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How Derivational Prefix Instruction Impacts Incidental Vocabulary Acquisition and Reading Comprehension*

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The study examined the effects of explicit derivational morphology instruction (henceforth DMI) on the incidental vocabulary acquisition and reading comprehension of 132 Korean 1st-year high school students who responded to a battery of tests (two vocabulary tests and a reading comprehension test). Multiple statistical tools were used to analyze the data: Analysis of Covariance (ANCOVA), Analysis of Variance (ANOVA), Simple Regression Analysis, Tests of Simple Main Effects, and effect size computation using Cohen's *d*. The results indicated that (a) DMI enhanced students' ability to infer word meanings in context, (b) DMI promoted high proficiency students' reading comprehension, whereas it impeded intermediate proficiency students' reading comprehension, (c) vocabulary knowledge has a strong positive predictive value for reading comprehension, and (d) the gaps of vocabulary knowledge across proficiency levels were still substantial, despite the observation that DMI promoted students' vocabulary acquisition. These results have a bearing on English as Foreign Language (EFL) reading pedagogy.

[derivational prefix/vocabulary/reading comprehension]

I. INTRODUCTION

The present study was motivated and guided by three overarching purposes in the field of Second Language Acquisition (SLA): (a) to determine whether explicit DMI promotes incidental vocabulary growth and reading comprehension, (b) to test whether explicit DMI interacts with EFL high school learners' English language proficiency

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levels, and (c) to help EFL teachers make informed decisions regarding the instructional practice of DMI.

Despite the growing body of evidence from first language (L1) research that explicit attention to morphology promotes language learners' vocabulary growth and possibly reading comprehension (e.g., Nagy, Berninger, Abbott, Vaughan, & Vermeulen, 2003), little second/foreign language (L2) research has been performed to date that examined the efficacy of DMI on vocabulary growth and reading comprehension in the L2 contexts. Further, EFL high school students increasingly face morphologically complex English words in their English textbooks (Choi, 2006), and such words make up a great proportion of the words that should be acquired by these students (Nagy & Anderson, 1984, cited from Kuo & Anderson, 2006). Considering these facts, there is an urgent need to investigate how DMI affects their vocabulary knowledge growth and reading comprehension, and also whether DMI interacts with students' English language proficiency.

II. RELEVANT LITERATURE

1. Incidental Vocabulary Acquisition vs. Explicit Vocabulary Instruction

Incidental vocabulary acquisition is defined as "learning of vocabulary as the by-product of any activity not explicitly geared to vocabulary learning," whereas explicit vocabulary instruction is defined as "any activity geared at committing lexical information to memory" (Hulstijn, 2001). Many L1 researchers posited that except for the first few thousand words, vocabulary learning predominantly occurs through extensive reading, with the learner guessing at the meaning of unknown words (Y. Kim, 2006; Nagy, 1997; Nagy, Anderson, & Herman, 1987; Robbins & Ehri, 1994). Nagy, Anderson, & Herman (1987) claimed it is probable that an average amount of reading accounts for roughly one-third of a child's vocabulary growth, and that regular and extensive reading is a potent predictor of substantial and permanent vocabulary development. Kuhn and Stahl (1998) also claimed that "Ultimately, increasing the amount of reading that children do seem to be the most reliable approach to improving their knowledge of word meanings, with or without additional training in learning words from context (p. 133)."

Along the same line, many L2 researchers (for more, refer to Huckin & Coady, 1999) advocated incidental learning of vocabulary. Specifically, Huckin and Coady (1999) pointed out several advantages of incidental learning of vocabulary over direct instruction. First, incidental vocabulary learning is contextualized, giving the learner a richer sense of a

word's use and meaning than can be provided in traditional paired-associate exercises. Second, it is pedagogically efficient in that it enables two activities—vocabulary acquisition and reading—to occur at the same time. Third, it is more individualized and learner-based because the vocabulary being acquired is dependent on the learner's own selection of reading materials.

Despite the claim that incidental independent reading and listening are critical in vocabulary acquisition (Nagy, 1997), counter-claims were proposed by many other L1 researchers stating that vocabulary growth should also be accomplished through systematic vocabulary instruction (e.g., Beck, Perfetti, & McKeown, 1982; B. Kim, 2006; McKeown & Beck, 1988; Zechmeister, Chronis, Cull, D'Anna, & Healy, 1995). They argued that incidental acquisition of new words is not sufficient because the meanings of words extracted from texts are not deeply processed, and therefore do not last. Nor does reading automatically equip readers with strategies for them to be autonomous word learners. Further, as Sternberg (1987) noted, many texts are not created to provide readers enough contextual clues for word meaning inference. According to Paribakht and Wesche (1997), vocabulary acquisition through reading is "unpredictable and not necessarily the most effective" (p. 175).

