English Teaching, Vol. 78, No. 4, Winter 2023, pp. 249-270
DOI: https://doi.org/10.15858/engtea.78.4.202312.249
http://journal.kate.or.kr

Does Reading Mediate the Relation Between Productive Vocabulary and Writing or Is It the Other Way Around?

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Moon, Youngsun, & Kang, Yusun. (2023). Does reading mediate the relation between productive vocabulary and writing or is it the other way around? *English Teaching, 78*(4), 249-270.

This study investigated whether the framework of writing for English learners should be guided by the well-established reading-writing relation or by the receptive and productive nature of literacy skills. The writings of 209 advanced English learners in Korea were analyzed in relation to receptive and productive vocabulary knowledge and reading comprehension while controlling for writing fluency. Two sets of structural equation models were fitted: (1) productive skills (productive vocabulary and writing fluency) mediating receptive skills (receptive vocabulary and reading) and (2) reading mediating receptive and productive vocabulary knowledge. The results supported the second model in which reading completely mediated the contribution of receptive and productive vocabulary to writing. Although there were no direct effects of receptive and productive vocabulary knowledge, both had significant indirect effects on writing through reading and writing fluency. These results show that reading has a strong direct effect on writing above and beyond vocabulary, and that vocabulary knowledge contributes to writing development through reading.

Keywords: writing, reading comprehension, productive vocabulary, receptive vocabulary, advanced Korean EFL learners

This study was supported by 2023 Korea University College of Education Research Grant.

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Received 30 September 2023; Reviewed 15 October 2023; Accepted 15 November 2023

1. INTRODUCTION

Writing is one of the most challenging skills to acquire. Becoming proficient in writing requires many subskills including various literacy skills and cognitive abilities (Berninger & Winn, 2006; Graham et al., 2019). Accordingly, understanding the underlying process of writing skills has been a topic of interest for many researchers. Based on previous research, we now know the importance of various cognitive skills (i.e., executive functions) as well as lower-level and upper-level literacy skills (i.e., vocabulary, grammar, spelling, and reading) in developing one's writing proficiency (Kim, 2020). When we narrow the scope to literacy skills, one of the most frequently studied skills in relation to writing is reading comprehension (Abbott, Berninger, & Fayol, 2010; Allen et al., 2014; Fitzgerald & Shanahan, 2000; Shanahan & Lomax, 1988). Based on how research indicates that reading and writing are built upon similar components, their relation has been well-documented. What is still of interest for further research is how the reading-writing relation may change when looked at together with different skills concurrently, and whether this relation portrays different results for readers/writers of different characteristics (Carson et al., 1990; Choi, Moon, Paek, & Kang, 2018; Choi, 2017).

Another literacy skill that should not be left out when discussing writing development is one's vocabulary knowledge. Vocabulary has also been extensively studied for its role in writing development (Lee, 2014; Olinghouse & Wilson, 2013). As previous research has reached a consensus on its importance for writing, studies have moved on to look at different types of vocabulary knowledge such as receptive-productive vocabulary knowledge for a more in-depth understanding of the vocabulary-writing relation (Choi, 2017; Maskor & Baharudin, 2016). With the plethora of research confirming that there is indeed a relation between reading-writing and vocabulary-writing, it is natural to question how these two literacy skills might interact with each other when contributing to writing.

Related to this line of thought, another way to think of these literacy skills is to consider them as either receptive or productive skills, as reading is a receptive skill, and writing, our variable of interest, is a productive skill. For vocabulary, there is both receptive and productive vocabulary knowledge. Thus, in the process of shaping the framework of writing, it would be interesting to examine which literacy skill between reading or productive vocabulary is positioned in the upper tier in proposing the best-fitted framework of writing. Literacy skills are often thought of in a hierarchical manner where certain skills (i.e., reading and writing) are considered higher-level than other foundational skills of literacy (Kim, 2020). In explaining writing performance, would reading, as a higher-level ability, mediate the contribution of vocabulary knowledge that encompasses both productive and receptive vocabulary knowledge? Or would productive skills (i.e., productive vocabulary knowledge) mediate the contribution of receptive skills, represented by reading and receptive vocabulary?

The current study investigates the complex relations between reading, vocabulary knowledge, and writing among advanced college-level Korean English as Foreign Language (EFL) learners. Specifically, we examine whether writing development in advanced Korean EFL learners is better explained by a hierarchical model, where higher- and lower-skills build upon each other, or if EFL learner's writing is better explained by the dynamic interplay between receptive and productive aspects of literacy skills by fitting alternative models.

2. LITERATURE REVIEW

2.1. Reading and Writing

It is a well-established fact that reading is deeply related to writing based on studies that have been carried out extensively throughout the past decades (Abbott et al., 2010; Carson et al., 1990; Fitzgerald & Shanahan, 2000; Grabe & Zhang, 2016; Kim et al., 2018; Shanahan & Lomax, 1988). For instance, Abbott and colleagues (2010) investigated longitudinal relations between reading and writing following two cohorts of native English speakers from first to fifth and third to seventh grade. Word-level skills such as word reading and spelling were found to have significant longitudinal relations across all grades, while the longitudinal path from text composition to text comprehension only had a significant relation in grades 3 to 5. Overall, the results from Abbott and colleagues (2010) indicated that the reading-writing relation is dynamic across text levels and is subject to change as students develop their literacy skills. Hence, although the presence of the reading-writing relation is well established, it is also important to look at learners with different characteristics at different timepoints to see whether their development of literacy skills differs for writers from various backgrounds or age ranges.

