point parallel to the PVKB test; the maximum possible score was 100 points. If near-synonyms were answered and could collocate with the given nouns, one point was given. For spelling errors, one-fifth point was deducted for one-letter mistakes such as *ulban* instead of *urban*; a half point was deducted for two-and-more-letter errors such as *vane* instead of *vain*. Considering the nature of collocation, no point was given for changing meaning (i.e., *soar* for *sour*), changing part of speech (i.e., *envy* for *envious*), or near-synonyms lacking collocatablility (i.e., *nearby* for *near* in *near future*).

3.2.2. Measure of L2 writing ability

A composition test was constructed to measure L2 writing ability. An argumentative writing topic was selected from the topics listed for the TOEFL TWE (Test of Written English). The topic for the essay was "With the help of technology students nowadays can learn more information and learn it more quickly." The participants were required to write at least 250 words on the topic. It was a 30-minute test and use of dictionaries was not permitted. For scoring, an analytic scoring rubric was constructed with four components: task completion, content, organization, and language use. Each component was given a score from zero to five. Task completion (WATC) was assessed in terms of the fulfillment of the task requirement, such as writing an argumentative essay with about 250 words and providing appropriate reasons supporting the writer's position. Content (WAC) was evaluated in terms of topic clarity and depth of topic discussions. Organization (WAO) was assessed in terms of clear topic sentences and conclusions and the logical progression of the main ideas. Language use (WALU) was measured in terms of appropriate use of

vocabulary and sentence structures and linguistic accuracy.

3.2.3. Measure of L2 reading comprehension ability

A multiple-choice reading test was designed to measure L2 reading comprehension ability. The test consisted of items testing four distinctive reading subskills: factual understanding, inferential understanding (e.g., filling in the missing information), topic or gist identification, and reference identification. The test included 24 five- or four-choice questions to solve within a 30-minute time limit. The multiple-choice questions included six questions for factual understanding (RFact); seven questions for inferential understanding (RInf); six questions for topic identification (RTop); and five questions for reference identification (RRef). The reading comprehension test was constructed based upon the Korean College Scholastic Ability Test (CSAT) of English and the preliminary Korean CSAT. The reading test used 20 passages selected from the CSATs from 2002 to 2011. For scoring, one point was given to one correct answer; 24 was the maximum possible score.

3.3. Data Collection and Analysis Procedures

The current study proceeded through five steps composed of collecting data and analysis. First, a set of vocabulary test, a writing test, and a reading test were constructed with the scoring criteria and rubrics. Second, pilot tests were conducted on 10 first- and second-year university students from one of the universities where the participants were recruited for this research, in order to examine the difficulty of the vocabulary tests including target 1K to 10K words, the format of the productive vocabulary tests, the clarity of the instructions and items, the time length needed to complete each test, and possible answers. After the pilot tests, revisions were made on the tests; for example, some words for the RVKD or PVKD test were replaced with others, since they were easier or more difficult compared to words from the same level in the tests. In addition, the scoring criteria for the productive vocabulary tests and the scoring rubric for the writing test were also revised while scoring the pilot tests. For instance, the criteria for acceptable answers and deduction for spelling errors were refined for the PVKB and PVKD test. Next, the final version of the tests was administered for about four hours to the participants recruited for the study in their university campuses without any intermission, though the participants were allowed to take a break individually between the tests if they wished. The composition test was administered prior to the vocabulary tests in order to make sure that the words included in the vocabulary tests would not provide ideas for lexical expressions in the writing test. Followed by the composition test, the participants had four vocabulary tests: PVKB,

RVKB, PVKD, and RVKD tests. The reading test was administered last.