Many L2 researchers (e.g., Coady, 1997; Nation, 2005) also voiced their concern that incidental vocabulary learning leads to substantially lower retention rates (Hinkel, 2006). They also voiced their concern that for words to be acquired they should be encountered 12-20 times in context (Coady, 1997), while in reality, L2 learners may not have ample opportunities to encounter the same words 12-20 times in context. Likewise, Nation and Wang (1999) claimed that a new word should be encountered before it is forgotten. Therefore, intensive reading of one or two books should be done per week. Further, there is no substantial empirical data to support the contention that incidental vocabulary learning is the best way for L2 learners to acquire vocabulary (Nation, 2005).

An enormous body of L2 vocabulary research showed that explicit vocabulary teaching is a promising venue to develop L2 learners' vocabulary knowledge (Hinkel, 2006). L2 research also showed that vocabulary knowledge can be improved by the instruction and use of vocabulary learning strategies. These strategies include effective use of either bilingual or monolingual dictionaries (Cho & Krashen, 1994), note-taking (McCarthy, 1990), keyword method (Atkinson, 1972), and various repetition strategies such as repeating aloud and repeating silently (Carter, 1987). The strategies also include using morphological analysis (e.g., Verhoeven & Perfetti, 2003), which is the focus of the present study.

2. Research on the Contribution of Morphology

Morphology is defined as "the structure of words in terms of morphemes" (Nagy, Berninger, Abbott, Vaughan, & Vermeulen, 2003, p. 730). Of the two major bound morphemes in morphology, inflectional (usually explains grammatical features) and derivational (usually changes meaning or part of speech), the present study focuses on the effects of explicitly instructing derivational prefixes.

Several researchers claimed that having good command of morphology is crucial to the readers' ability to read long, multi-syllabic words (e.g., Nagy, Diakidoy, &Anderson, 1993). They argued that morphological knowledge enables readers to parse word structures and to facilitate the process of deriving meanings of structurally complex multi-syllabic words. With an exception of Freyd and Baron (1982), there is a mounting body of empirical evidence from L1 researchers that DMI and knowledge promoted learner's ability to extract word meanings (Baumann, Edwards, Font, Tereshinski, Kame'enui, & Olejnik, 2002; Graves & Hammond, 1980; White, Sowell, & Yanagihara, 1989; Wysocki & Jenkins, 1987; Verhoeven & Perfetti, 2003). For instance, Bauman et al. (2002) reported positive effects of DMI on vocabulary meaning inference as measured by immediate and delayed posttests, whereas no positive effects were observed on reading comprehension. In contrast, Nagy, Berninger, Abbott, Vaughan, and Vermeulen (2003) reported statistically significant correlation between morphology awareness and reading comprehension. Specifically, they explored the relative efficacy of orthography, oral vocabulary, and morphology with ninety-eight second graders in the United States. The results showed that morphology was the most potent predictor of reading comprehension. However, since their statistical methods were correlational, no assertions can be made about the directionality of the relationship between morphology awareness and reading comprehension, as the researchers acknowledged.

In the L2 context, Tomesen and Aarnoutse (1998) found that morphology analysis significantly enhanced Dutch children's (4^{th} graders) ability to extract word meanings. More recently, Choi (2006) found that derivational prefix instruction substantially increased EFL learners' ability to infer word meanings from a list of words. While the findings of Choi have important implications for EFL learners and teachers, his study had undesirable aspects that may lead to overestimation of the effects of DMI. First, his experiment lacked ecological validity since the vocabulary inference test was done entirely out of context, using a vocabulary word list. Second, there was no delayed posttest, so Choi's findings may have reflected short-term memory of the instructed morphology rather than legitimate vocabulary acquisition.

Given this brief outline of previous research, it can be concluded that L1 research showed generally positive effects of explicit DMI on vocabulary growth. However, in light

of controversial effects on reading comprehension in the L1 context and limited empirical evidence coupled with methodological drawbacks of earlier studies (i.e., Baumann, Edwards, Font, Tereshinski, Kame'enui, & Olejnik, 2002; Choi, 2006; Nagy, Berninger, Abbott, Vaughan, & Vermeule, 2003), it is apparent that more researchers need to reexamine the effects of DMI with refined methodology. These issues were addressed in the present study. Specifically, the following research questions and hypotheses were examined and tested in the present study.

3. Research Questions

1) Does explicit DMI promote EFL learners' incidental vocabulary acquisition, as measured by their ability to infer word meanings in written texts?
2) Does explicit DMI enhance EFL learners' reading comprehension of the written texts that contain target prefixes?
3) What interaction effects can be seen between DMI (presence and absence of it) and learner proficiency (low, intermediate, high) in word meaning inference and in reading comprehension?
4) Is vocabulary knowledge a predictor of reader comprehension, as measured by students' performance on the Meaning Inference Vocabulary Posttest and reading comprehension test? If so, what is the predictive value of vocabulary knowledge for reading comprehension?