In fact, several studies have looked at the reading and writing relation from the perspective of second language (L2) learners (Choi, 2017; Hedgcock & Atkinson, 1993; Llach, 2010; Moon et al., 2019; Pae, 2019; Stæhr, 2008). It is likely for these learners to demonstrate a different picture for their reading-writing relation, especially for those who are not in English-speaking countries since they are prone to experience a wider gap between their receptive (reading) and productive (writing) skills (Lee, 2003; Lee, 2014). Also, not only their limited L2 proficiency (Silverman et al., 2015) but also their first language (L1) may have an impact on their writing development through cross-linguistic transfer (Durgunoğlu, 2002; Koda, 2007; Pae, 2019; Sparks et al., 2009), which may be even more prevalent for learners in foreign language contexts (Schoonen, 2019).

While the relation between reading and writing does not appear to be a one-size-fits-all

for English learners, one other guiding question for the literature on reading and writing development has been its directionality (Schoonen, 2019). The writing-to-read model best described beginner learners (Shanahan & Lomax, 1988), while the reading-to-write unidirectional relation was confirmed by many more recent studies with English L1 writers (Ahmed et al., 2014; Babayiğit & Stainthorp, 2011; Kim et al., 2018). Consequently, the current study will also be looking at how different literacy skills (including reading comprehension) contribute to writing, further investigating whether the previously identified reading-to-write model for English L1 writers (Ahmed et al., 2014) fits EFL learners' writing as well.

Overall, numerous studies have been conducted with the attempt to understand the relation between English learner's reading and writing. However, there is more to learn about certain groups of learners that have not been looked at as extensively as others, such as EFL learners with a distant L1 from English. Unlike L1 writers that researchers have been conducting research with for various proficiency levels and grade levels (Abbott et al., 2010; Fitzgerald & Shanahan, 2000; Kim et al., 2018; Shanahan & Lomax, 1988), it is still hard to find studies on L2 learners who are in non-English speaking countries and have succeeded in becoming relatively proficient in writing despite the lack of opportunities to practice productive skills (Choi et al., 2018). For instance, Pae (2019) looked at Korean middle school student's L1 (Korean) and L2 (English) reading and writing to determine their relations and found that both L1 writing and L2 proficiency had significant contributions to L2 writing. Whereas Pae's study was informative in understanding cross-linguistic transfer of literacy skills (Koda, 2007), the focus was on the simultaneous relation between reading and writing in L1 and L2 and the question of how reading and vocabulary knowledge plays a role in English writing remains. In addition, the students in Pae (2019) had intermediate English proficiency with limited writing proficiency in English. Thus, with an emphasis on investigating how the framework of writing should be constructed, this study will look at how reading comprehension ability, along with other literacy skills (i.e., vocabulary knowledge), plays a role in writing proficiency for advanced Korean EFL learners.

2.2. Receptive and Productive Skills

Based on the fact that reading and writing are deeply intertwined, one question that arises is whether reading is related to writing because the two literacy skills share common underlying skills (Fitzgerald & Shanahan, 2000), or because of its nature of receptiveness. That is, the well-known reading and writing relation may be because reading as a receptive skill acts as a precursor to a productive skill, writing. This thought is not unrealistic if we look at how previous studies on receptive and productive (or expressive) vocabulary have revealed that receptive vocabulary knowledge precedes that of productive knowledge

(Laufer, 1998; Lee, 2014). This is also true for L2 learners, as receptive vocabulary size was identified as a potential indicator for that of productive vocabulary (Webb, 2008).

In fact, there have been different results for receptive and productive vocabulary in terms of its contribution to writing skills. Most studies report productive vocabulary as a stronger predictor of writing than receptive vocabulary (Oh, Lee, & Moon, 2015; Schoonen et al., 2011). According to Choi (2017), a study that focused on the direct and indirect roles of receptive and productive vocabulary for writing, only productive vocabulary had a direct contribution to writing, while receptive vocabulary had an indirect contribution through productive vocabulary or reading comprehension. Likewise, it would be important to see how the hierarchical relations of component skills for writing should be constructed since it would inform us of potential indirect effects of literacy skills on writing which instead might have the risk of being misinterpreted as having no effects at all.

Then, we can hypothesize that the framework for writing can be thought of as either "receptive skills → productive skills → writing" or "vocabulary knowledge → reading comprehension → writing" based on whether we look at the underlying component skills of writing with the lens of receptive/productive skills or different literacy skills. For receptive skills that contribute to writing, we can consider receptive vocabulary knowledge (Stæhr, 2008), reading comprehension (as mentioned above), and listening comprehension as in discourse-level oral language skills (Dockrell & Connelly, 2009). As for productive skills, handwriting, spelling, productive vocabulary knowledge, sentence writing, and writing fluency can be considered (Kim, 2020).

First of all, receptive vocabulary knowledge has been studied for its relation with writing and resulted in contradicting findings where some studies found no significant relation between receptive vocabulary and writing, while others did (Miralpeix & Muñoz, 2018; Stæhr, 2008). In Schoonen et al.'s (2011) study looking at the writing of Dutch EFL students, vocabulary did not turn out to be a significant predictor after accounting for metacognitive skills, grammar, spelling, and typing fluency. On the other hand, in Stæhr (2008), receptive vocabulary size accounted for almost half of the variance in performing higher than average in writing. Thus, the specific role that receptive vocabulary knowledge plays in writing is still unclear due to mixed results depending on which variables are accounted for.