The tests were then scored by the researcher and four research assistants, who were English Education MA and Ph.D. students. After the preliminary scoring, the scoring rubrics were revised and modified. Furthermore, pilot scoring was conducted in order to ensure the validity and reliability of scoring as well as inter-rater reliability. To establish inter-rater reliability for the writing test, two raters, who were two of the research assistants and an English Education MA and Ph.D. student, individually scored 15 randomly selected essays. The researcher reviewed their scores and resolved any disagreements between the raters. After the sample scoring, the two raters independently scored 33% of the data (58 of the 178 participants) and then discussed their scoring processes and resolved any score discrepancies again. Finally, each rater scored the remaining essays. If the scores given by the two raters differed by more than one point, the researcher scored the essay and finalized the scores. The two raters achieved high inter-rater reliability, which was calculated by using the Pearson Moment Correlation: .872 for task completion; .833 for content; .879 for organization; and .855 for language use. Statistical analyses were conducted with the mean scores of the two raters.

The reading test and the receptive vocabulary tests (RVKB and RVKD), which were multiple-choice tests, were scored by a pair of the research assistants. An assistant scored a half of each test. For cross-checking of the scoring, 20% of the tests were randomly selected and the scores given by the two scorers were compared to secure inter-rater reliability. Finally, the productive vocabulary tests (PVKB and PVKD) were split into two halves; each half was independently scored by an assistant; and the scores were reviewed by the other scorer. The scores were finalized by the two scorers while reviewing the scoring of the whole tests.

The data from the writing and reading and vocabulary tests were analyzed by calculating correlations between all the observed variables such as RVKB scores, PVKD scores, and content scores of the writing, and using the SEM method. A SEM analysis was conducted to estimate the direct and indirect contributions of receptive or productive vocabulary knowledge to writing and the mediation effect of reading. AMOS 20.0 version was used for a two-step modeling approach: the measurement model and the structural model. The relationships between latent variables (unobserved variables) and observed variables (indicators) are designated through the measurement model. The present study hypothesized four latent variables: receptive and productive vocabulary knowledge (RVK and PVK), writing, and reading. Each latent variable included its own observed variables (see Table 1 and Figure 1). The model was tested through the use of a confirmatory factor analysis to verify whether the observed variables were well loaded to the latent variables. The structural model identifies the pathways among latent variables to describe whether a significant relationship exists between the variables. The model was tested and proven in

order to investigate the direct and indirect relationships among the four latent variables.

4. RESULTS

4.1. Descriptive Statistics and Correlation Analysis

The correlations among the observed variables are presented with descriptive statistics of the variables in Table 1. The observed variables contain two variables of receptive vocabulary knowledge such as the size and depth (RVKB, RVKD) and two variables of productive vocabulary knowledge such as the size and depth (PVKB, and PVKB); four of writing ability including task completion, content, organization, and language use (WATC, WAC, WAO, and WALU); and four of reading ability including factual and inferential understanding and reference and topic identification (RFact, RInf, RRef, and RTop). The correlations were all presented to be positive and high; they were statistically significant.

TABLE 1

Descriptive Statistics and Correlations of the Observed Variables

	1	2	3	4	5	6	7	8	9	10	11	12
1. RVKB	----											
2. RVKD	.781*	----										
3. PVKB	.800*	.705*	----									
4. PVKD	.794*	.714*	.920*	----								
5. WATC	.585*	.572*	.637*	.620*	----							
6. WAC	.593*	.569*	.637*	.631*	.927*	----						
7. WAO	.575*	.582*	.618*	.597*	.908*	.894*	----					
8. WALU	.623*	.578*	.685*	.678*	.905*	.887*	.868*	----				
9. RFact	.514*	.440*	.463*	.480*	.429*	.500*	.493*	.459*	----			
10. RInf	.478*	.492*	.509*	.539*	.433*	.501*	.482*	.462*	.524*	----		
11. RRef	.644*	.552*	.644*	.645*	.405*	.447*	.475*	.447*	.454*	.515*	----	
12. RTop	.557*	.524*	.539*	.527*	.424*	.532*	.530*	.511*	.554*	.576*	.601*	----
M	80.56	293.58	54.97	40.94	2.79	2.64	2.66	2.71	5.31	4.05	5.01	4.63
SD	9.82	70.48	14.15	15.92	1.00	1.02	1.06	.89	1.43	1.18	1.25	1.27
Maximum possible score	100.00	400.00	100.00	100.00	5.00	5.00	5.00	5.00	6.00	7.00	5.00	6.00