4. Research Hypothesis

The research hypotheses tested in the present study were as follows:

1) DMI students will outperform their No-DMI counterparts on the Meaning Inference Vocabulary Posttest: *DMI > No-DMI.*
2) DMI students will score about the same as their No-DMI counterparts on a reading comprehension test: *DMI = No-DMI.*
3) DMI students will outperform their No-DMI counterparts on the Meaning Inference Vocabulary Posttest, regardless of proficiency levels: *No statistically significant interaction.*
4) DMI students will score about the same as their No-DMI counterparts on a reading comprehension test, regardless of proficiency levels: *No statistically significant interaction*
5) Students' performance on the Meaning Inference Vocabulary Posttest will be a significant predictor for their performance on a reading comprehension test: *Positive* Beta Coefficient and Coefficient of Determination.

5. Rationale for Research Hypothesis

Four research Hypotheses were tested based on previous findings. Directional Hypothesis 1 is based on the findings of several researchers (Baumann, Edwards, Font, Tereshinski, Kame'enui, & Olejnik, 2002; Choi, 2006) who found that explicit teaching of morphology structures promoted students' ability to infer meanings of words. Hypothesis 2 is nondirectional and consistent with Baumann et al.'s (2002) findings with primary grade children. They reported that DMI did not significantly foster the reading comprehension of young learners.

Hypotheses 3 and 4 are concerned with interaction of DMI and learner proficiency levels. Hypothesis 3 derived its rationale from Choi (2006). He reported no statistically significant interaction of DMI and learner proficiency in an out-of-context vocabulary meaning inference test. It is predicted that similar results will be observed in an in-context vocabulary meaning inference test. Hypothesis 4 predicts no interaction because no previous study examined the potential interaction effect of DMI and learner proficiency on reading comprehension. Finally, Hypothesis 5 is based on previous studies that indicated positive association between vocabulary knowledge and reading comprehension (e.g., Nagy, Berninger, Abbott, Vaughan, & Vermeule, 2003; Nation & Snowling, 2004).

III. METHODOLOGY

1. Participants and Research Design

The study's target population is 1st year high school EFL learners enrolled in regular prep schools in Korea. The sample for the present study was taken from a major metropolitan area in southern Korea. Initially, 192 students from six intact classrooms were recruited on a volunteer basis. They were informed of their right to withdraw from the present study at any phase and were also informed that the specific goals of the research would be disclosed after all data were collected. The English language test, nationally administered in March 2007, showed that the mean score of all students was 51.9 (approximately a mean percentile of 71 nationally), which was 9.8 points higher than that of the national average (M = 42.1).

Regarding research design, six participating classrooms were randomly assigned to one of the two conditions (i.e., DMI and No-DMI). Based on students' performance on the English language test noted previously, the students in each condition were then assigned

to one of three proficiency levels[1] (low, intermediate, high), resulting in six groups. In other words, each student served in one cell of a 2 x 3 between subject factorial design, with the first factor being the presence or absence of DMI (i.e., DMI and No-DMI) and the second factor being the proficiency levels (low, intermediate, high) of the students. Next, for statistical analysis, 22 students from each cell were randomly selected (22 x 6 = 132 students). Finally, Levene's Test of Equality of Error Variances showed that the error variance of the English language test scores is equal across groups, $p = .056$.

2. Instrumentation

The instrumental component of the present study embraces (a) six short reading passages, (b) comprehension questions, and (c) Meaning Inference Vocabulary Tests (Pre-, Post-), each typed in 21 x 29.7 cm sheets of paper. The instruments were field-tested among 20 EFL high school students from other schools who did not participate in the main data collection. Subsequent modifications were made before the instruments were actually used in the main study. To measure the internal consistency reliability of the instruments, Cronbach's alpha was computed for the two identical vocabulary tests and a reading comprehension test, $\alpha = .82$, .79, and .87, respectively, thus confirming the reliability of the instruments.

1) Reading Passages

To address the issue of ecological validity (Shadish, Cook, & Campbell, 2002), a pool of candidate reading passages were taken from ordinary textbooks which were used in other high schools. The final six reading passages were chosen based on the verdict of two trained raters (the researcher and a doctoral level student).

The topics of the passages included advertisement and social issues such as overpopulation and anorexia. The passages included 10 target words which contained 10 target derivational prefixes: *re-, post-, mis-, in-, over-, dis-, bi-, sub-, under-, anti-*. The target words were not highlighted in any way in the reading passages. Moreover, deceptive words were replaced by other non-deceptive words in the reading passages, as noted by several researchers (White, Power, & White, 1989). For instance, words such as '*reserve*' and '*display*,' may be misconstrued as '*re* + *serve*' and '*dis* + *play*.'

The passages were analyzed in terms of linguistic complexity using the S-nodes per T-unit measure. An S-node is defined as a verb phrase (both finite and infinite), while a main clause and any subordinating clause is counted as a T-unit (Hirano, 1991). Averages of T-

[1] The mean scores of the three groups were 29.3, 49.7, and 76.7, respectively.

units and S-nodes were 6.83 and 12.33, respectively.