One point that should be acknowledged is one's receptive vocabulary not revealing any significant relations or contributions to writing should not be interpreted as having no relation to writing development. Not all components make a direct contribution to writing and may instead have an indirect contribution through mediating variables (Kim, 2020). Also, as seen in Schoonen et al. (2011), vocabulary knowledge may not be a significant predictor depending on which other stronger predicting variables are taken into account. It is thus important to know how literacy variables contribute to writing and unveil potential indirect effects of literacy variables through mediators, similar to how Choi (2017) found receptive

vocabulary playing an indirect role through both productive vocabulary and reading comprehension.

Moving on to productive skills, some of the literacy-relevant components that are expected to play a role are handwriting, spelling, productive vocabulary, sentence writing, and writing fluency (Choi, 2017; Graham & Santangelo, 2014; Kim, 2020; Maskor & Baharudin, 2016). Among these skills, productive vocabulary is a frequently studied literacy variable in relation to writing (Choi, 2017; Lee, 2014; Maskor & Baharudin, 2016; Oh et al., 2015). Going back to our question about how the framework of writing should be constructed, it is unclear whether productive vocabulary as a productive skill should be positioned higher in the framework of writing, contributing to writing more directly than reading comprehension. It would be interesting to directly compare productive vocabulary that shares a productive nature with writing with reading comprehension that shares common subskills with writing and see which literacy variable mediates or is mediated by one another for its role in writing.

Another productive skill to be considered is writing fluency, which is usually defined as the rate at which a writer produces text (Chenoweth & Hayes, 2001). Writing fluency is usually measured through pausing times, number of revisions, and the writer's writing speed or length of production (MacArthur et al., 2008, as cited in Van Waes & Leijten, 2015). This is based on the notion that the more proficient a writer becomes, the faster the speed of producing text without being hindered by lower-level sub-processes and can focus on textual quality (Palviainen et al., 2012). In our current study where writing is assessed with a timed task, it would be important to control for one's writing fluency to see contributions of literacy skills to writing above and beyond the restraints of lower cognitive skills on writing processes that English learners may experience.

Considering how writing fluency indicates students' ability to access words and grammatical structures within a limited time, there are various measures that can represent these traits for student writing. For example, previous studies have pointed out the validity of using mean length of t-unit (dividing number of t-units by the number of tokens) as a measure of writing fluency (Vasylets & Marín, 2021; Wolf-Quintero, Inagaki, & Kim, 1998). Readability can also be used as a measure of writing fluency that taps into the grammatical aspect of writing (Johnson et al., 2012). Formulas used to derive readability scores consider the complexity of a given text using mean length of sentences (total words/ total sentences) and mean length of words (total syllables/total words). As the participant group of the present study is characterized as second language learners of English, it would be desirable to use a readability index that reflects their language status. Crossley and colleagues (2008) developed a readability index for L2 students using three indices that reflect lexical, syntactic, and meaning from Coh-metrix (Graesser et al., 2004). In a later study, Crossley and colleagues (2011) demonstrated the superiority of the L2 readability index (referred to as

RDL2 per Coh-metrix indices) for classifying text level from a large corpus of texts validating its use over other readability indices.

2.3. Present Study

The scope of this study examining the construct of writing will be limited to only looking at the underlying literacy skills of writing including reading comprehension and vocabulary knowledge. Although previous research has revealed important roles of other components such as topic knowledge, executive functions, and socio-emotions for writing (Graham et al., 2019; Kim, 2020), restricting the inclusion to only literacy skills is also expected to yield important implications for teaching English in second or foreign language settings. As mentioned before, only a few studies looked at English writing proficiency in relation to reading and vocabulary knowledge in an integrative manner within EFL settings (Choi, 2017; Moon et al., 2019; Pae, 2019), although they will likely have reciprocal influences within the framework for writing. Once we understand this relation better, it would be insightful to also include other cognitive skills that contribute to writing as well. In addition, there is no previous study to our knowledge that directly compared different models of writing with literacy variables to determine how their hierarchical relations should be formed to inform and construct a framework for understanding L2 writing for EFL learners with advanced proficiency.

Thus, in this study, we will attempt to see whether the framework for writing should be formed as reading comprehension mediating vocabulary knowledge, or as productive skills (productive vocabulary) mediating receptive skills (reading comprehension and vocabulary knowledge) while controlling for writing fluency drawing on the data of advanced Korean EFL learners. The following research questions will guide our attempt of doing so:

1) Does reading comprehension mediate the contribution of vocabulary knowledge (both productive and receptive) to writing, or does productive vocabulary mediate the contribution of receptive skills (i.e., reading comprehension and receptive vocabulary knowledge) to writing in explaining advanced Korean EFL learners' writing abilities?

2-1) If reading mediates vocabulary knowledge, does receptive and productive vocabulary knowledge have direct and/or indirect roles in explaining advanced Korean EFL writers' writing qualities?

2-2) If productive skills mediate receptive skills, do receptive skills have direct and/or indirect roles in explaining advanced Korean EFL writers' writing qualities?

