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교육학석사 학위논문

**Meta-Analysis
of Reading Interventions
on Reading Comprehension Outcomes
of Students with Learning Difficulties**

학습부진 학생의 읽기이해에 대한
읽기중재의 효과 메타분석

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이 논문을 교육학석사 학위논문으로 제출함
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Abstract

Meta-Analysis of Reading Interventions on Reading Comprehension Outcomes of Students with Learning Difficulties

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Reading is a fundamental ability for all learning activities. Most of all, reading comprehension is so critical that it is called the goal of reading activity. For students at risk for or with learning disabilities who have a lot of difficulty understanding text, therefore, effective reading comprehension instructions must be provided. Thus, a copious amount of meta-analyses have been conducted to identify evidence-based practice for reading. The meta-analyses provided strong support for general components of effective instruction; however, they were unable to provide definitive answers for practitioners looking for concrete suggestions of what evidence-based practices to implement in their classrooms. Focused on providing practical

evidence-based practice, the purpose of this meta-analysis is to determine the overall effect of reading interventions on reading comprehension in current studies, and to investigate the effects of student-related variables, intervention-related variables, implementation-related variables, and measurement-related variables on reading comprehension by analyzing the variable categories separately. Based on the results of analyses of these variables, furthermore, this study suggests both controllable and uncontrollable variables for educational practitioners to manipulate for their students with reading difficulties. Eventually, practitioners and policy makers will be able to develop and implement effective reading programs with the practical evidence-based practice for enhancing reading comprehension of students with reading difficulties or disabilities in grades 3 through 9.

Keywords: *Reading Comprehension, Meta-analysis, Reading Intervention, Learning Disabilities, Reading Difficulties*

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I . INTRODUCTION

1. Purpose of the Study

In the contemporary era of text as a core of learning, reading is the essential basis for all learning and everyday living. Understanding and learning from text is the ultimate goal of reading, and “skilled reading is the ability to derive meaning from text accurately and efficiently (McCardle, Scarborough, & Catts, 2001, p. 230).” Admittedly, word recognition, the other part of reading, is also crucial ability to attend, still there are students who have difficulties understanding text and extracting knowledge from it even with appropriate word recognition skills (Klinger & Vaughn, 1996). These students experience more difficulties while getting older, especially entering upper grade level of elementary school when the transition from “learning to read” to “reading to learn” occurs (Kim, Lee, & Shin, 2009).

There are a lot of factors hindering a student’s reading comprehension, such as a failure of strategic information processing or using background knowledge, lack of metacognitive awareness, vocabulary, and text structure, low level of reading fluency, and passive

reading (Gersten, Fuchs, Williams, & Baker, 2001). Reading comprehension problems caused by these challenges raise even more immense difficulty for students with learning disabilities. Students with learning or reading disabilities might be affected heavily by these problems with their limited acquisition of reading comprehension skills (Mastropieri, Scruggs, & Graetz, 2003). Moreover, lack of successful reading comprehension skills may lead to secondary adversity of obtaining relevant knowledge in the content area. Therefore, there is an urgent need to provide effective evidence-based reading interventions for children with reading difficulties or disabilities who suffers from a shortage of comprehension skills.

In the same manner as transition to upper elementary grade, transition from elementary to middle school requires increasingly higher level of reading comprehension ability. Because middle school students are taught more and more amount of knowledge in content area subjects like social studies or science, they are believed to possess reading abilities to comprehend gradually challenging expository text (Berkeley, Mastropieri, & Scruggs, 2011). Reflecting such phenomenon, underachievement in reading among the middle school students is on the rise (McCardle & Chharba, 2004). It is depicted as a crisis in middle schools in the US, reporting that approximately twenty-five percent of students are in lack of adequate reading skills to detect main

idea (Kamil, 2003). Denton, Wexler, Vaughn, and Bryan (2008) posed three possible explanations for the low achieving in reading of adolescents: insufficient knowledge of the alphabetic principle and word reading, lack of vocabulary and adequate reasoning abilities, and lack of the task orientation and propensity toward reading.

Even so, every student should and can learn as we can see in the related legislations and evidence from researches. Since Education for All Handicapped Children Act (EAHCA) of 1975 (Public Law 94-142) was passed, school districts have been required to provide all students including those with disabilities with a free appropriate public education (FAPE) in the least restrictive environment (LRE) to the maximum extent appropriate. Likewise, at the core of the No Child Left Behind Act (NCLB) of 2001 (PL 107-110) are plenty of measures developed to encourage large gains in student achievement and to hold states and schools more accountable for student progress. According to Denton, Fletcher, Anthony, and Francis (2006), converging researches have suggested that with appropriate instruction, nearly all students can become competent readers (Denton & Mathes, 2003; Lyon, Fletcher, Fuchs, & Chhabra, 2006; Mathes & Denton, 2002; Snow, Burns, & Griffin, 1998). At this time, the appropriate instruction becomes the key point. Thus, evidence-based instruction should be determined for students who are struggling with reading.

Evidence-based intervention is a concept of scientific, research-based strategies and interventions, especially emphasized in the Response to intervention (RTI) context, which is an identification model for learning disability based on how students respond to the interventions (Fuchs & Fuchs, 2006). These instructions should be verified by series of research to be effective in meeting student's needs and to be aligned with practices (Glover & Vaughn, 2010). As an example showing importance of intensive evidence-based intervention, Denton et al. (2006) reported that Students who received tier 1 and tier 2 interventions in a row but still have difficulties presented better responses than students who was instructed only in tier 1 level and who had not participated in any previous interventions.

A copious amount of research syntheses or meta-analyses have tried to identify the evidence-based reading interventions for students with reading difficulties or disabilities (e.g. Edmonds et al., 2009; Scammacca et al., 2007). Especially, meta-analyses are worthy tools that can give us relevant information when deciding apposite education services for students with learning difficulties (Therrien, Zaman, & Banda, 2011). Their strengths, such as eliminating study selection bias (Sindelar & Wilson, 1984) and detecting statistical interactions (Kavale & Glass, 1981), are incomparably better than traditional literature reviews. By prior studies using this promising method, considerable

amount of information of evidence-based reading interventions were already found out and is still coming out to give significant professional support to teachers of struggling readers.

However, actual educational practice in the fields seems to be at the far distance from valuable research findings. Klingner, Urbach, Golos, Brownell, and Menon (2010) revealed the gap between research and reality in their study which conducted participatory observation of special education classrooms. They analyzed 124 classes of 41 special education teachers for enhancing reading comprehension of 3-5 grade students. Unfortunately, the results only showed lack of explicit reading comprehension instruction and passive fragmentary teaching activities.

Therrien, Zaman, and Banda (2011) pointed out that although meta-analyses provide much information on general components of effective instructions, they can hardly give conclusive solution for practitioners searching for helpful advices to employ evidence-based practices in classes. Needless to say, it is not easy to suggest definitive answer for what is evidence-based intervention through just several studies. Research findings from large numbers of meta-analyses should be piled up through decades to identify effective instructions. Yet, upon the desperate field circumstance, there is an urgent need to give practical support for evidence-based practice for practitioners to apply directly. Hence, this meta-analysis seeks to take a small step toward

practical evidence-based practices with a concept of controllable or manipulative variables, meaning significant variables affecting students' comprehension outcome that practitioners can manipulate along their judgment and decision.

To achieve this goal of contributing to the tradition of identifying practical evidence-based practice, this study aims to confirm several significant factors that prior meta-analyses reported. They are composed of student-related variables, intervention-related variables, implementation-related variables, and measurement-related variables. By analyzing the effects of these variables on reading comprehension of students with reading difficulties or disabilities, this research will be able to contribute to the advancement of practical evidence-based practice for both practitioners and decision-makers. And hopefully, the results of this analysis may be able to be applied in the classes for enhancing reading comprehension of students with reading difficulties or disabilities, particularly in 3 through 9 grades.

2. Research Questions

This study is mainly focused on identifying evidence-based practice for enhancing reading comprehension ability of students at risk for or currently classified with learning disability in reading. The

purpose of this analysis is to determine the overall effect of reading interventions on reading comprehension in current studies, and to investigate the effects of student-related variables, intervention-related variables, implementation-related variables, and measurement-related variables on reading comprehension by analyzing the variable categories separately. Based on the results of the analyses of these variables, furthermore, this study suggests both controllable and hard-to-control variables for educational practitioners to manipulate for their students with reading difficulties.