2) Comprehension Test

Multiple choice format was used to explore the students' general understanding of the six reading passages (1 question each passage x 6 passages = 6 questions) while controlling for three confounding variables. First, care was taken that knowledge of target vocabulary was not directly related to comprehension questions. Second, the semantic distance between the correct response and the distractors was close, as recommended by several researchers (Beck & McKeown, 1991; Jenkins, Matlock, & Slocum, 1989). Lastly, the questions were presented in Korean language to control for the unnecessary effects of unknown English words on student performance on the reading comprehension test.

3) Meaning Inference Vocabulary Test

An earlier version of the Meaning Inference Vocabulary Test required students to provide the most appropriate meanings of the target words in context. However, the first pilot testing of the Meaning Inference Vocabulary Test revealed that inferred meanings of the target vocabulary were tremendously varied, so much so that reliable scoring seemed virtually unachievable. Thus, the researcher relied on a multiple choice format in which there was one correct choice (i.e., answer) and four incorrect alternatives (i.e., distractors). Regarding the four distractors, care was taken so that the four distractors were not syntactically or semantically distant from the answer.

The Meaning Inference Vocabulary Pretest, which is identical to the Meaning Inference Vocabulary Posttest, served two purposes: (a) to control for any pre-experimental vocabulary knowledge differences between groups, and (b) to serve as a baseline against which to assess students' performance on the Meaning Inference Vocabulary Posttest.

3. Treatment: Derivational Morphology Instruction

Two separate 10 minute DMIs were given to the MI group only by the participating English teacher, while the researcher assessed the treatment fidelity[2] of the instructions across three experimental classrooms. Instructions were given based on the following five steps, which is a partially modified version of Choi (2006):

1) The English teacher initiates DMI, stating that many English words are formed by

[2] Treatment fidelity was assessed by the researcher and a research assistant. 4.8 on a 5 point scale confirm the fidelity of treatment procedures of this study.

combining prefixes and stems, and also that the meaning of many long, multi-syllabic words can be inferred by parsing them into their components (i.e., prefixes, stems).

2) The teacher elicits students' responses on the meaning of the first prefix '*re-*' from the target prefix list: *re-, post-, mis-, in-, over-, dis-, bi-, sub-, under-, anti-* (the first five prefixes were instructed in the first session, and the remaining five prefixes in the second session).
3) The teacher provides or confirms the basic meaning of the prefix '*re-*'.
4) The teacher introduces stems, such as '*enter*' and '*arrange*,' invites students to present the meaning of the stems, encourages students to combine '*re-*' and stems, and asks for the meaning of the prefixed words.
5) For deeper processing of the target prefix, the teacher models sample sentences which include prefixed words (reenter, rearrange). The teacher then encourages students to compose simple sentences using the prefixed words and to share the sentences with others. In the process, care is taken so that target vocabulary is not discussed. Steps 1 through 5 are repeated for the remaining prefixes.
6) At the end of each session, students are reminded that many English words are formed by combining prefixes and base words. They are also reminded that the meaning of many long, structurally complex words can be inferred by separating those words into their components and analyzing them first separately, then together.

4. Data Collection Procedures

Main data collection occurred in intact classrooms and in two separate Stages within a four week span, while the treatment (i.e., DMI) was administered one week after the Meaning Inference Vocabulary Pretest and two weeks prior to the Meaning Inference Vocabulary Posttest and a reading comprehension test. Informing students of specific research purposes waited until the termination of data collection as noted by Mackey and Gass (2005).

In Stage 1, students were tested on their pre-experimental knowledge of target vocabulary. In Stage 2, which occurred three weeks later, the participating English teacher distributed to each participant an experimental packet corresponding to their instructional treatments (i.e., DMI, No-DMI). The English teacher read aloud the instructions which were also presented on the first page of the experimental packet. Specifically, students were informed that they would read six passages, respond to comprehension questions about what they read, and choose the most appropriate meaning of ten words in the text, not out of their memory. Next, a sample item was examined by the students while the

researcher asked if they had any questions about the test. Students were then instructed to respond to the reading comprehension test and the Meaning Inference Vocabulary Posttest. Students were allowed to mark or to take notes on their packets. Although a 20 minute time limit was imposed, all students finished the whole task within the time constraint. After the answer sheets were collected, the researcher informed students of the research purposes, thanked the students for their participation, and asked them not to discuss the contents of the tests with other students outside classroom.

5. Statistical Methods

In attempting to address Research Questions 1 and 3, raw scores from the Meaning Inference Vocabulary Pre- and Post-test were submitted to a 2 x 3 Analysis of Covariance (ANCOVA). DMI (DMI, No-DMI) and learner proficiency levels (low, intermediate, high) served as independent variables, while the Meaning Inference Vocabulary Posttest served as a dependent variable. Scores from the Meaning Inference Vocabulary Pretest served as a covariate, "to control for pretreatment group differences" (Huck, 2004, p. 394).