3. METHODOLOGY

3.1. Participants

209 Korean EFL college seniors (109 males and 100 females) attending six different four-year colleges in Seoul, Korea, participated in this study. Their majors varied widely, from humanities to science and engineering, and they all had taken TOEFL iBT for their preparation for employment or for graduate school admissions in English-speaking countries. Their mean *TOEFL iBT* score was 104.76 (*SD* = 8.73), based on the official score reports issued by ETS that were provided at the time of data collection, which further identified them as highly advanced EFL learners. Many of the participants reported having lived in English-speaking countries in the past, as part of participation in the exchange student programs during college or family relocation during childhood, but none of them lived abroad for more than a year.

3.2. Measures

3.2.1. Reading comprehension

Gates-MacGinitie Reading Test (GMRT; MacGinitie et al., 2000) Reading Comprehension subtest was adopted as a measure of the participants' reading comprehension abilities. A standardized test designed for adult-level reading comprehension, this test asked 48 multiple-choice comprehension questions for eleven different reading passages, with 55-minute time limit. Each correct response scored 1 point and thus the maximum possible score was 48. The researcher-reported Kuder-Richardson reliability for this test is .89 (MacGinitie et al., 2002).

3.2.2. Receptive vocabulary knowledge

The vocabulary subtest of the standardized GMRT was employed in assessing the participants' receptive vocabulary knowledge. It contained 45 multiple-choice vocabulary test items asking the participants to choose the best substitute for the given cue word used in context. Each correct answer was given one point and thus the maximum possible score was 45. The reported Kuder-Richardson reliability for this subtest was .88 (MacGinitie et al., 2002).

3.2.3. Productive vocabulary knowledge

In assessing the participants' productive vocabulary knowledge, the Woodcock Reading Mastery Test-Revised (WRMT-R; Woodcock, 1998) Word Comprehension subtest was used. This subtest measured the participants' productive vocabulary knowledge in terms of antonyms (34 test items), synonyms (33 test items) and analogies (79 test items), for which the test-takers were shown discrete words or word pairs and were asked to come up with antonyms, synonyms or appropriate word to complete the given word-pair relations, respectively. Each correct word choice received one point and thus the maximum possible scores were 34, 33, and 79 for antonyms, synonyms and analogies, respectively. The reported test-retest reliability for this subtest was .91 (Woodcock, 1998).

3.2.4. Writing skill

For the writing task, the participants wrote a 30-minute timed argumentative essay on whether technology was beneficial or detrimental to human lives. Their essays were further evaluated for their overall qualities holistically by an ETS-developed e-rater program *Criterion*. The scores range from 1 to 6. The weighted Kappa reliability estimate has been reported to be .72 (Enright & Quinlan, 2010).

3.2.5. Writing fluency

Different units of production are often used as measures for writing fluency since it reflects the writer's speed of writing by measuring their written output within a limited amount of time. In the current study, two indices were used to indicate students' writing fluency. First, the mean length of t-unit in a written essay was used to account for the participants' writing fluency and written productivity in this study. The participants' written responses were analyzed using L2SCA (Lu, 2010), an online software that was developed based on Chinese second language English learners at the college level, to obtain the mean length of t-units. Next, the RDL2 (L2 readability) index was also used as a measure of writing fluency (Crossley et al., 2008). As the RDL2 index reflects a text's *readability*, the more difficult the text is, the lower the RDL2 index. This results in the RDL2 index having an opposite directionality compared to the mean length of t-unit measure. Coh-metrix was used to analyze students' writing to derive this measure (Graesser et al., 2004).

3.3. Data Analysis

The primary data analysis for this study relied on Structural Equation Modeling (SEM)

using AMOS 21 with maximum likelihood estimation. After initial examination of the descriptive statistics and correlation analysis, latent variables were created for productive vocabulary knowledge and writing fluency. The writing fluency latent variable included two measures (mean length of t-unit and L2 readability) whereas the productive vocabulary latent variable included three measures (synonyms, antonyms, and analogies). Observed variables were used for reading comprehension, receptive vocabulary, and writing qualities.

In addressing the first research question regarding whether Korean EFL writers' writing abilities should be conceptualized as 1) productive skills mediating the relations of receptive skills and their writing abilities or as 2) reading comprehension mediating the relations of both receptive and productive vocabulary knowledge to writing abilities, two sets of structural models were fitted. Models in Figure 1 present four competing models differing in the presence of direct and indirect relations of receptive skills to writing qualities in addition to the direct paths from the productive language skills, while the four competing models in Figure 2 are based on the hypothesis that reading comprehension mediates the relations of vocabulary knowledge to writing, while writing fluency is taken into consideration.

In Figure 1a, it was hypothesized that the productive skills completely mediated the relations of receptive skills and writing abilities. Direct paths were drawn from the productive skills, writing fluency and productive vocabulary, while only indirect effects of receptive vocabulary and reading comprehension were considered through the productive skills. In Figures 1b and 1c, additional direct path from receptive vocabulary and reading comprehension, respectively, was added to direct paths included in Figure 1a, in order to test whether either of them have any unique direct contribution to writing qualities over and above the productive skills. In Figure 1d, additional direct paths were drawn from both receptive vocabulary and reading comprehension to writing qualities, to test whether they collectively have additional direct effects over and above productive skills. On the other hand, in Figure 2a, reading comprehension was hypothesized to completely mediate the relations of both types of vocabulary knowledge and writing abilities. Each of the other three competing models differed in the additional direct path(s) drawn from either receptive vocabulary (2b) or productive vocabulary (2c), or from both receptive and productive vocabulary concurrently (2d) to writing qualities.