Specific research questions are as follows:

Question 1. What is the estimated mean effect size of reading interventions for students at-risk for or with learning disabilities in grade 3 through 9 on enhancing reading comprehension?

Question 2. To what extent do student-related, intervention-related, implementation-related, and measurement-related variables have effect on enhancing reading comprehension of students at-risk for or with learning disabilities in grade 3 through 9?

II. LITERATURE REVIEW

1. Students with Reading Difficulties or Disabilities

Competent readers are aware of how to employ diverse strategies while reading and to draw precise meaning out of given text. They are able to use metacognitive skills to monitor, control, and improve their reading comprehension. Meanwhile, students who do not have those skills and abilities for understanding the meaning of text exist. These students with learning difficulties or disabilities are in lack of reading comprehension strategies resulting in poor comprehension.

Although students' difficulty reading adeptly is often derived from phonological deficits (National Reading Panel, 2000), comprehension difficulties of struggling readers are also influenced by deficits in skillful strategies usage, knowledge of language and motivation to read and comprehend (Snow, Burns, & Griffin, 1998). Weaknesses in reading comprehension are often rooted in students' lack of the metacognitive strategies to monitor one's own reading comprehension status and to redress detected problems of own understanding (Torgesen, 1977). Students who have difficulties in reading often rely on simpler

and less efficient reading strategies and fail to apply those strategies in an adroit and natural manner, compared to average-achieving peers. They also experience frustrating moments when encounter multiple information at once. Generally, these students use inefficient or receptive methods for learning instead of using proactive methods for learning (Zimmerman, 2000).

Nevertheless, there are proofs that students with reading difficulties of disabilities can learn from texts and benefit from adequate interventions targeted for them (Edmonds et al., 2009; Scammacca et al., 2007). According to Johnson-Glenberg (2005), students with learning difficulties are the readers who often demonstrate the greatest improvement when taught with comprehension instruction programs.

2. Reading Comprehension

The five key components of reading are known as phonemic awareness, phonics, fluency, vocabulary, and text comprehension (National Reading Panel, 2000). Among these components, comprehension is the ultimate goal of reading. Reading comprehension is critical element for students to develop their reading skills and to learn some knowledge from texts while taught in education settings.

The National Reading Panel (2000) proposed three main themes about the development of comprehension skills in its study on reading comprehension. The themes are as follows:

First, reading comprehension is a complex cognitive process that cannot be understood without a clear description of the role that vocabulary development and vocabulary instruction play in the understanding of what has been read. Second, comprehension is an active process that requires an intentional and thoughtful interaction between the reader and the text. Third, the preparation of teachers to better equip students to develop and apply reading comprehension strategies to enhance understanding is intimately linked to students' achievement in this area (National Reading Panel, 2000, p. 3).

A series of research on reading comprehension have been increasing our knowledge of better practices for students with reading difficulties. Early theory on reading insists that automaticity of the lower level components such as consonants, vowels, syllables, grammatical endings, meaningful parts, and the spelling units that represent them allows attention to be allocated to the acquisition of higher level components like fluency and comprehension (LaBerge &

Samuels, 1974). This acceptable hypothesis implies that comprehension needs various preceding cognitive factors.

Several cognitive components were found to be required for successful reading comprehension. They are varied from background knowledge, concept knowledge, and metacognitive awareness for monitoring and controlling one's understanding to diverse strategies of self-questioning, identifying main idea from texts, and summarizing (Garner, Alexander, & Hare, 1991; Vaughn et al., 2003). When students increase their knowledge and understanding of a text, they can deal with more complicated information and then can read and comprehend more. This text practice may also cause better automaticity in reading (Garner, Alexander, & Hare, 1991).

1) Reading Comprehension of Upper Elementary Students

In the upper elementary grades, teachers' expectations for students extend to independent reading and learning on their own, deemphasizing additional instruction on learning how to read (Wanzek & Roberts, 2012). This transition which often starts from grade 3 is important for students to successfully adjust to academic school life. For students with reading difficulties, however, it may be burdensome and stressful circumstance that they can hardly overcome. The students still need explicit instruction on reading comprehension with a lot of

opportunities to practice understanding text on their own. Explicit manner of teaching may be the most appropriate intervention method for students who struggle to read, especially considering the complex expository text of content area in the upper elementary level (Wanzek & Roberts, 2012).

Wanzek, Wexler, Vaughn, & Ciullo (2010) have synthesized studies on reading interventions for upper elementary students with reading difficulties and disabilities. Only nine experimental studies were found to be included in this synthesis. Reading comprehension with or without vocabulary instruction found in five studies yielded moderate to large effects on comprehension outcomes. In the interventions, previewing, retrieving background knowledge, self-questioning, self-regulating, and summarization were involved and tested. There is a possibility that the significant effects were partially due to use of research-developed measurements rather than standardized ones. Regardless of the significance of results, the authors especially pointed out upper elementary students need additional attention of researchers, in that most of previous studies for struggling readers have been divided into two parts, K-3 and secondary level.

2) Reading Comprehension of Middle School Students

The problem of a large number of struggling readers at the middle

school level is broadly known, typically in the United States (Kamil, 2003; McCardle & Chharba, 2004), indicating the immediate educational need for effective reading intervention practices for those students with learning difficulties or disabilities. Middle school students have critical difficulties particularly in reading comprehension sector(Kamil, 2003; RAND, 2002), which is worried fact in that reading instructions for secondary level students are primarily focused on vocabulary and comprehension (Kamil et al., 2008; Snow, Burns, & Griffin, 1998).

The RAND Reading Study Group (2002) have also identified reading comprehension of older students as the most pressing issue. The three reasons for the identification are as follows, according to Denton, Wexler, Vaughn, and Bryan (2008). First of all, older students with poor comprehension outcomes are making insufficient progress on the National Assessment of Educational Progress. No change was discovered between 1992 and 2005 in the percentage of eighth-graders scoring at or above the Proficient level. Second, they are scarcely expected to learn from texts of content area. Lastly, the students tend to display undesirable achievement gaps among peer groups from diverse demographic backgrounds.

Denton, Wexler, Vaughn, and Bryan (2008) proposed three possible explanations for the secondary students with inadequate

reading skills. First one is that most of the students are in lack of knowledge of the alphabetic principle and word reading.

Approximately ten percent of all secondary students or about sixty percent of students with learning difficulties are reported to have deficit in word reading. Their inadequate word reading skills would influence their reading fluency and comprehension. Another plausible explanation could be their insufficient vocabulary and reasoning ability, and incompetent use of various reading strategies like, monitoring, questioning, and summarizing (Edmonds et al., 2009). The other explanation is dearth of task orientation and inclination to read.

Students who are highly engaged in reading are reported to use reading comprehension strategies more often and properly (Guthrie & Wigfield, 2000).

All these deficiencies of struggling readers in various parts of reading require proper interventions for them to achieve appropriate reading comprehension outcomes (Kamil et al., 2008). And most instructions for reading comprehension involve vocabulary and explicit comprehension strategies (Denton, Wexler, Vaughn, & Bryan, 2008). However, struggling readers at secondary level tend to read less, and teachers are likely to circumvent reading according to the students' preference. In this despairing situation in the classes, evidence-based reading interventions are in dire need for students not to fall further

behind than their peers and to engage in reading proactively.

The findings from Edmonds and colleagues (2009) and Scammacca and colleagues (2007) show that interventions for enhancing reading comprehension outcomes of older students with difficulties could yield moderately effective result. Improving comprehension of struggling readers at middle school is not too late, though it may surely take longer time and rather intensive instruction than their peers.