* $p < .05$

The breadth and depth of receptive and productive vocabulary knowledge correlated with each other and all the other variables, especially with the writing scores for language use (WALU) and the reading scores for reference identification (RRef). Among the observed variables of vocabulary, the correlation between the breadth and depth of productive vocabulary knowledge (PVKB and PVKD) was the highest, while that between

the depth of receptive vocabulary (RVKD) and productive vocabulary (PVKD) was the lowest. The four variables of writing were also significantly correlated with each other and the other observed variables. The correlations among the writing variables were the highest; they were more strongly correlated with the productive vocabulary variables than with the receptive vocabulary variables or the reading variables. The four observed variables of reading had significant correlations with each other and all the other variables; however, the correlations among the four variables were lower compared with those among the other latent variables. The correlation analysis indicated that reading ability is more closely related with vocabulary than writing.

4.2. Confirmatory Factor Analysis and Structural Equation Modeling

As the first step to the SEM analysis, the measurement model was tested by using a confirmatory factor analysis. In the measurement model, four latent variables, receptive vocabulary knowledge (RVK), productive vocabulary knowledge (PVK), writing and reading, were included, having their own observable variables (see Figure 1). For receptive vocabulary knowledge, two variables, RVKB and RVKD, were loaded as observable variables. Productive vocabulary knowledge also had two observable variables, including PVKB and PVKD. The latent variable writing had four observable variables: WATC, WAC, WAO, and WALU. For reading, four variables, RFact, RInf, RRef, and RTop, were loaded as observable variables. The results of the confirmatory factor analysis indicated that all observable variables were well loaded to the latent variables with the factor loadings between .668 and .970.

Table 2 presents the factor loadings, *p*-value and R^2 of each construct in terms of the standardized regression estimates for the measurement model. The factor loading of RVKB (β = .931, p < .001) and RVKD (β = .839, p < .001) was found to be well loaded on receptive vocabulary knowledge, which explained about 86.7% of the variance in RVKB and about 70.4% of the variance in RVKD. The factor loading of PVKB (β = .961, p < .001) and PVKD (β = .957, p < .001) was well loaded on productive vocabulary, which explained about 92.3% of the variance in PVKB and about 91.6% of the variance in PVKD. The four observed variables of writing were well loaded on writing: WATC, β = .970, p < .001; WAC, β = .954, p < .001; WAO, β = .935, p < .001; and WALU, β = .934, p < .001. Writing explained about 94.0% of the variance in WATC, 91.1% of the variance in WAC, 87.4% of the variance in WAO, and 87.2% of the variance in WALU. As for reading, the four variables were found to be well loaded on the latent variable: RFact, β = .668, p < .001; RInf, β = .714, p < .001; RRef, β = .772, p < .001; and RTop, β = .774, p < .001. Reading explained about 44.6%, 51.0%, 59.7%, and 60.0% of the variance in each observed variable.