Various goodness-of-fit indices, including χ^2 statistic, Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Goodness of Fit (GFI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR), were used to test model fit. CFI and TLI values equal to or greater than .90, GFI values equal to or greater than .95, and RMSEA and SRMR values equal to or less than .08 are recommended cut-offs that indicate good model fit (Hu & Bentler, 1999; Kline, 2005). The four models in each set (Figure 1 and Figure 2) were compared using goodness-of-fit indices

for model fits and identicality first, and their differences/identicalities were tested by chi-square difference tests.

4. RESULTS

As presented in Table 1, the Korean EFL learners in this study were highly proficient in English, with good grasp of English receptive vocabulary knowledge (M = 32.87, SD = 4.88), productive vocabulary knowledge (M = 20.22, SD = 2.43; M = 13.91, SD = 2.24; M = 43.86, SD = 3.14 for antonyms, synonyms, and analogies, respectively) and reading comprehension abilities (M = 38.17, SD = 6.19). Their performance on the productive vocabulary knowledge is grade equivalent for American 10^{th} graders (Woodcock et al., 1998), while that on the receptive vocabulary knowledge and reading comprehension measures placed them as American post-high school level (MacGinitie et al., 2007). The holistic evaluation of their argumentative writing (M = 4.06, SD = .73) as well as their writing fluency reflected in the mean length of t-unit (M = 17.48, SD = 3.34) and the L2 readability index (M = 17.57, SD = 4.56) also labeled them as proficient English writers. On the whole, the Korean EFL learners in this study were highly advanced English writers with high proficiency in both receptive and productive language abilities.

TABLE 1
Descriptive Statistics of Tested Variables (N = 209)

Constructs	Measures	Mean	*SD*	Min.	Max.
Writing Abilities	E-Rating	4.06	0.73	2	6
Reading Comprehension	GM Reading Test	38.17	6.19	19	48
Receptive Vocabulary	GM Vocabulary Test	32.87	4.88	20	45
Productive Vocabulary	Antonyms	20.22	2.43	13	27
	Synonyms	13.91	2.24	10	20
	Analogies	43.86	3.14	36	52
Writing Fluency	Mean Length of T-unit	17.48	3.34	11.55	31.40
	L2 Readability (RDL2)	17.57	4.56	7.20	29.55

Next, correlation analysis was conducted to examine the potential relation among the included variables. As shown in Table 2, Korean EFL learners' performance on most of the tasks was significantly correlated to one another. Their writing scores were significantly correlated to reading comprehension abilities (r = .42, p < .001), all three measures of productive vocabulary (r = .29, p < .001; r = .28, p < .001; r = .29, p < .001, for antonyms, synonyms, and analogies, respectively) and both measures of writing fluency (r = .23, p < .01;

r = -.41, p < .001 for mean length of T-unit and L2 readability, respectively). The significant negative correlation between the writing score and L2 readability index shows that lower L2 readability was significantly associated with better writing performance. Reading comprehension abilities were also significantly correlated to three measures of productive vocabulary knowledge (r = .54, p < .001; r = .40, p < .001; r = .52, p < .001 for antonyms, synonyms, and analogies, respectively) and both measures of writing fluency (r = .21, p < .01; r = -.30, p < .001 for mean length of T-unit and L2 readability, respectively), thus suggesting it to be highly related to productive language abilities as well as receptive vocabulary knowledge (r = .42, p < .001). In addition, L2 readability displayed significant negative correlations with both receptive and productive vocabulary measures. Here, again, the negative correlations of L2 readability with reading and vocabulary measures suggest that individuals with stronger reading abilities and vocabulary knowledge tend to produce more complex writing.

TABLE 2
Correlations Coefficient Among Variables (N = 209)

	1	2	3	4	5	6	7
Writing Abilities							
1. E-Rating							
Reading Comprehension							
2. GM Reading Test	.42***	.21**					
Receptive Vocabulary							
3. GM Vocabulary Test	.32***	.42***					
Productive Vocabulary							
4. Antonyms	.29***	.54***	.40***				
5. Synonyms	.28***	40***	.48***	.49***			
6. Analogies	.29***	.52***	.53***	.55***	.48***		
Writing Fluency							
7. Mean Length T-Unit	.23**	.21**	.16*	.09	.02	.14*	
8. L2 Readability	-.41***	-.30***	-.38***	-.24**	-.22**	-.24**	-.43***

*p < .05, **p < .01, ***p < .001

Before fitting the structural models, the adequacy of the measurement model with two latent constructs was first tested through confirmatory factor analysis (CFA). The two latent constructs were: productive vocabulary that comprised antonyms, synonyms, and analogies; and writing fluency including mean length of T-unit and RDL2 (L2 readability) in argumentative writing. In constructing the writing fluency latent variable, RDL2 was reverse-coded, since lower RDL2 score indicates better writing fluency. The measurement model had an excellent fit: $\chi^2(5) = 13.95$, p = .02, CFI = .96, TLI = .92, GFI = .97, and SRMR

= .06. The factor loadings for all three latent variables were significant: β = .74, p < .001, β = .65, p < .001 and β = .75, p < .001 for antonyms, synonyms and analogies, respectively, on the productive vocabulary construct; and β = .74, p < .001 and β = .56, p < .01 for mean length of T-unit and L2 readability, respectively, on writing fluency. Thus, overall, the respective observed variables turned out to be adequate indicators of the two latent constructs and the measurement model fit the data well.