3. Evidence-Based Reading Instructions for Students with Reading Difficulties or Disabilities from Meta-Analyses

Several recent syntheses on reading instructions for students with reading difficulties or disabilities have added meaningful knowledge base for evidence-based practices in reading. Wanzek and Vaughn (2007) mentioned about the position of evidence-based intervention or research-based instruction in RTI framework as follows:

RTI provides a framework for accomplishing several highly valued goals: (a) early identification of students at risk for

academic difficulties through universal screening practices; (b) early and targeted intervention for students at risk; (c) ongoing progress monitoring—more frequently for students most at risk and less frequently for typical achieving students; (d) use of increasingly more intensive tiers of research-based instruction to meet students' needs; and (e) improved confidence that students referred for special education who participated in evidence-based RTI models are less likely to be students who are academic casualties from inadequate or inappropriate instruction (Wanzek & Vaughn, 2007, p. 541).

In RTI framework, evidence-based practice takes pivotal role for identifying and intervening students with learning disabilities. In such circumstances, several research reviews on intervention studies for students with learning difficulties has been tried by using analytic procedures to clarify what determines evidence-based practices. The quality indicators for evaluating intervention studies have also been proposed to establish the standard for the evidence-based practice (e.g. Gersten et al., 2005; Horner et al., 2005). The results of meta-analyses could be used in process to investigate the effect of certain intervention or variables, to propose evidence-based practice with significant variables found in the analyses, and to develop new educational

programs for students with learning difficulties.

From the results of two prior syntheses, Edmonds and colleagues (2009) and Scammacca and colleagues (2007) proved that many students with learning difficulties or disabilities could improve their comprehension skills with adequate interventions on word reading and/or comprehension. Edmonds et al. (2009) conducted a meta-analysis on remedial reading for adolescents with difficulties in reading. The results of this study showed that majority of the included studies employed comprehension intervention for the students, followed by multicomponent instruction, fluency intervention, and word study instruction in this order. The overall effect of each intervention on reading comprehension was similar to that order, locating comprehension intervention with effect size over one at the first position. Meanwhile, interesting subgroup results displayed students who have difficulties in decoding gained more from decoding interventions. Scammacca and colleagues (2007) extended the grades of participants and publishing years of included studies from the research of Edmonds et al. (2009), yielding similar results. One of their primary finding is that students with learning disabilities can benefit from interventions in reading comprehension.

In addition to Scammacca and colleagues (2007), Apthorp and Clark (2007), and Wanzek, Wexler, Vaughn, and Ciullo (2010) also

implemented meta-analyses regarding overall reading area. Apthorp and Clark (2007) analyzed effects of using strategy instruction to help struggling high school students understand what they read. They found out rather low effect of strategy instruction on reading comprehension, contradicting high and positive effects from previous syntheses. However, there is some voice criticizing the searching phase for analysis had limitations (Denton, Wexler, Vaughn, & Bryan, 2008). Wanzek, Wexler, Vaughn, & Ciullo (2010) synthesized studies on reading interventions for students with reading difficulties at upper elementary level, and showed positive effects of interventions on students' comprehension.

There were several meta-analyses on interventions aimed for specific reading area; morphological interventions (Goodwin & Ahn, 2010; Reed, 2008), self-monitoring strategies (Joseph & Eveleigh, 2011), graphic organizers (Kim, Vaughn, Wanzek, & Wei, 2004), read-aloud interventions (Swanson et al., 2011), and reading comprehension instructions (Berkeley, Scruggs, & Mastropieri, 2010). Besides, assorted meta-analyses or syntheses on reading comprehension outcomes were published (Faggella-Luby & Deshler, 2008; Gajria, Jitendra, Sood, & Sacks, 2007; Gersten, Fuchs, Williams, & Baker, 2001; Hall, 2004; Jitendra, Burgess, & Gajria, 2011; Kim, Linan-Thompson, & Misquitta, 2012; Mastropieri et al., 2003).

The number of research synthesis is increasing in South Korea since the midst of 2000s with necessity of systematic and comprehensible analysis to detect the evidence-based practice (e.g. Hu et al., 2010; Jung & Kim, 2008; Kim, 2006; Kim & Jung, 2007; Kim & Park, 2007; Kim & Park, 2010; Kim et al., 2009; Lee, Jeon, & Paik, 2006; Lee & Son, 2010; Na & Seo, 2010; Park & Heo, 2010). Four narrative research reviews and two meta-analyses are roughly examined here.

The four reviews were to probe general characteristics of preceding intervention studies for students with learning disabilities regardless of any subject area. Kim (2006) synthesized 47 intervention studies for students with learning disabilities published from 1975 to 2004, and broadly analyzed across all of the content area such as reading, mathematics, and writing. Both Kim and Jung (2007) and Kim and colleagues (2009) conducted syntheses in even more broad manner. Kim and Jung (2007) analyzed 204 articles published in major journals between 1996 and 2006 to synthesize research trends in education for students with learning disabilities. Among these articles, a total of 84 studies on intervention were analyzed in terms of the number of intervention sessions, intervention environment, and intervention provider. And Kim and colleagues (2009) synthesized research findings of students with learning disabilities which were 289 articles published

from 1999 to 2008. They provided recent trends in intervention studies by analyzing 170 articles on intervention for students with learning disabilities in terms of domains of disabilities. Hu and colleagues (2010) analyzed group experimental or quasi-experimental studies for student with learning disabilities based on quality indicators which were reorganized from the ones by Gersten et al. (2005). A total of 27 experimental studies published in major special education journals in Korea from 1999 to 2009 were included in the analysis. The authors pointed out that researchers in Korea should seek to increase the quality of their research.

Recently, Lee and Son (2010) and Na and Seo (2010) used meta-analytic procedures in order to amalgamate research evidence on interventions for students with learning disabilities. First, Lee and Son (2010) examined 45 articles on reading intervention for students with learning disabilities or reading difficulty published in Korean journals between 2000 and 2009. A total of 39 intervention studies were included for meta-analysis by using MIX program. They scrutinized and described on influential study characteristic variables. Na and Seo (2010) systematically investigated the effect sizes of 14 intervention studies in mathematics for students with learning disabilities published from 2000 to 2010. And they used the quality indicators proposed by Gersten et al. (2005) and Horner et al. (2005) assessing the quality of

the studies to determine the evidence based practice in mathematics for students with learning disabilities.

4. Critical Variables of Intervention for Enhancing Reading Comprehension

1) Student-Related Variables

Therrien, Zaman, and Banda (2011) investigated what student characteristics are necessary to benefit from the interventions summarized in meta-analyses. This research question was set up to draw a solid inference as to whether the results of meta-analyses will generalize to other students, especially in that students with learning disabilities are heterogeneous. They found the importance of students' pretest scores in relation to achievement and student age or grade. Although there were limited number of studies reviewed in the meta-analyses reported student characteristics in detail, several meta-analyses which included pretest score in their analysis procedure reported distinct and more reliable results about the effect of interventions. For student age, three of fifteen meta-analyses presented students' grade for which certain interventions were more effective. Self-concept interventions were more effective for middle school

students compared to high school and elementary students (Elbaum & Vaughn, 2001), math word problem interventions for older students (Xin & Jitendra, 1999), and word recognition instruction for younger students (Swanson, 1999b).

2) Intervention-Related Variables

Multicomponent vs. targeted intervention

Interventions which include multiple reading components are reported to be helpful to improve reading comprehension outcomes of students with learning difficulties. A multicomponent intervention may contain diverse components: not only five basic reading skills such as word reading, phonics, fluency, vocabulary, and comprehension strategies, but also self-regulating, self-questioning, metacognitive awareness, and peer-mediated learning. Especially, prior syntheses for secondary students reported that multicomponent interventions were beneficial in reading comprehension (Kamil et al., 2008; Scammacca et al., 2007).

Unlike the suggestion for multicomponent intervention, explicit targeted strategies are also required by word study (decoding), fluency, vocabulary, and comprehension (Edmonds et al., 2009; National Reading Panel, 2000; Kim et al., 2009; Kim et al., 2006). Relevant empirical evidences show that comprehension strategy lessons should

include explicit instruction in the targeted strategies (Edmonds et al., 2009; Gersten et al., 2001; Swanson, 1999a).