Next, in an effort to answer Research Questions 2 and 3, a two-way ANOVA was performed, treating DMI (DMI, No-DMI) and learner proficiency levels (low, intermediate, high) as independent variables, and comprehension test scores as the dependent measure. For Research Question 3 only, the statistically significant interaction in reading comprehension was further examined via tests of simple main effects.

Regarding Research Question 4, the predictive value of Meaning Inference Vocabulary Posttest scores for reading comprehension was analyzed using Linear Regression Analysis, treating the scores of the Meaning Inference Vocabulary Posttest as a predictor variable, and comprehension test scores as a criterion variable.

Finally, the magnitude of the treatment effects was computed to determine practical significance (Huck, 2004). To that end, the researcher calculated *d* statistic (Rosnow & Rosenthal, 1989) and made reference to Cohen's (1988) criteria: .20 (small), .50 (moderate), and .80 or greater (large). Although Cohen's *d* can be estimated using $(M_1 - M_{2)} /S_{\text{pooled,}}$ for convenience sake the researcher used the following website for its calculation: http://web.uccs.edu/lbecker/Psy590/escalc3.htm.

IV. RESULTS

Data screening was performed for outliers and normality of distribution prior to data analysis and interpretation. It revealed that there were no serious outliers and departure from normality (kurtosis and skewness were smaller than 1.0). Data screening also

revealed that the error variances of the dependent variables (pre-test, comprehension, post-test) were all above .05 (*p*s = .135, .250, .060, respectively), indicating that the error variances of the three dependent variables were equal across groups.

1. The Effects of DMI on Vocabulary Acquisition

The results revealed that DMI students (adjusted mean = 5.93) scored higher than their No-DMI counterparts (adjusted mean = 5.27, adjusted mean difference between DMI and No-DMI = .66). An Analysis of Covariance (ANCOVA) was carried out to probe whether a statistically significant difference existed between the means of the two groups. The ANCOVA showed statistically significant main effects for DMI, $F(1,130) = 6.918$, $p = .010$, Cohen's $d = .34$, indicating that the difference was statistically significant. This finding is consistent with the researcher's prediction (Hypothesis 1).

TABLE 1

Descriptive Statistics Obtained from Meaning Inference Vocabulary Pre- & Post- Tests

Dependent Variables	Group	Proficiency	Pretest Mean	SD	Posttest Mean	SD
Meaning Inference Vocabulary Pre- and Post- Tests	No-DMI	Low	3.36	1.177	3.73	1.316
		Intermediate	4.77	1.660	5.41	1.736
		High	6.23	1.445	6.73	1.518
		Total	4.79	1.844	5.29	1.951
	DMI	Low	3.45	1.335	4.59	1.098
		Intermediate	4.59	1.436	5.50	1.225
		High	6.18	2.218	7.64	1.136
		Total	4.74	2.205	5.91	1.716

Also consistent with the researcher's prediction (Hypothesis 3), there was no statistically significant interaction of treatment effect (i.e., DMI, No-DMI) and learner proficiency levels (low, intermediate, high), p = .286, revealing that higher proficiency students consistently outperformed lower proficiency students.

More specifically, high proficiency level students tended to perform significantly higher than intermediate (mean difference = 1.727, Cohen's $d = 1.44$) and low proficiency level students (mean difference = 3.023, Cohen's $d = 1.88$), and also that intermediate proficiency level students tended to score significantly higher than low proficiency level counterparts (mean difference = 1.295, Cohen's $d = 1.29$). The consistently large effect size

indices (Cohen's *d*) revealed a trend that there were significant gaps of vocabulary knowledge across proficiency levels even after DMI. TABLE 1 illustrates the descriptive statistics obtained from the two vocabulary tests.

2. The Effects of DMI on Reading Comprehension

The results revealed that DMI students (M = 3.74) performed better than No-DMI students (M = 3.56). A 2 (DMI, No-DMI) x 3 (low, intermediate, high) ANOVA was performed to determine whether the mean difference (= .18) was statistically significant. The analysis revealed no statistically significant difference, $F(1,130) = 1.128$, $p = .290$, confirming the researcher's prediction (Hypothesis 2).

However, the results were *in*consistent with the researcher's prediction (Hypothesis 4) that there will be no statistically significant interaction of DMI and learner proficiency in reading comprehension. Specifically, data analysis indicated that DMI did interact significantly with students' proficiency levels, $F(2,129) = 3.124$, $p = .047$, meaning that the presence or absence of DMI had differential effects on the students' comprehension, depending on their language proficiency.

To follow up on the statistically significant interaction of DMI and learner proficiency, further analysis was performed via the tests of simple main effects. The results indicated that high proficiency DMI students outperformed high proficiency No-DMI students to a statistically significant degree, $F(1,130) = 8.022$, $p = .007$, and large effect size, $d = .85$. In contrast, no other comparisons were statistically significant, $p = .249$ and .495, for intermediate and low proficiency group comparisons.