FIGURE 1

Four Fitted Candidate Models of Productive Skills-Mediation

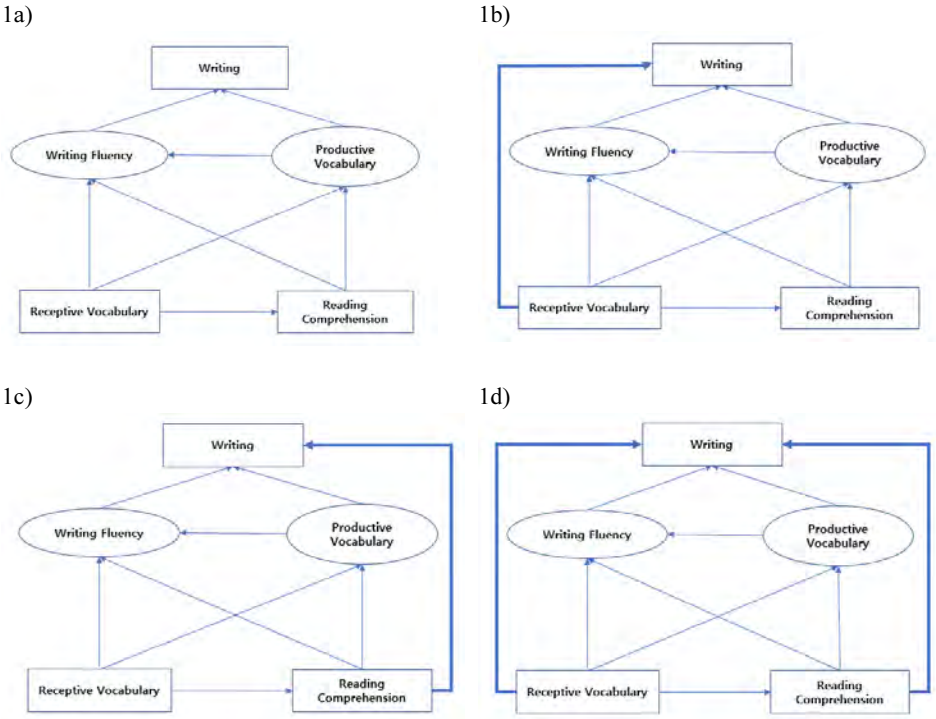


Figure 1 presents the four competing models assessing the hypothesis that productive language skills mediate the receptive language skills. Each of the latent variables in the four models in Figure 1 had significant loadings (ps < .001). In Figure 1a, productive language skills, writing fluency and productive vocabulary, were hypothesized to mediate the contributions of receptive language skills represented by receptive vocabulary knowledge and reading comprehension, and additional models were fitted with added direct path(s) from receptive vocabulary, reading comprehension, and both of the receptive skills together, as presented in Figure 1b-1d, respectively. The model fits were great for Model 1a, $\chi^2(15)$ = 23.26, p = .08, CFI = .98, TLI = .94, GFI = .98, RMSEA = .05, and SRMR = .03; Model 1b,

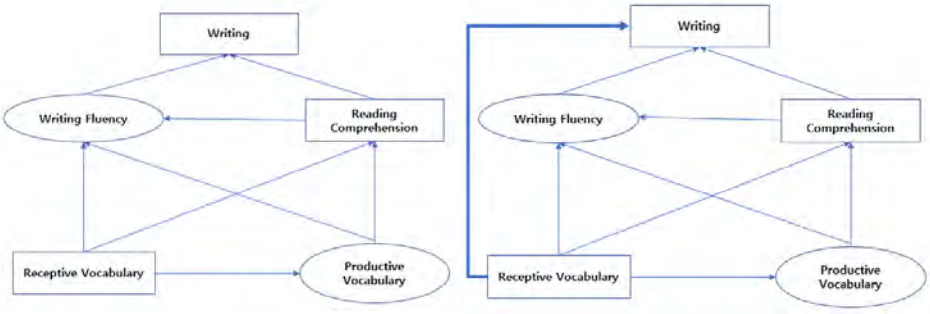
$\chi^2(14) = 22.49$, $p = .07$, CFI = .98, TLI = .96, GFI = .98, RMSEA = .05, and SRMR = .03; Model 1c, $\chi^2(14) = 18.47$, $p = .19$, CFI = .99, TLI = .98, GFI = .98, RMSEA = .04, and SRMR = .03; and Model1d, $\chi^2(13) = 18.47$, $p = .14$, CFI = .99, TLI = .98, GFI = .98, RMSEA = .05, and SRMR = .03. While Model 1a was not significantly different from Models 1b and 1d, $\Delta\chi^2 = .47$, $\Delta df = 1$, $p = .38$; $\Delta\chi^2 = 4.79$, $\Delta df = 2$, $p = .09$, respectively, it was significantly different from Model 1c ($\Delta\chi^2 = 4.79$, $\Delta df = 1$, $p < .05$). Given the significantly better fit indices of Model 1c, it was selected to be the best fitting model among the four alternatives in Figure 1.