FIGURE 1

Measurement Model with Factor Loadings in Standardized Regression Weights

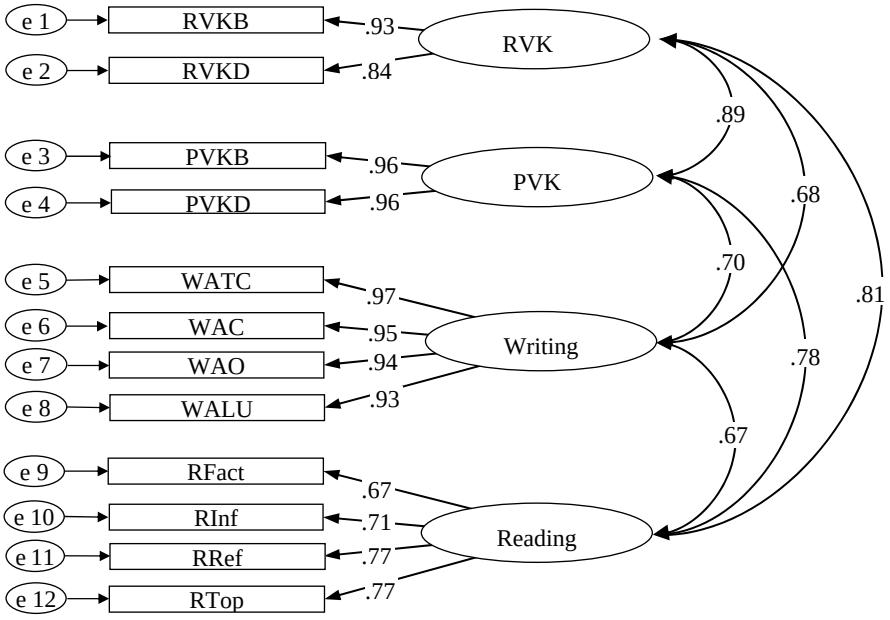

TABLE 2

Parameter Estimates of the Measurement Model for Confirmatory Factor Analysis

Paths			*β*	*p*	R^2
RVKB	←	RVK	.931	< .001	.867
RVKD	←	RVK	.839	< .001	.704
PVKB	←	PVK	.961	< .001	.923
PVKD	←	PVK	.957	< .001	.916
WATC	←	Writing	.970	< .001	.940
WAC	←	Writing	.954	< .001	.911
WAO	←	Writing	.935	< .001	.874
WALU	←	Writing	.934	< .001	.872
RFact	←	Reading	.668	< .001	.446
RInf	←	Reading	.714	< .001	.510
RRef	←	Reading	.772	< .001	.597
RTop	←	Reading	.774	< .001	.600

The structural model was then constructed to specify the potential relationships among the four latent variables: receptive vocabulary knowledge, productive vocabulary knowledge, writing, and reading. Based on the review of the previous studies and literatures, direct and indirect relationships among receptive vocabulary knowledge, productive vocabulary knowledge, writing and reading were hypothesized as shown in Figure 2. The goodness of model fit of the structural model was assessed. The chi-square

of the model (χ^2 = 60.1) and the model fit indices indicated that the model fits the data well: Goodness of Fit Index (GFI) (.95), Comparative Fit Index (CFI) (.99), Normed Fit Index (NFI) (.97), and Root Mean Square Error of Approximation (RMSEA) (.04).

As for the first research question, the results of the SEM analysis show that only productive vocabulary knowledge measured by the size and depth of knowledge had a direct effect (β = .353, p < .05) on writing with a total effect (β = .431, p < .05) (see Figure 2 and Table 3). Receptive vocabulary knowledge, including the size and depth of knowledge, was not found to have a direct effect on writing (β = .132, p > .05), though its indirect effect (β = .549, p < .05) and total effect (β = .681, p < .05) were significant.

The second research question addressed whether L2 vocabulary knowledge has an indirect contribution to L2 writing through the mediation of other constructs such as reading. Receptive and productive vocabulary knowledge together explained 67.2% of the variance of reading; a direct effect of vocabulary knowledge on L2 reading was found from receptive vocabulary knowledge (β = .573, p < .05), but not from productive vocabulary

FIGURE 2

The Structural Model for the Relationships among L2 Receptive and Productive Vocabulary Knowledge, Writing, and Reading