TABLE 2

Descriptive Statistics Obtained from Reading Comprehension Test

Dependent Variable	Group	Proficiency	Mean	SD
Reading Comprehension	Non-DMI	Low	2.36	1.177
		Intermediate	3.82	1.220
		High	4.50	.913
		Total	3.56	1.416
	DMI	Low	2.59	1.008
		Intermediate	3.45	.800
		High	5.18	.664
		Total	3.74	1.362

To determine the predictive value of Meaning Inference Vocabulary Posttest scores and reading comprehension test scores, Simple Regression Analyses were run. Consistent with the researcher's prediction (Hypothesis 5), data analysis showed that there was a statistically significant, strong positive correlation, r = .63, R^2 (coefficient of determination) = .397, adjusted R^2 = .392, beta coefficient = .47, $F(1,130) = 99.994$, $p < .001$. Specifically, the coefficient of determination value .397 indicates that approximately 40% of the variation in the reading comprehension test scores can be explained by the students' Meaning Inference Vocabulary Posttest scores. In addition, beta coefficient value .47 reveals that with other variables held constant, Meaning Inference Vocabulary Posttest scores were positively related to comprehension scores, increasing by .47 for every extra vocabulary score, as indicated in the Regression Equation[3]. The TABLE 2 summarizes the descriptive statistics obtained from the reading comprehension test.

V. DISCUSSION

In this part of the article, the results of the present study are discussed in light of previous research findings and extant theories.

1. The Effects of DMI on Vocabulary Acquisition

Consistent with the researcher's prediction (Hypothesis 1), DMI students scored significantly higher than No-DMI counterparts. The results are also consistent with Choi (2006) and Baumann et al. (2002). At the same time, the results extend those of Choi (2006) in that the effect of DMI was investigated only in a de-contextualized research method. The present study provided some preliminary evidence that DMI may promote EFL learners' vocabulary knowledge in context as well, that is, while they are engaged in authentic readings.

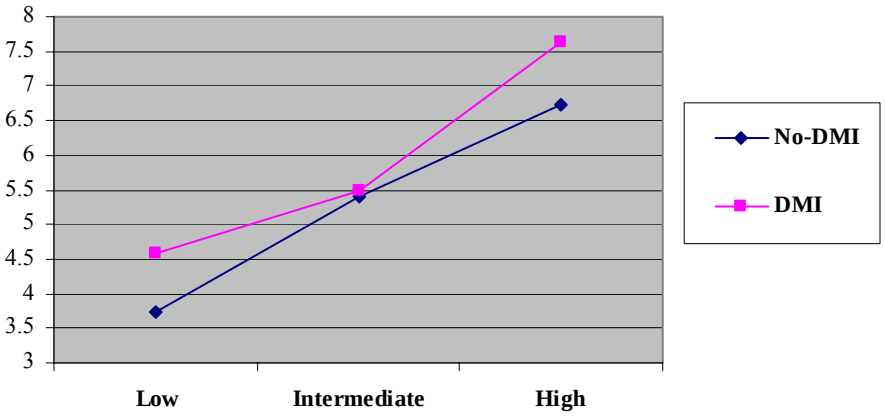
It appears that DMI caused students to deliberately attend to linguistic forms (prefixes and stems) and promoted morphological awareness of the students. The findings generally support Schmidt's Noticing hypothesis (1990), which places great importance on the role of noticing as a necessary condition for Second Language Acquisition (SLA). Schmidt (1995) posited that "what learners notice in input is what becomes intake for learning" (p. 20). Truscott (1998) also posited that noticing is crucial for acquiring metalinguistic knowledge (e.g., the ability to analyze and manipulate words and grammar rules).

[3] Regression Equation: Y = 1.705 + .47*X. Y = comprehension score, X = vocabulary score

However, as illustrated by FIGURE 1, it is rather unanticipated that the advantages of DMI substantially diminished for intermediate level students only. A reasonable interpretation concerning this almost non-effect of DMI for intermediate proficiency students can be explained by the students' current knowledge of stems. For instance, while controlling for the variable of contextual analysis, the target prefixed words, '*underestimate*' and '*undervalue*,' are difficult to infer unless readers are familiar with the meanings of the stems, such as '*estimate*' and '*value*'. In other words, DMI may not promote intermediate level students' vocabulary knowledge beyond their current knowledge of stems. This speculation is further supported by Nagy, Diakidoy, and Anderson (1987). Nagy et al. reported significant correlation between stem and derivative knowledge, $r = .67$, $p < .001$, and concluded that ability to infer word meanings from DMI may be constrained by students' knowledge of stems. Yet this speculation does not apply to low and high proficiency students. Future studies should examine this speculation.