Similar analyses and comparisons were carried out for the competing models in Figure 2. The loadings for the latent variables for all four models in Figure 2 were strong ($ps < .001$). The complete mediation model, shown in Figure 2a, hypothesized that reading comprehension completely mediated the contribution of both receptive and productive vocabulary while the effects of writing fluency are accounted for, and thus assumes only indirect effects of vocabulary knowledge. This model had a great fit to the data, $\chi^2(15) = 20.37$, $p = .16$, CFI = .99, TLI = .98, GFI = .98, RMSEA = .04, SRMR = .03. In the competing models shown in Figure 2b, 2c, and 2d, additional direct path(s) from receptive vocabulary, productive vocabulary, and both types of vocabulary concurrently, were added, respectively. Model fit was good for Model 2b, $\chi^2(14) = 19.60$ $p = .14$, CFI = .99, TLI = .98, GFI = .98, RMSEA = .04, and SRMR = .03; for Model 2c, $\chi^2(14) = 18.47$, $p = .19$, CFI = .99 TLI = .98, GFI = .98, RMSEA = .04, and SRMR = .03; and for Model 2d, $\chi^2(13) = 18.47$, $p = .14$, CFI = .99 TLI = .98, GFI = .98, RMSEA = .05, and SRMR = .03. Chi-square difference tests revealed that Figure 2a was not different from Figure 2b, $\Delta\chi^2 = .77$, $\Delta df = 1$, $p = .38$; Figure 2c, $\Delta\chi^2 = 1.9$, $\Delta df = 1$, $p = .17$; or Figure 2d, $\Delta\chi^2 = 3.72$, $\Delta df = 2$, $p = .39$. Therefore, the most parsimonious model, 2a was selected as the best fitting model among the set of models in Figure 2.

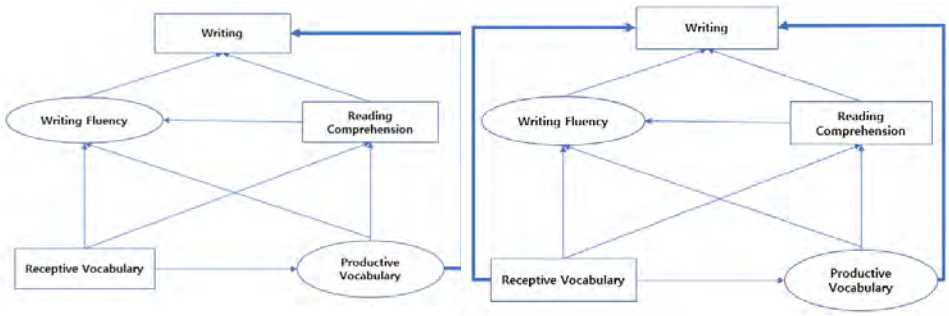
FIGURE 2

Four Fitted Candidate Models of Reading Comprehension-Mediation

2a) 2b)



2c) 2d)



In this model (See Figure 3 for the standardized regression weights), reading comprehension had strong relations to writing ($\beta = .29$, $p < .001$) when controlling for the significant direct effects of writing fluency ($\beta = .37$, $p < .001$). Important to note is that L2 readability was reverse-coded for this analysis – thus the significant positive effects of writing fluency on writing abilities indicate that more complex written products with lower readability were significantly related to better overall writing qualities. Receptive vocabulary had strong significant relations to productive vocabulary ($\beta = .66$, $p < .001$) and writing fluency ($\beta = .35$, $p < .01$), but not to reading comprehension ($\beta = .06$, $p = .51$). Productive vocabulary, on the other hand, had strong significant relations to reading comprehension ($\beta = .73$, $p < .001$) but not to writing fluency ($\beta = .02$, $p = .90$).

FIGURE 3

Standardized Structural Regression Weights for the Final Model

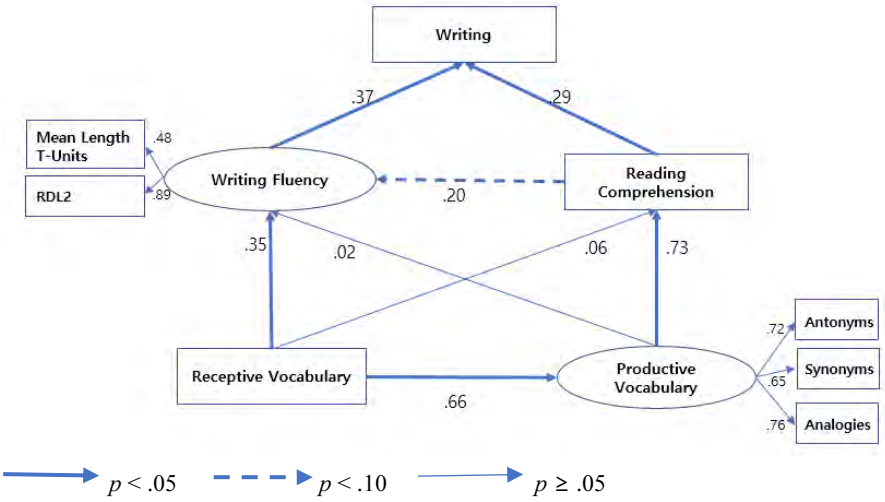


TABLE 3
Standardized Parameter Estimates of the Structured Model

	Direct Effects		Indirect Effects		Total Effects	
	β (SE)	p	β (SE)	p	β (SE)	p
Reading Comprehension	.29 (.07)	.001	.07 (.05)	.07	.36 (.07)	.001
Writing Fluency	.37 (.08)	.001			.37 (.08)	.001
Receptive Vocabulary			.28 (.05)	.001	.28 (.05)	.001
Productive Vocabulary			.26 (.07)	.001	.26 (.07)	.001

However, when the overall contribution of each of the included variables was estimated (See Table 3), all four considered variables showed significant total effects on writing, ranging from .26 to .37. Interestingly, although paths from productive vocabulary to writing fluency and from receptive vocabulary to reading comprehension were not significant, the collective indirect effects of both receptive and productive vocabulary were significant (β = .28, p < .01; β = .26, p < .01, respectively), thus making significant total contributions to writing. In sum, although vocabulary knowledge did not show significant direct effects on writing abilities, it had significant indirect effects through reading comprehension and writing fluency, in addition to the significant direct effects of writing fluency and reading comprehension.