Cognitive and metacognitive strategies vs. text enhancement strategies

According to Jitendra and Gajria (2011), reading comprehension instructions for students with learning disabilities could be categorized into two strategies: cognitive and metacognitive strategies and text enhancement strategies. Cognitive and metacognitive strategies include recognizing test structure, cognitive mapping, questioning, identifying main ideas, summarization and multiple strategy instructions such as Collaborative Strategic Reading (CSR), POSSE (Predict, Organize, Search, Summarize, Evaluate), and SQ3R (Survey, Question, Read, Recite, Review). On the other hand, text enhancement strategies refer to graphic organizers, mnemonic illustrations, study guides, and Computer Assisted Instruction (CAI).

Many prior syntheses (Berkeley et al., 2010; Gajria et al., 2007; Gersten et al., 2001; Sencibaugh, 2007; Swanson, 1999b) reported that the effect of cognitive and metacognitive strategies are higher than the effect of text enhancement strategies on students' reading comprehension gains.

Motivation and engagement

Motivation and engagement of students in the interventions are increasingly catching researchers' attention (Guthrie & Wigfield, 2000). Motivation can be a driving force for students to read (Guthrie et al., 2009). When they are fully motivated, they may read and learn more with arduous efforts. More interventions into which embedded motivation and engagement factor have been employed. For example, Computer Assisted Collaborative Strategic Reading (CACSR) seeks an interactive learning environment to maintain students' interest and motivation (Kim et al, 2006).

Likewise, Lau and Chan (2007) emphasized four motivational elements into the intervention implemented in their study: demonstrating students' improvement in class for their self-efficacy, including authentic texts for intrinsic interest, allocating group activities and discussions for engagement and social motivation, building attribution for effort and strategy.

Generally, the level of effort, background knowledge and cultural experience regarding text, interest of students, reading strategies acquisition are the relevant factors affecting students' motivation and engagement (Guthrie & Wigfield, 2000; Morgan & Fuchs, 2007). Particularly, the use of reading strategies can expedite a student's motivation and stronger motivation let the student learn more reading

skills reversely (Morgan & Fuchs, 2007).

Peer-mediated intervention

Peer-mediated intervention is well known as a key component of effective reading programs such as Peer Assisted Learning Strategy (PALS) and Collaborative Strategic Reading (CSR). Those intervention programs with peer-mediated element yielded large and positive effect sizes on reading comprehension (Fuchs et al., 1997; Vaughn, Klingner et al., 2011).

Peer-mediated interventions can be demonstrated in various forms as following. Collaboration (Guthrie et al., 2009), paired, the partner reading strategy, and reciprocity taking the lead in partner reading or controlling the keyboard and mouse (Kim et al., 2006; Klinger et al., 2004; Vaughn et al., 2010; Wanzek, Vaughn et al., 2011), practiced collaboratively in pairs (Mason, 2004), partner reading with story retell, paragraph shrinking (summarization), and prediction relay (Saenz et al., 2005).

By forming pairs and groups or teams as a way of peer-mediated intervention, practitioners aim to motivate their students and to let them actively engage in learning activities (Saenz et al., 2005).

3) Implementation-Related Variables

Teacher vs. researcher-delivered intervention

In most educational experiments, interventions are delivered by either a researcher of the study or a teacher of the participants. Many prior syntheses confidently suggest that researcher-delivered interventions lead larger gain in reading comprehension outcomes than teacher-delivered interventions (Gersten, Fuchs, Williams, & Baker, 2001; Hall, 2004; Jitendra, Burgess, & Gajria, 2011). However, the fact that researcher-delivered interventions are more effective does not change the reality that teachers are the practitioners who are with students on their own.

Group size

An intervention can be delivered in either one to one, small group, or whole class setting. Among several group sizes, small group interventions are believed to be effective and widely used in research and classrooms (e.g. Graves, Duesbery, et al., 2011).

Vaughn and colleagues (2003) scrutinized the effects of grouping formats on reading outcomes of second-grade students with reading difficulties. According to the result of the study, 1:1 format (one teacher with one student) and 1:3 format (one teacher with three students) were both beneficial than 1:10 format (one teacher with ten students) for the

students' reading outcomes. Among the two effective formats, 1:1 grouping format did not lead to significantly higher gains than 1:3 small grouping format.

4) Measurement-Related Variables

Standardized vs. researcher-developed measurement

Though it has nothing to do with enhancing true reading comprehension ability of students, standardized measurement and researcher-developed measurement have rather different aspect of effects on reading comprehension outcomes (Swanson, 1999b; Swanson & Hoskyn, 1998). This difference comes from how strong the measurement is aligned with instruction materials, and the impact reaches even to effect sizes. This can be viewed as a difference between the norm-referenced assessments and the criterion-referenced assessments. Many prior syntheses have proved that researcher-developed measurement which is aligned with instruction materials give rise to larger gains than standardized measurement (e.g. Scammacca et al., 2007).

III. METHOD

This study aimed to identify pertinent components of evidence-based practice for enhancing reading comprehension outcomes of students with reading difficulties or disabilities. A meta-analysis was appropriate to explore the research questions. According to the general steps of meta-analysis, data for analysis were collected first. Inclusion and exclusion criteria were set to select studies, and study characteristics were coded. Then, data analysis was conducted to determine important factors for establishing practical evidence-based practice.

1. Data Collection

A comprehensive search of the literature was conducted through a three-step process developed during prior meta-analytic studies (Edmonds et al., 2009; Swanson et al., 2011). First, a computer search was performed to locate studies published between 2000 and 2012 from peer-reviewed journals based on the databases of ERIC, Academic Search Complete, SocINDEX with Full Text, and Education Research Complete for studies written in English, and KISS (Korean studies

Information Service System) and RISS (Research Information Sharing Service) for studies written in Korean. The publish period of last thirteen years was selected to reflect most recent trend of reading interventions for students. Keywords or root forms of them (i.e. learning disabilit*, reading disabilit*, reading difficult*, at-risk, struggling reader, low-achiev*, reading comprehension, intervention, instruction, strateg*) were used in various combinations.

Second, reference lists from prior syntheses and literature were carefully reviewed and compared to the collected data from electronic databases to capture any possible studies for the analysis.

Third, searching for several seminal journals from 2000 to 2012 was conducted via web pages of the journals: *Journal of Learning Disabilities*, *Journal of Special Education*, *Learning Disabilities Research and Practice*, *Remedial and Special Education*, and *Journal of Educational Psychology*.

2. Inclusion and Exclusion Criteria

Among the collected data, only studies that met all the following six criteria were included to the analysis.

First, participants were students with reading difficulties and/or learning disabilities. The terms including struggling readers, low

achievers, and at-risk students were considered same as students with reading difficulties. Most of the studies defined struggling readers as a combination of below certain level of standardized measures and teacher nomination. Some studies which included a few students with other disabilities such as ADHD and Other Health Impairment were included. Studies providing disaggregated data for low achievers were also included if the majority of participants in the study were not at risk. Studies mainly for ELL or students in low socio-economic status were excluded because they differ from students with learning difficulties in many traits.

Second, studies for participants who are in grades 3 through 9 were accepted. This grade range was set as a representative of upper elementary and middle school students. The third grade was selected as a baseline grade because reading comprehension is gradually required since the transition period from “learning to read” to “reading to learn.”

Third, both experimental and quasi-experimental designs were included. One group’s pretest-posttest designs that do not have a comparison group were excluded because effect sizes derived from these studies are not comparable to effect sizes from treatment-control group designs (e.g., Benner, Nelson, Stage, & Ralston, 2011; Bentum & Aaron, 2003). Small number of studies was included because the purpose was to compare the effects of two interventions with an

assumption of one favorable intervention, even if they did not employ a treatment-control group design (i.e. Manset-Williamson & Nelson, 2005; Mason, 2004; Torgesen et al., 2001).

Fourth, studies were included when the purpose is to improve students' reading comprehension through reading interventions and they have dependant measures for reading comprehension abilities. Studies that aimed only for improving other reading skills were excluded, even though they contained a comprehension measure.

Fifth, studies were included with any type of reading interventions, including decoding, fluency, vocabulary, comprehension or a multicomponent instruction of these.

Sixth, only studies providing enough quantitative statistics to calculate effect sizes were accepted. The imperative statistics were mean posttest score, standard deviation, and the number of participants of treatment and control groups.