FIGURE 1

No Significant Interaction of DMI and Learner Proficiency in Vocabulary Post-Test



Additional analysis using effect size computation shows that the magnitude of treatment effect (i.e., DMI) was closer to small than moderate (Cohen's $d = .34$), meaning that although DMI students outperformed No-DMI students to a statistically significant degree ($p = .010$), the mean difference (adjusted M = .66) between the two groups does not appear to be of practical significance. This finding contrasts with Choi (2006) who found large effect size, ranging from .85 to 1.10. Thus judged from the perspective of practical significance, a good command of morphology will greatly augment EFL learners' ability to infer word meanings *out of context* only, while it may not be the case *in context*. Yet the

findings are encouraging when compared to that of Nagy, Anderson, and Herman (1987), whose study showed that incidental vocabulary growth from reading is "too small to be of any practical value" (p. 261).

The contrasting results between Choi (2006) and the present study regarding the effect size index differences may lie in the availability of contextual clues. Specifically, in Choi's (2006) study, the students were asked to infer word meanings from a list of target words. Thus, there were no other contextual clues available for control and experimental groups alike. In contrast, in the present study, students in both groups (DMI, No-DMI) were instructed to infer word meanings in context which included several contextual clues. This in turn might have facilitated all students' meaning inference processes while reducing the relative effectiveness of DMI. Yet this speculation should be examined in future studies by including both in and out of context conditions in a single experiment.

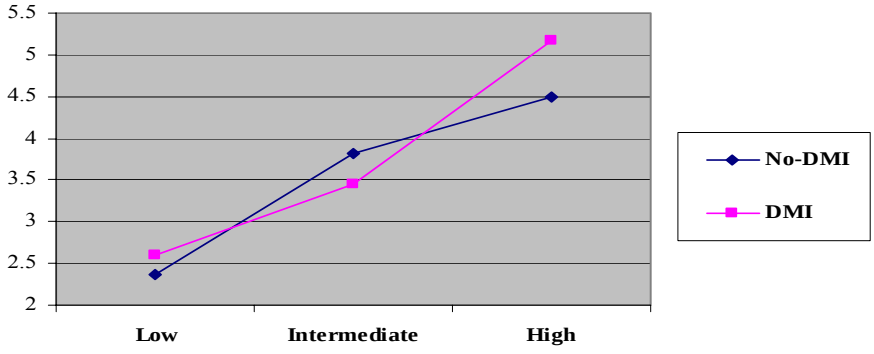
However, despite the positive effects of DMI, as seen from FIGURE 1, the results clearly show that vocabulary knowledge gaps across different proficiency levels were still present even after DMI. The results confirm the findings of previous studies which found that a students' ability was related to their ability to extract word meanings from context (e.g., Choi, 2006; McKeown, 1985; Sternberg & Powell, 1983).

2. The Effects of DMI on Reading Comprehension

The researcher predicted that DMI students would perform about the same as No-DMI students. However, unexpectedly, FIGURE 2 shows that DMI interacted with learner language proficiency, meaning that DMI had differential effects on the reading comprehension of the students depending on the students' proficiency level.

FIGURE 2

Significant Interaction of DMI and Learner Proficiency in Reading Comprehension



Specifically, DMI facilitated high proficiency students' reading comprehension to a statistically significant degree, while it moderately promoted low proficiency students' reading comprehension. In contrast, DMI impeded intermediate level students' reading comprehension, although the mean score difference between DMI and No-DMI groups at the intermediate level did not differ significantly.

Possibly, the metalinguistic task (i.e., parsing word structures) might have made great demands on intermediate level students' cognitive load or short-term memory. From the perspective of the theory of cognitive load[4], reading comprehension is facilitated when the working memory is freed up. That is, when the working memory is devoted to decoding or analyzing word parts as in this study, there are not sufficient cognitive resources for high-level processing (i.e., reading comprehension) and for constructing coherent and meaningful representation of the reading passages. However, this speculation should be examined in future studies.

Regarding the predictive value of the Meaning Inference Vocabulary Posttest on reading comprehension scores, the findings were consistent with the researcher's prediction that a students' performance on the Meaning Inference Vocabulary Posttest will be a significant predictor for their performance on a reading comprehension test. However, the values (coefficient of determination = .397, beta coefficient = .47) may have been overrated because the present study did not control for the contribution of phonological awareness to reading comprehension. This issue should be addressed in future studies.

VI. CONCLUSION

The major findings are summarized in this section of the article, followed by pedagogical implications and limitations of this study.

The present study revealed several important findings. First, DMI enhances EFL readers' ability to infer word meanings in context. DMI students significantly outperformed their No-DMI counterparts on the Meaning Inference Vocabulary Posttest. Second, despite positive effects of DMI, the vocabulary knowledge gaps across proficiency levels are still considerably great. Cohen's *d* indices (1.44, 1.88, 1.29) documented that the gaps are practically as well as statistically significant. Third, depending on their English language proficiency levels, DMI has varying effects on the reading comprehension of EFL readers.