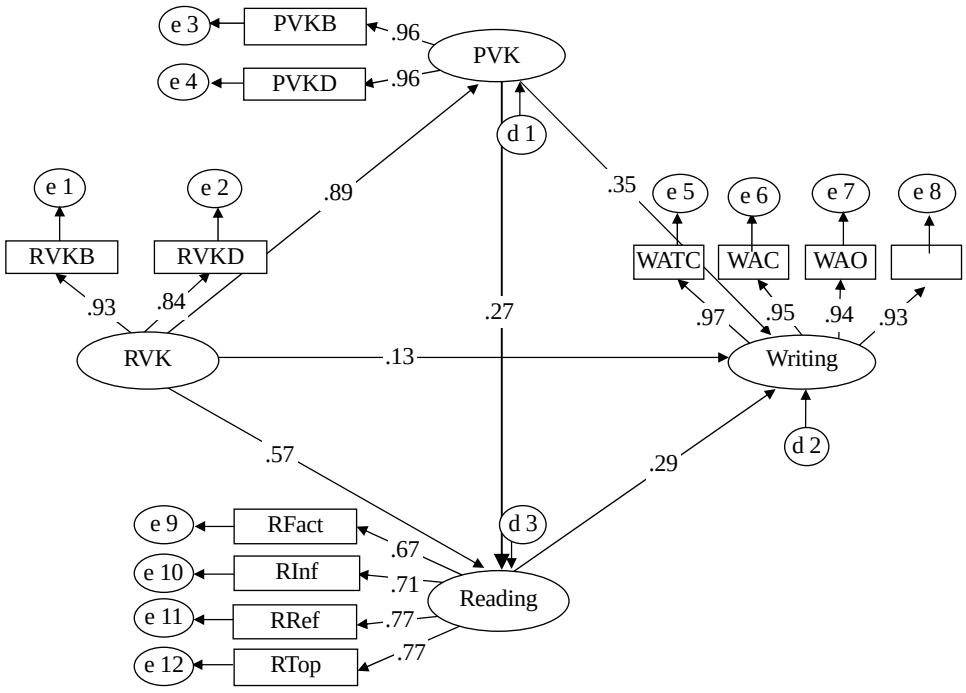

TABLE 3

Parameter Estimates of the Structural Model

Predictors		Direct Effects			Indirect Effects		Total Effects	
		β	*p*	R^2	*β*	*p*	*β*	*p*
Writing				.529				
	← RVK	.132	.531		.549	.016	.681	.015
	← PVK	.353	.019		.077	.088	.431	.025
	← Reading	.289	.031				.289	.031
Reading				.672				
	← RVK	.573	.012				.573	.012
	← PVK	.267	.169				.267	.169
PVK				.792				
	← RVK	.890	.012				.890	.012

knowledge (β = .267, p > .05); and reading was directly linked to writing (β = .289, p < .05). These results reveal that only receptive vocabulary knowledge has an indirect effect on writing through the mediating role of reading.

The indirect contribution of receptive vocabulary knowledge to writing was hypothesized through multiple paths, either through reading or productive vocabulary knowledge, as specified in the two sub-questions of the second research question. Thus, a further analysis on each path was conducted after examining the direct contribution of receptive vocabulary knowledge to productive vocabulary knowledge, which illustrates that receptive vocabulary knowledge was directly linked to productive vocabulary knowledge (β = .890, p < .05) and explained about 79.2% of its variance. The results reveal that the indirect effect of receptive vocabulary through both paths was significant (PVK, β = .385, p < .05; reading: β = .263, p < .05) with a slightly stronger effect of receptive vocabulary on writing through productive vocabulary.