Among over five hundred studies from the earlier collection procedure, 55 studies were determined to be included in the analysis.

3. Coding procedure

Extensive coding procedure was employed to arrange relevant information of each study. Previously designed code sheets from earlier

syntheses were adjusted for this study (Kim, Linan-Thompson, & Misquitta, 2012; Yeo, 2011). The codebook developed by the researcher is shown in Appendix 1.

All eligible studies were coded for statistics needed for calculation of effect sizes, and study characteristics including student-related variables, intervention-related variables, implementation-related variables, and measurement-related variables. The coding scheme was as follows:

General study characteristics: nationality of research (based on language used in instruction), researcher, publication year, title, publication type (all were open-ended items).

Student-related variables: mean age, grade, number of participants, number of male, number of female (open-ended items by here), number of grade included, sampling method, exceptionality type (reading ability level), selection criteria in case of low-achieving students, identification criteria in case of learning disabilities, ethnicity, placement of special education, SES (forced-choice items by here).

Intervention-related variables: title of intervention (open-ended item), type of intervention, key instructional components included, motivation and engagement, metacognitive strategy or training, peer-mediated (forced-choice items by here).

Implementation-related variables: group size, duration of

intervention (weeks), total number of sessions, frequency per week, length of each session (min) (open-ended items by here), interventionist, setting (forced-choice items by here).

Measurement-related variables: title of measurement, reliability coefficient, validity coefficient (open-ended items by here), type of measurement (standardization or researcher-developed), type of reliability, type of validity, person implemented measurement (forced-choice items by here).

Quality indicator variables: method of treatment-control group assignment, fidelity of intervention, quality information of interventionist (all were open-ended items).

Quantitative data: mean, standard deviation, number of participants of both pretest (if reported) and posttest of both treatment and control group.

In case of the values assigned to a moderator variable are not obvious enough, the assignment required a greater degree of inference that might be influenced by coder biases. For “high-inference” moderators such as motivation and engagement, this study employed two solutions proposed by DeCoster (2004). As a low-inference coding method, such variables were only coded when obvious articulation about the variables (e.g. motivation) was found in the description of intervention and procedure section. And there were three other

individuals not working on this meta-analysis.

Reliability of coding was assessed by having other coders code 25 (46%) of the 55 articles. For this procedure, four coders including the researcher conducted coding. They were two doctoral students and two students in master's course of special education major. Three other coders were trained by the researcher on the coding procedure using developed codebook. After well-acquainted with the whole procedure, twenty-five studies were randomly selected to be pre-coded by four coders. Three coders except the researcher coded ten or five studies (ten studies for two coders and five studies for one), and then the researcher checked the coding results. Inter-coder agreement was determined using percentage agreement ($\text{percentage agreement} = \frac{\text{agreements}}{\text{agreements} + \text{disagreements}}$). The calculated agreement ranged from 81% to 100%. The researcher reconciled all disagreements by reviewing meticulously with discussion with the coder if needed.

4. Data Analysis: Multilevel Meta-Analysis

The standardized mean differences effect size was used after adjustments. And two-level meta-analysis through multilevel hierarchical linear modeling (HLM) was employed to analyze the computed effect sizes. Overall data analysis procedure is as follows.

1) Effect Size Computation

The standardized mean difference is one type of the effect size that compares the means of scores from outcome measures for treatment and control group. This statistic indicates, in standard deviation units, the extent to which the treatment groups outperformed the control groups (Swanson et al., 2011). This effect size, called Cohen's d , is calculated by the following equation:

$$ES = \frac{M_t - M_c}{SD_{pooled}}$$

The pooled standard deviation, SD_{pooled} , is defined as,

$$SD_{pooled} = \sqrt{\frac{SD_1^2(n_1 - 1) + SD_2^2(n_2 - 1)}{n_1 + n_2 - 2}}$$

The calculated effect sizes were adjusted from raw forms to overcome biases. Three procedures, including pretest effect size adjustment, correction for small sample size bias, and correction for attenuation (Hunter & Schmidt, 2004).

Pretest effect size adjustment is conducted by subtracting pretest effect sizes from posttest effect sizes. This has to be done because some studies did not achieve group comparability at pretest and lead to skewed distribution of posttest effect sizes. This adjustment was applied for all studies that had pretest statistics.

The second adjustment for effect sizes was correction for small sample size bias. The standardized mean difference effect size has been presented to show upward tendency with small sample sizes, particularly when the samples are less than 20 (Hedges, 1981). To rectify the small sample size bias, the following transformation procedure can be applied with total sample size N.

$$ES = ES_{biased} \left(1 - \frac{3}{4N - 9} \right)$$

Lastly, correction for attenuation was conducted to adjust effect sizes. According to Hunter and Schmidt (2004), the key to computing the effect of error of measurement on effect sizes is to measure the extent of random measurement error in the dependent variables. If the reliability coefficient of the dependent measurement is provided, then the extent of the attenuation can be calculated with the value. Prior standardized effect size could be algebraically corrected for attenuation by division like the following equation.

$$ES = \frac{ES_0}{\sqrt{r_{YY}}}$$

2) Determining Analysis Method for Data

The method of data analysis is determined by the data (Konstantopoulos, 2011). After conducting three adjustment procedures,

data was reviewed to confirm the analysis method. There were several studies that provide multiple effect sizes: studies that employed over two interventions for over two treatment groups (Number of studies = 13), studies that provide disaggregate data for heterogeneous participants group by grade (Kim et al, 2011) or reading level (Graves, Brandon et al, 2011; Klingner et al, 2004; Saenz et al, 2005; Vaughn et al, 2012) (Number of studies = 5), and studies that used multiple kind of measurements to measure reading comprehension (Number of studies = 23). Overall, 35 studies (64%) provided multiple effect sizes among 55 articles, showing the data is hierarchically structured.

Multilevel models can provide a useful framework for analyzing meta-analytic data and take into account variation in all levels of the hierarchy (Konstantopoulos, 2011). If most of the studies in a multilevel meta-analysis have several effect sizes, the two-level meta-analysis is considered to be not suitable, for the reason that distinct effect sizes within a study might not be homogeneous (Beretvas & Pastor, 2003; Yeo, 2010). In such case, the solution for the heterogeneous effect sizes between samples within a same study is to employ the three-level meta-analysis that allows for examining whether or not effect sizes between samples within the individual study are identical (Beretvas & Pastor, 2003; Yeo, 2010).

To consider a three-level model, however, the third-level variance

should be considerable in the analysis. And larger sample sizes, for example ten or more, at the third level are preferred because more information is used in the estimation. In addition, ideally, each level-three unit should include multiple studies (Konstantopoulos, 2011). Considering all these facts, data of this study was determined to be analyzed by level-two multilevel meta-analysis using a form of a mixed effect model.

3) Homogeneity Analysis: HLM Unconditional Model

According to the basic concept of HLM, the two-level unconditional model can be expressed as follows. At level one, the variability of effect size parameter within a study is modeled as:

$$\zeta_j = \beta_0 + r_j \quad r_j \sim N(0, \tau^2)$$

where β_0 represents the mean effect size value for study j and r_j is the with-in study error term assumed to be theoretically normally distributed with a mean of zero and a variance of τ .

Level two can be written as:

$$\beta_{0j} = \gamma_{00} + u_{0j} \quad u_{0j} \sim N(0, \omega^2)$$

where γ_{00} represents the overall mean effect size for the population and u_{0j} represents the sampling variability between studies assumed to be normally distributed with a mean of zero and a variance or ω .

In HLM, the unconditional model can be implemented to identify the overall effect size across all estimates and to test for homogeneity. When an assumption of homogeneity is rejected by an insignificant chi-square coefficient in the unconditional model, variability among samples is assumed to exist. The variance of overall effect sizes is statistically significant and effect sizes are considered to be heterogeneous. There presumed to be differences within and/or between studies. Therefore, the next step to find moderators that influence effect sizes is required.