5. DISCUSSION

The present study attempted to see whether the framework of writing should be constructed as productive skills mediating receptive skills or reading mediating vocabulary knowledge, while accounting for writing fluency. Alternative models hypothesizing variations of different mediation paths were also compared for each hierarchical structure. The results overall indicated that the framework of writing should be constructed as reading comprehension completely mediating the contribution of both productive and receptive vocabulary knowledge. Despite productive vocabulary sharing its nature of productivity with writing, it seems that reading should be placed at a hierarchically higher level than productive vocabulary when explaining writing abilities of advanced Korean EFL learners. Also, both types of vocabulary knowledge did not have any direct effects on writing as demonstrated in comparing alternative models presented in Figure 2 but did have significant indirect effects.

The results of this study are in line with the large body of research indicating that the relation between reading and writing is deeply intertwined for both L1 and L2 learners

(Abbott et al., 2010; Fitzgerald & Shanahan, 2000; Schoonen, 2019; Shanahan & Lomax, 1988). We not only found that reading comprehension had a significant direct effect on writing after controlling for writing fluency, but also demonstrated that reading comprehension completely mediated the effects of vocabulary knowledge on writing.

On the other hand, vocabulary knowledge did not have a direct effect on writing in our final model but did have significant indirect effects through reading comprehension and writing fluency. It is important to point out that the absence of a direct effect of vocabulary knowledge on writing does not mean that it does not play a role in writing development. Comparing between receptive and productive vocabulary knowledge, their indirect effects had similar magnitudes. This finding is somewhat discrepant from previous studies that particularly found productive vocabulary than receptive vocabulary to have a stronger contribution to writing (Choi, 2017; Schoonen et al., 2011; Stæhr, 2008). It seems that the receptive and productive vocabulary knowledge are comparable in their contribution to writing when reading comprehension and writing fluency are accounted for. One particular study that looked at similar participants (i.e., Korean EFL university students), Choi (2017), found receptive vocabulary to only have an indirect role via productive vocabulary and reading and a direct role of productive vocabulary for students' writing. This discrepancy could be due to the current study including a writing fluency variable that could have influenced the relations between vocabulary knowledge, reading comprehension, and writing. In addition, the present study focused on high-proficiency English learners, whereas Choi (2017) did not control for English proficiency, although the relations between literacy skill may vary by proficiency levels. Further research aimed at replicating these results will be necessary to resolve conflicting findings.

Another variable included in the structural model was writing fluency which was constructed with the mean length of t-unit and L2 readability. Controlling for writing fluency allowed us to look at the relations between writing and other literacy skills beyond potential cognitive restraints. Based on the results, the contribution of writing fluency to writing was large, but the direct effect of reading and indirect effects of vocabulary on writing development was observed above and beyond writing fluency.

This study is not without limitations in a few ways. First, there is a variety of measures that are used for writing fluency in the field. Although this study chose mean length of t-unit and L2 readability as indicators of writing fluency as did several previous studies (Johnson et al., 2012; Vasylets & Marín, 2021; Wolf-Quintero et al., 1998; Zhan et al., 2021), other potential proxies for fluency are the number of pauses during writing, number of revisions, and production rate. This study showed one way of including writing fluency when looking at literacy skills relations, and future studies that use different measurements such as key stroke logging will be insightful. Next, the results of the current study should be interpreted with caution as the generalizability of the chosen model may be limited to higher level EFL

learners. Attempts to replicate the current study with both similar and different learner groups would be informative. Nonetheless, writing of higher level EFL learners has been relatively understudied since not many EFL learners succeed in achieving higher proficiency in English writing. This study adds to our understanding of writing for advanced EFL learners.

Revisiting the arguments surrounding the directionality of the reading-writing relation, (e.g., reading-to-write and writing-to-read), pedagogical implications can also be drawn from the results. Results from this study reconfirm that the reading-to-write model is more adequate for advanced L2 writers (Ahmed et al., 2014; Babayiğit & Stainthorp, 2011; Kim et al., 2018). We can apply this to learners studying English in a foreign language context who have relatively more opportunities to study reading and take English assessments that are mostly focused on receptive skills (Choi, 2008; Jeon, 2010). That is, learning how improving one's reading and vocabulary knowledge can contribute to the development of writing can be particularly insightful for learners in non-English speaking countries who may find it hard to improve writing itself. It will also be informative for teachers to acknowledge the relations between literacy skills when promoting learners' writing development.

The nature of relations between literacy skills and how they contribute to each other are subject to change due to each skill being greatly related with one another. The results may also be sensitive to characteristics of the participants. Thus, this study contributes to the accumulated knowledge on the framework of writing by revealing that reading comprehension is a higher-level skill than productive vocabulary in its role in writing development while controlling for writing fluency for advanced EFL learners.

Applicable level: Tertiary

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