[4] The cognitive load theory was proposed by Miller (1956) and developed by Sweller (1994). The theory of cognitive load is related to the working memory capacity during thinking, perceiving, reading, etc. This theory, as defined by Sweller (1988), predicates that the load on the short-term or working memory needs to be freed up to increase the potential of the new information to be stored in the long term memory.

For instance, high proficiency students who received DMI performed significantly better than their high proficiency counterparts who did not receive DMI. Fourth, DMI alone may impede reading comprehension of intermediate proficiency EFL students. Intermediate proficiency students (M = 3.45) who received DMI performed worse than their counterparts (M = 3.82) who did not receive DMI. Finally, vocabulary knowledge of EFL students is a potent predictor of their reading comprehension performance. Approximately 40% of the variation in the reading comprehension test was explained by the students' Meaning Inference Vocabulary Posttest.

Several pedagogical implications are drawn from the findings stated above. First, DMI for EFL learners should be executed with some caution. While striving to maximize learner's vocabulary acquisition by explicitly teaching morphology, EFL teachers should also consider the language proficiency levels of their students: the results revealed that DMI rarely promoted intermediate proficiency students' ability to unlock the meaning of morphologically complex words, whereas the same instruction enhanced that of high and low proficiency students. This is also true when DMI is connected to reading comprehension activities. High proficiency students significantly benefited from DMI in reading comprehension, whereas the same instruction impeded intermediate proficiency students' reading comprehension.

Second, DMI alone may not reduce the differences of vocabulary knowledge across different proficiency levels. Accordingly, additional instructional scaffolds should be provided to lower proficiency students. Although DMI may have a pronounced effect on vocabulary knowledge expansion, the results indicated that the gaps of vocabulary knowledge were still substantial across proficiency levels even after DMI. This means that a more systematic approach to vocabulary learning and teaching is needed for lower level students.

Third, DMI combined with multiple exposures in multiple settings is critical. Although DMI appears to be an effective approach to expand EFL learners' vocabulary repertoire, DMI *per se* does not automatically augment vocabulary growth because a) vocabulary learning is not a matter of all or nothing, and b) knowledge of stems is essential. Nagy, Anderson, and Herman (1987) claimed that "Any one encounter with a word usually results in only a small gain in knowledge of that word" (p. 238). Accordingly, explicit DMI should be executed in combination with rich opportunities for students to reencounter those instructed words in multiple contexts. As Beck, McKeown, and McCaslin (1983) claimed, it takes a great amount of exposure and effort for words to be a permanent part of a learner's vocabulary repertoire.

Lastly, active monitoring and interactive approach is recommended. EFL learners should be warned that many structurally complex words are not analyzable and are often deceiving, as noted previously (Nagy & Anderson, 1984; White, Power, & White, 1989).

Accordingly, to maximize EFL students' ability to infer word meanings and also their reading comprehension, EFL teachers need to encourage their students to adopt both bottom-up (e.g., morphology analysis) and top-down approaches (e.g., prior knowledge activation) and to actively monitor their comprehension.

The findings and implications of this study should be interpreted within the confines of several limitations. To begin with, the confounding variable of prior knowledge was not controlled for, for the sake of enhancing ecological validity of the present study. Next, the findings of the study may not be applicable to the teaching of inflectional suffixes (e.g., *-able, -ance*) because they are difficult to master and acquired later (Nagy, Diakidoy, & Anderson, 1993). Moreover, the prefixed target words did not reflect essential information for comprehension questions. If the texts had included prefixed words which were critical for comprehension questions, the results regarding reading comprehension may have been different. Lastly, the study should be replicated with different methodology. Specifically, immediate or delayed recalls in conjunction with think-aloud protocols may reveal more about the cognitive processes related to the effects of DMI.

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APPENDIX A

Comprehension Passage and Question Sample

* (1-3) Read the following passage and answer.

The use of private cars is discouraged, since parking is limited and the streets of the historical district are narrow. Fortunately, excellent alternatives are available. The public transit system provides fast, inexpensive transportation to all areas of the city. Bus service operates 24 hours a day for those who prefer to travel above ground. Those of you who want to make sure that you see all the tourist attractions may be especially interested in tour buses, which make stops at all points of interest throughout the city.

1. The passage is written to _____.

A. criticize B. apologize C. praise D. inform E. invite

*Note: This question item was translated from Korean version.

APPENDIX B

Meaning Inference Vocabulary Test Sample

No	Words	Choose the most appropriate meaning of each word.	Your Choice
1	discouraged	(1) 어려운 (2) 권장되는 (3) 권장되지 않는 (4) 많이 늘어난 (5) 줄어드는	
2	inexpensive	(1) 값비싼 (2) 값싼 (3) 편리한 (4) 불편한 (5) 경제적인	

Examples in: English

Applicable Languages: English

Applicable Level: Secondary

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