4) Moderator Analysis: HLM Conditional Model

A conditional model contains moderators in the level-two meta-analysis as explanatory variables for variability of effect sizes. Promising moderators among various study characteristics can be added to the analysis to provide informative results. The moderator analysis using a conditional model is conducted to investigate the extent of influence of included variables. When there are several variables expected to affect effect sizes, the level-two model can be represented as follows:

$$\zeta_j = \beta_{0j} + r_{0j}$$

$$\beta_{0j} = \gamma_{00} + \gamma_{1ij}X_{1ij} + \gamma_{2ij}X_{2ij} + u_{0ij}$$

where X_{1ij} and X_{2ij} are moderators.

To account for differences specific to the critical variable categories, individual meta-analyses were run for student-related variables, measurement-related variables, intervention-related variables, and implementation-related variables.

5) Aggregation between Studies: Weighted Mean Effect Size

To present descriptive results of data analysis, weighted mean effect size was employed. It means weighting by the sample sizes of studies that generally vary in sample sizes. Weighted mean effect size is able to take into account important factors like the number of studies about a specific instruction, the number of participants in studies, and the magnitude and consistency of effects (Han, 2009). The optimal weight for meta-analysis is as follows:

$$w = \frac{1}{SE^2} \qquad SE = \sqrt{\frac{1}{n_1} + \frac{1}{n_2} + \frac{1}{n_1+n_2} \left(\frac{d^2}{2}\right)}$$

And the weighted mean effect size is as follows:

$$\overline{ES} = \frac{\sum w_i d_i}{\sum w}$$

IV. RESULTS

This study aims to find influential variables that count for reading comprehension ability of students with reading difficulties or disabilities. In this chapter, the results of analyses are described.

1. Descriptive Analysis

A total of 55 studies were eligible for analysis, yielding 79 comparisons and 143 effect sizes (see Table 1). Searching for Korean research databases identified six studies with thirteen effect sizes. Among studies from Korea, Kim (2004) used English for delivering instructions to student sample of English speakers. In addition to five Korean studies, three more studies used other language than English: Antoniou & Souvignier (2007, Germany), Lau & Chan (2007, Hong Kong, China), Sanchez et al. (2007, Spain).

Vaughn et al. (2012) provided two sets of statistical information for both a group of low achievers and learning disabilities. Because population of students with learning disabilities was included in the group of low achieving students, the data for the students with learning disabilities was excluded in the analysis.

Table 1. Included Studies

Authors	No. of Comparisons	No. of ESs
Aaron, Joshi, Gooden, & Bentum (2008)	2	2
Antoniou and Souvignier (2007)	1	1
Berkeley, Mastropieri, and Scruggs (2011)	2	4
Biggs, Homan, Dedrick, Minick, and Rasinski (2008)	1	1
Boyle (2010)	1	6
Burns, Dean, and Foley (2004)	1	1
Calhoon (2005)	1	1
Calhoon, Sandow, and Hunter (2010)	2	2
Denton et al. (2008)	1	1
DiCecco and Gleason (2002)	1	8
Diliberto et al. (2009)	1	1
Ertem (2010)	2	2
Faggella-Luby, Schumaker, and Deshler (2007)	1	2
Faggella-Luby and Wardwell (2011)	1	8
Graham, Bellert, Thomas, and Pegg (2007)	1	1
Graves, Brandon, Duesbery, McIntosh, and Pyle (2011)	2	3
Graves, Duesbery, Pyle, Brandon, and McIntosh (2011)	1	1
Guthrie et al. (2009)	1	2
Han and Park (2008)	1	1
Higgins and Raskind (2004)	2	2
Hwang and Park (2004)	1	1
Jeong and Park (2001)	1	4
Jitendra, Hoppes, and Xin (2000)	1	1
Johnson-Glenberg (2005)	1	1
Kim (2004)	1	5
Kim et al. (2006)	1	5
Kim, Capotosto, Hartry, and Fitzgerald (2011)	2	6
Kim, Samson, Fitzgerald, and Hartry	1	1

(2010)		
Klingner, Vaughn, Arguelles, Hughes, and Leftwich (2004)	2	2
Kwon (2005)	1	1
Lau and Chan (2007)	1	1
Lovett et al. (2000)	4	4
Macaruso and Rodman (2009)	1	2
Manset-Williamson and Nelson (2005)	2	2
Mason (2004)	1	8
O'Conner et al. (2002)	2	4
O'Connor, Harty, and Fulmer (2005)	1	1
O'Connor, White, and Swanson (2007)	2	4
Saenz, Fuchs, and Fuchs (2005)	2	6
Sanchez, Garcia, and Gonzalez (2007)	1	1
Seo and Park (2000)	1	1
Swanson and O'Connor (2009)	2	2
Therrien and Hughes (2008)	1	2
Therrien, Wickstrom, and Jones (2006)	1	1
Torgesen et al. (2001)	1	2
Vadasy, Sanders, and Peyton (2006)	1	1
Vaughn et al. (2000)	1	1
Vaughn et al. (2010)	1	3
Vaughn, Klingner, et al. (2011)	1	3
Vaughn, Wexler, et al. (2011)	2	2
Vaughn et al. (2012)	1	4
Wanzek and Roberts (2012)	3	6
Wanzek, Vaughn, Roberts, and Fletcher (2011)	1	1
Westerveld and Gillon (2008)	1	2
Xin and Rieth (2001)	1	1
Total 55 studies	79	143

From Table 2 to 4 shows descriptive summaries of study characteristics categorized by participants and measurement, intervention, and implementation.

Table 2. Characteristics of Participants and Measurement (N=79)

Descriptors	n	(%)
Grade		
3-6	50	63.3
(6)7-9*	29	36.7
Number of grade included		
single	26	32.9
multiple	53	67.1
Exceptionality type		
learning disability	39	49.4
low achieving	40	50.6
Identification criteria for LD		
dual discrepancy	38	97.4
RTI	1	2.6
Type of measurement		
standardized	53	67.1
researcher-developed	26	32.9

* 6th grade was included 7-9 category when aggregated with upper grades.

Table 3. Characteristics of Interventions (N=79)

Descriptors	n	(%)
Type of intervention		
cognitive and metacognitive	54	68.4
text enhancement	14	17.7
others	11	13.9
Key instructional components included		
word study (a)	7	8.9
fluency (b)	5	6.3
vocabulary (c)	2	2.5
comprehension (d)	30	38.0
word, fluency (a, b)	2	2.5
word, voca (a, c)	3	3.8
word, comp (a, d)	1	1.3
fluency, voca (b, c)	2	2.5
voca, comp (c, d)	4	5.1
word, voca, comp (a, c, d)	1	1.3
word, fluency, comp (a, b, d)	2	2.5
fluency, voca, comp (b, c, d)	1	1.3
word, flu, vo, comp (a, b, c, d)	19	24.1
Motivation and engagement		
Included	23	29.1
Not included	56	70.9
Metacognitive strategy or traing		
Included	33	41.8
Not included	46	58.2
Peer-mediated activity		
Included	19	24.1
Not included	60	75.9

Table 4. Characteristics of Implementation (N=79)

Descriptors	n	(%)
Group size		
one to one tutor	18	22.8
less than 5	48	60.8
more than 5	13	16.5
Duration		
less than 16 wks	46	58.2
more than 16 wks	33	41.8
length of each session		
less than 30 min	30	38.0
more than 30 min	49	62.0
Interventionist		
teacher	47	59.5
researcher	20	25.3
undergraduate or graduate stu.	12	15.2
Setting		
self-contained or resource room	11	13.9
elective class	13	16.5
general education classroom	17	21.5
others or not reported	38	48.1

2. Effects on Reading Comprehension

Effect sizes were adjusted through three steps. Among 143 effect sizes, 106 were adjusted based on pretest effect size. Then, 18 of which sample sizes were less than 20 were adjusted by correction procedure for small sample size bias. Also, 99 were adjusted from attenuation bias based on the reliability coefficients of dependent measures.

To detect any possible outliers, histogram was used (DeCoster, 2004). Two possible outliers were detected (Fagella-Luby et al., 2007; Guthrie et al., 2009). The largest effect size from Fagella-Luby et al. (2007) was resulted from almost four times difference between the posttest score of treatment group and control group. The second largest effect size from Guthrie et al. (2009) came from the procedure of correction for attenuation, because reliability coefficient was only 0.48. These effect sizes were retained because they were decided as systematic figures.