5. DISCUSSION AND CONCLUSION

The present study tested a hypothesized model of the pathways of L2 receptive and productive vocabulary knowledge of Korean EFL university students to their L2 writing with two research questions. The results of the SEM analysis for the first research question provide evidence of the direct contribution of only productive vocabulary knowledge, which entails the size and depth of the knowledge, to writing performances. This is consistent with the previous studies, which illustrated the strong relation of productive vocabulary and writing (Kang, 2011; Laufer & Nation, 1995; Lee, 2014, 2015; Oh et al., 2015; Yi & Luo, 2013; Yu, 2009), though they measured only productive vocabulary size or analyzed lexical variations or diversity in written essays. It also appears to conflict with the results of Stæhr (2008) and Chon and Lee (2015), which found the predictive power of

L2 receptive vocabulary knowledge for L2 writing. Due to methodological discrepancies, nevertheless, it is not possible to make a direct comparison of the results of the present study with those of the two studies.

For the first sub-question of the second research question, the results of the study reveal the indirect contribution of L2 vocabulary knowledge to L2 writing performances through the mediation of L2 reading ability only from receptive vocabulary knowledge, since a direct path was found from receptive vocabulary knowledge to reading and from reading to writing, but not from productive vocabulary knowledge to reading. The significant role of receptive vocabulary in reading and that of reading in writing have also been observed in previous studies (Eisterhold, 1990; Horiba, 2012; Ito, 2011; Kim, 2015; Kim & Kang, 2014; Koda, 1989; Kroll, 1993; Laufer, 1997; Li & Kirby, 2015; Nassaji, 2003; Shim, 2004; Zhang, 2012). What needs to be further discussed here is the indirect role of receptive vocabulary in writing, since the results of the regression analysis in Schoonen et al. (2011) and Oh et al. (2015) did not reveal L2 receptive vocabulary knowledge as a predictive factor of L2 writing. These two studies also have methodological differences with the present study in the aspects of receptive vocabulary knowledge measured and statistical analysis methods. In Oh et al. (2015), for example, receptive vocabulary size was not found to have a significant predictive power for writing compared with productive vocabulary size. They explored only the size of vocabulary knowledge, unlike the current study, which measured both the size and the depth of the knowledge.

The analysis of multiple paths of L2 receptive vocabulary knowledge to L2 writing provides an answer for the second sub-question of the second research question: receptive vocabulary knowledge had an indirect contribution to writing through the mediation of productive vocabulary knowledge because of a direct path from receptive vocabulary to productive vocabulary and from productive vocabulary to writing. The former path implies that productive vocabulary learning can benefit from receptive vocabulary knowledge. The path supports the development of receptive vocabulary to productive vocabulary reported in previous L2 studies (Fan, 2000; Henriksen, 1999; Laufer, 1998; Makarchuk, 2013; Meara, 1997; Nation, 1990; Shin et al., 2011; Webb, 2008; Zhong, 2016). It is also in line with Clark's (1993) claim that L1 children understand words before they can produce them. The indirect role of receptive vocabulary in writing through productive vocabulary suggests that receptive vocabulary knowledge, as well as productive vocabulary knowledge, can enhance the quality of L2 writing.

Since productive vocabulary knowledge appeared to have significantly direct effects on L2 writing, practicing productive use of words in written text would be crucial in increasing L2 writing ability. Prewriting tasks on vocabulary can also be helpful in enhancing the quality of writing. L2 writers often express their weaknesses in selecting appropriate expressions or revising lexical expressions (Choi, 2014). Learning words that

are related to the writing topic in a prewriting task would lessen L2 writers' cognitive burden and facilitate their writing process, which can ultimately lead to the development of productive vocabulary, since the task can provide an opportunity to practice using words in writing.

Another pedagogical implication can be drawn from the finding that receptive vocabulary knowledge had an indirect effect on L2 writing through productive vocabulary or reading. Since developing productive vocabulary knowledge is a challenging task, L2 writing instruction can integrate productive vocabulary learning with receptive vocabulary learning, which incorporates Nation's (2001) three psychological processes in vocabulary use: noticing, retrieval, and generative use. L2 learners may first learn the form and meaning of new words in a given input and practice retrieval of the newly learned words such as recalling their meaning, which is followed by guided sentence writing tasks to use them. L2 writing teachers can also use reading tasks to facilitate retrieval of receptively known words, which leads to their generative use in expressing ideas in L2 writing.