1) Unconditional model: Homogeneity analysis

An unconditional model of meta-analysis was tested first. In the analysis, restricted maximum likelihood estimation was used. This analysis was conducted to confirm the overall mean effect size and to examine the variability among all samples. The results are shown in

Table 5.

Table 5. Results of the Unconditional Model Analysis

Fixed Effect					
	Coefficient	SE	t Ratio(df)	95% CI	
				Lower	Upper
Intercept	.576	.053	10.853***(142)	.422	.618
Random Effect					
	Variance Component	SD	Chi-square		
Intercept	.272	.521	563.876***		

Note. SE=Standard Error, SD=Standard Deviation.

*** $p < .001$

The intercept coefficient in the fixed model is same as the overall mean effect size from 143 effect sizes. The coefficient was 0.576 ($t = 10.853, p < .001$), meaning that on average, the effect of reading interventions on reading comprehension for students at-risk for or with learning disabilities is moderate high with a mean effect size of 0.576. Cohen's d is generally interpreted as "small $d = 0.2$," "medium $d = 0.5$," and "large $d = 0.8$."

The variance component is able to inform about the variability among samples. The estimate was 0.272 and remained significant ($\chi^2 = 563.876, p < .001$). This statistical significance means that the

variability stemmed from some variables other than sampling error. At this point, moderator analysis with influential predictors in a model is required to investigate the sources of variability.

2) Conditional model: Moderator Analysis

A conditional model of meta-analysis followed up as a next step to examine the variability among effect sizes discovered in the prior unconditional model analysis. Besides, this moderator analysis using conditional model was expected to identify promising factors which have impact on the strength of effect sizes. The moderator analysis was administered by four critical variable categories: student-related variables, measurement-related variables, intervention-related variables, and implementation-related variables. Among the measurement-related variables coded, only one variable was included in the analysis. Therefore, the one measurement-related variable was added to the analysis of student-related variables.

The predictors under the four categories are shown in Table 6. These variables were dummy-coded for the analysis and ease of interpretation. Three predictors were coded by reference coding. Reference coding was employed to identify the difference of dependent variable between the categories of independent variables. The researcher sets one reference group which is thought to be the most

influential group among groups in a variable (Park, 2004).

The results of three conditional meta-analyses are presented individually in the following sections.

Table 6. Predictors Selected for Moderator Analysis

Predictors	Recoding As a Dummy Variable	
	0	1
Student		
Grade	3-6	7-9
No. of grade	Single	Multiple
Exceptionality type	Low achieving	LD
Measurement		
Standardized	Standardized	Researcher-developed
Intervention		
No. of components*	1 to 4	
Intervention type	Cognitive & Metacognitive	Text enhancement
Motivation	Included	Not included
Peer-mediated	Included	Not included
Implementation		
Interventionist*	Teacher, graduates, researcher	
Grouping*	1:1, below 5, more than 5	
Duration	Less than 16 weeks	More than 16 weeks
Session length	Less than 30 min	More than 30 min

* Predictors were coded by reference coding.

(1) Student-related variables and a measurement variable

The results of the conditional meta-analysis for student and measure-related variables are presented in Table 7. The significant coefficients means that the mean effect sizes are significantly higher for studies in reference condition, with other variables in the analysis held constant. For student-related variables, all three predictors, grade, number of grade, and exceptionality or reading level were not significant ($-0.208, p=0.085$; $0.091, p=0.492$; $-0.132, p=0.0.304$). In other words, whether what grade level students are participated, whether single or multiple grades of students are participated, and how severe the participants' reading difficulty is (low achieving or LD) did not lead to significant differences in mean effect sizes. The coefficient for the measurement-related variable was significant ($-0.460, p=0.000$), meaning that effect sizes of standardized measurements ($ES=0.301$) were significantly lower than effect sizes of researcher-developed measurements ($ES=0.748$).

Table 7. Results of Moderator Analysis for Student and Measurement-related Variables

Fixed Effect	Coefficient	SE	t Ratio	Approx. d.f.	p-value
Student					
Grade	-.208	.120	-1.733	138	.085
No. of Grade	.091	.133	.689	138	.492
Exceptionality	-.132	.128	-1.032	138	.304
Measurement					
Standardized	-.460	.115	-4.002	138	.000

(2) Intervention-related variables

Table 8 shows the results of the moderator analysis for intervention-related variables. First, the number of key reading components (decoding, fluency, vocabulary, and comprehension) was tested if it has any influence to effect sizes. Studies included all four components were functioned as a reference group (coded as 0, 0), based on an assumption that the full multicomponent intervention will be most effective. Seen from Table 5, whether three or two components included in a study did not lead to significant differences in mean effect sizes (0.453, $p=0.068$; 0.270, $p=0.157$). However, studies applied only one component (0.438, $p=0.000$, $ES=0.649$) had a significantly higher effect than the studies with four components ($ES=0.149$). For intervention types, cognitive and metacognitive intervention was fixed

as a reference group, and compared to text enhancement intervention and others. The result did not draw significant differences in mean effect sizes between the two relations (-0.185, $p=0.167$; -0.108, $p=0.555$). For the rest of three predictors, meaning of the significant coefficients is higher effect sizes for studies that included those three factors in their interventions. Among the two factors, only motivation and engagement factor was found to be lead significantly higher effect sizes (0.368, $p=0.001$, $ES=0.816$). Whether peer-mediated learning activities were included did not have significant influence to the effect sizes (-0.096, $p=0.400$).

Table 8. Results of Moderator Analysis for Intervention-related

Variables					
Fixed Effect	Coefficient	SE	t Ratio	Approx. d.f.	p-value
4 components*					
3 components	.453	.247	1.838	135	.068
2 components	.270	.190	1.423	135	.157
1 component	.438	.113	3.859	135	.000
Cog-metacog*					
Text enhance	-.185	.133	-1.389	135	.167
Others	-.108	.183	-0.591	135	.555
Motivation	.368	.109	3.371	135	.001
Peer-mediated	-.096	.113	-0.844	135	.400

* Reference group of reference coding.

(3) Implementation-related variables

The results of moderator analysis for implementation-related variables are shown in Table 9. Two variables, interventionist and group size, were coded by reference coding, each assigning reference group status to researcher and small group variables. For interventionist predictors, effect sizes from researcher-delivered interventions ($ES=0.572$) were significantly higher than those from teacher-delivered and graduates-delivered interventions (-0.398 , $p=0.002$, $ES=0.368$; -0.781 , $p=0.000$, $ES=0.373$). Furthermore, interventions with small groups of less than five participants ($ES=0.382$) led significant increase of effect sizes than those with large group of more than five (-0.339 , $p=0.009$, $ES=0.528$). One to one setting was not significant (0.274 , $p=0.057$, $ES=0.595$), but the p-value was close to the significant level.

Duration of interventions was divided by 16 weeks, and interventions during less than 16 weeks ($ES=0.719$) were significantly influential to larger effect size than those over 16 weeks (-0.483 , $p=0.000$, $ES=0.190$). Length of a session turned out to have no significant effect on effect sizes.

Table 9. Results of Moderator Analysis for Implementation-related

Variables

Fixed Effect	Coefficient	SE	t Ratio	Approx. d.f.	p-value
Researcher*					
Teacher	-.398	.123	-3.219	136	.002
Graduate stu.	-.781	.185	-4.231	136	.000
Less than 5*					
1:1	.274	.143	1.919	136	.057
More than 5	-.339	.127	-2.671	136	.009
Duration	-.483	.109	-4.432	136	.000
Length	.131	.107	1.228	136	.222

* Reference group of reference coding.

V. CONCLUSION

1. Research Findings and General Discussions

The purpose of this study was to explore the effect of reading interventions and to identify critical variables for evidence-based practice for enhancing reading comprehension ability of students at risk for or currently classified with a learning disability in reading. To achieve the goal, this study tried to find out the answer to two research questions. What is the estimated mean effect size of reading interventions for students with learning difficulties or disabilities in grade 3 through 9 on enhancing reading comprehension? And To what extent do student-related, intervention-related, implementation-related, and measurement-related variables have effect on enhancing reading comprehension of students with learning difficulties or disabilities in grade 3 through 9? In this chapter, a brief summary of the results of this meta-analysis and discussion of the research results are presented. And the research findings are reviewed in light of controllable and hard-to-control variable concept to seek to give practical suggestions to practitioners.