The current study has provided a valuable insight into the direct contribution of L2 productive vocabulary knowledge to L2 writing and the indirect contribution of L2 receptive vocabulary knowledge to L2 writing through the mediating effect of L2 productive vocabulary or reading. The study measured both breadth and depth of receptive and productive vocabulary knowledge, unlike previous studies that dealt with only receptive or productive vocabulary or only breadth or depth knowledge, though the role of both dimensions of receptive or productive vocabulary knowledge was not independently explored. Nonetheless, the present study has several limitations. The study tested only one hypothesized model with unidirectional relations. It did not also examine the role of linguistic knowledge other than vocabulary knowledge and processing skills such as processing efficacy (e.g., lexical retrieval speed), which are often found as a key variable affecting L2 writing, as shown in Schoonen et al. (2011). Future studies thus need to examine more diverse reciprocal or unidirectional relations among the variables explored in the study and other processing skills. Such studies could shed more light on the role of vocabulary knowledge and reading in L2 writing compared to other linguistic components; for example, reading would lead to the development of receptive vocabulary and be indirectly linked to writing through receptive vocabulary as well as productive vocabulary.

Second, this study did not explore developmental patterns in the contributions of L2 receptive and productive vocabulary knowledge to L2 writing, though such contributions would change across different L2 writing proficiency levels or L2 vocabulary levels or in the language development processes. If further research compares the role of L2 vocabulary knowledge across L2 writing proficiency or vocabulary levels or analyzes longitudinal data, the developmental patterns in the relationship of L2 receptive and productive vocabulary with L2 writing proficiency may be discovered. Such research

would provide meaningful pedagogical implications for different writing proficiency or vocabulary levels and language development stages.

Though the present study measured both breadth and depth of receptive and productive vocabulary knowledge, it did not examine their roles in L2 writing separately due to the research design for the SEM analysis, unlike Chon and Lee's (2015) regression analysis of predictive powers of receptive and productive vocabulary size and receptive collocation knowledge. More specifically, the study did not explore whether the size of receptive or productive vocabulary or the knowledge of synonyms or collocation directly or indirectly affects L2 writing performances. If future studies with an SEM analysis are conducted on which type of receptive and productive vocabulary knowledge significantly contributes to L2 writing, a better understanding of their roles in L2 writing can be provided and meaningful pedagogical implications can be drawn from the results. L2 writing teachers could design their vocabulary instruction by determining its focus on the breadth or depth of receptive or productive vocabulary knowledge and the types of appropriate tasks, for example, whether they should place a focus on their students' learning individual words in isolation or associated words such as words with similar meanings or collocated words.

It is possible that the results of the current study would be the outcomes of the measures used in the study including the formats of the writing, reading or vocabulary tests and target words in the vocabulary tests. The findings may not thus be generalized into other research contexts with different measures, as Yu (2009), Kim and Ryoo (2009), and Yoon (2010) found lexical variations in L2 writings on different topics or between timed or untimed writings by analyzing lexical diversity or productive vocabulary with lexical frequency profiles. Li and Kirby (2015) also argue that different assessment techniques of reading comprehension are related to different types of vocabulary knowledge, since they measure different reading skills. In this study, the receptive and productive collocation tests measured knowledge for adjective-noun collocation and the adjectives for the receptive and productive collocation tests were mainly selected from 1K to 10K word families of the BNC English words list, which are used in previous studies (Nation & Beglar, 2007; Shin et al., 2011). The possibility of the influence of the measures and the target words on the results cannot be eliminated; thus, cautions are needed in interpreting the findings from the study. Further SEM analyses also need to be conducted by using different measures to explore whether they observe the same pathways of L2 vocabulary knowledge to L2 writing found in the study.

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