The first primary finding from this meta-analysis is that students with learning difficulties can improve their reading comprehension ability when provided appropriate reading interventions. To resolve the two main research questions, two-level meta-analysis was employed in this study. For the first research question, the unconditional model of HLM was conducted to investigate the mean effect size of reading interventions on reading comprehension of students with reading difficulties or disabilities. The result of that analysis indicated that the overall mean effect size of reading interventions of studies included in this analysis yielded effect size of 0.576, which means moderate high level of effect. From this result, we can conclude that the reading interventions generally have a clear effect for students with reading difficulties or disabilities in 3 to 9 grades on reading comprehension outcomes. This is along with the line of prior syntheses reporting positive effects of reading interventions on reading comprehension (Berkeley et al., 2010; Edmonds et al., 2009; Sencibaugh, 2007; E. Swanson et al., 2011; Wanzek et al., 2010).

The second primary finding of this meta-analysis comes from the analysis by four variable categories: student-related variables, intervention-related variables, implementation-related variables, and measurement-related variables. To be specific, the variables proved to have significant effect on reading comprehension outcomes of students

with reading difficulties or disabilities in grades 3 through 9 were as follows: targeted intervention for one key component, motivation and engagement embedded in the interventions (two predictors for intervention-related variables), researcher-delivered intervention, small group comprised of less than 5 participants, and duration of an intervention not exceed 16 weeks (three predictors for implementation-related variables), and researcher-developed measurements (measurement-related variable).

However, all of the student-related variables including grade, number of grades given instruction together, and the level of reading difficulty turned out not to have any significant effect on reading comprehension of students at risk for or with learning disabilities. Cognitive and metacognitive strategies that outperformed text enhancement strategies in previous syntheses (Berkeley et al., 2010; Gajria et al., 2007; Gersten et al., 2001; Sencibaugh, 2007; Swanson, 1999b) did not show any statistically significant difference between the two to reading comprehension of struggling readers. In addition, length of a session did not affect reading comprehension gains, whether the instruction lasts for less than or more than 30 minutes. Neither did peer-mediated factor, presenting an inconsistent result with prior research (e.g. Fuchs et al., 1997; Vaughn, Klingner et al., 2011). These findings of predictors those are not statistically significant are also vital

information, in that practitioners and policy makers does not have to be soberly flustered with those variables. That is, students with learning difficulties are able to achieve their academic gains in reading comprehension, regardless of in what grade they are, in what grade their peers are, whether they were identified as learning disability.

These important findings can be explained with the concept of controllable and hard-to-control variables for practitioners in the classrooms with students. First, among the significant variables, targeted intervention for one key component, motivation and engagement embedded in the interventions, small group comprised of less than 5 participants, and duration of an intervention not exceed 16 weeks are the controllable variables for teachers and practitioners in the field. They may possibly choose to adopt these findings into their practices. Especially, with the highest effect size and significance among all variables, motivation and engagement factor is worth considering. Practitioners may design their class pondering upon how students can be highly motivated and how they actively engage in learning activities.

The result of this study took side of targeted intervention over multi-component, even though multi-component intervention has been also tensely supported by many other researches. In that this meta-analysis focused only on reading comprehension outcome, absolute

majority of targeted interventions of included studies centered on reading comprehension. Thus, targeted intervention could be concluded to be effective in enhancing comprehension when it is designed for reading comprehension.

For the duration, it is commonly believed that the longer period an instruction has been provided for, the stronger effect occurs. However, the result of this meta-analysis yielded the duration of an intervention not exceed 16 weeks is more beneficial. A possible explanation for this apparently incomprehensible result might be different responsiveness of the participants of included studies. In other words, slow responders might have participated in interventions provided over 16 weeks, while rather fast responders in interventions not exceed 16 weeks.

Though researcher-delivered intervention and researcher-developed measurements were factors that increase students' reading comprehension, meanwhile, these are likely to be under category of hard-to-control variables. For researcher-delivered intervention, the possible explanation for it to surpass the students' outcome of teacher-delivered intervention could be provided as in previous research (Gersten et al., 2001; Hall, 2004; Jitendra et al., 2011). In that researchers are well-aware of the core and procedure of intervention in their research than teachers; this might not be a surprising result. However, the point is that teachers, not researchers, are the one that

should bring the best practice to students. Therefore, practitioners should develop themselves in professional ways to deeply absorb evidence-based interventions and practices just like a teacher researcher.

Among the student-related variables identified as insignificant predictors, the level of reading difficulty or the exceptionality needs additional explanations. The predictor was categorized by low achieving students and students with learning disabilities. These two notions of students are in indiscriminate condition (O’Conner et al., 2002). The arguments over the reliability of special education classifications (Shaywitz, Escobar, Shaywitz, Fletcher, & Makuch, 1992) and the overlap among children with reading disabilities and children with generally low achievement (Reynolds, Zetlin, & Wang, 1993) are still valid. The studies included in this meta-analysis were reflecting this confusion, and this might affect the significance level of that predictor. A positive inference can be led from this discussion. It is fortunate that even if students are with low achieving or learning disabilities, they still can learn and improve through evidence-based practices, as seen from the effect sizes.

2. Limitations

Despite of several momentous points of the present study, there

are limitations that should be considered when interpreting and accepting the results.

According to Han (2009), with the other predictors held constant, the mean effect sizes decreased significantly with the increase of the quality of studies. If there is no information on whether the intervention was implemented as it was intended to, we cannot be confident that the results were due to the intervention (Elleman et al, 2009). Thus, reading comprehension outcomes cannot be guaranteed to be affected only the four variable categories of this research without quality indicators of the studies included in the analysis fully met. In other words, there is some possibility several effect sizes from the studies with better quality than others might be estimated downward.

Yeo (2011) stated that if each study reports multiple effect sizes within a study instead of a single effect size, a two-level, multi-level model is not appropriate because effect sizes between samples clustered within studies might be somewhat correlated (Beretvas & Pastor, 2003). Even though the method of this study was determined based on plausible reasons, it might be one of the limitations that this study did not applied a three-level meta-analysis with multiple effect sizes from each studies.

3. Implications for Research and Practice

Regardless of some limitations mentioned above, this study provides meaningful implications to practitioners, researchers, and policy makers for research and practice with respect to enhancing reading comprehension of students with reading difficulties or disabilities.

Considering further application, these meta-analytic findings could guide the practitioners and policy makers to develop effective evidence-based reading comprehension program or policies (Calhoun, 2005). The elements which should be included in the new program development are the ones that significant variables in this study results. With the factors for evidence-based practice, new programs will be able to successfully enhance students' reading comprehension.

To researchers, Quality Indicators have a huge implication on the experimental studies. Although this study applied minimum of Quality Indicators—fidelity of intervention, reliability coefficient of measurements, treatment-control group design— to filter out the target studies for analysis, very few studies among not so small amount of literature groups were met the criteria of Quality Indicators, especially in case of Korea. Therefore, researchers need to consider the quality of

their research to be able to generalize meaningful results.

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Appendix

Appendix 1. Codebook

	Items (Open-ended or forced-choice)	Choices for forced-choice items
General study characteristics		
A	ID of the line	
B	ID number of the study	
C	nationality of the study	
D	researcher	
E	publication year	
F	title of the study	
G	publication type	
Student-related variables		
H	mean age	
I	grade	
J	number of grade included	single (0), multiple (1)
K	number of participants	
L	number of male	
M	number of female	
N	sampling method	random (0), others (1), nr ^a (2)
O	exceptionality type (reading ability level)	LD (0), low achieving (1)
P	selection criteria in case of low- achieving students	
Q	identification criteria in case of learning disabilities	dual discrepancy (1), RTI (2), others (3)
R	ethnicity	European-American (1), Hispanic (2), African-American (3), Asian/Pacific Islander (4), Other (5), nr (6)

S	placement of special education	Yes (1), No (2)
T	SES	lower, lower-middle (1), middle, upper-middle (2), upper (3), nr (4)
<hr/>		
Intervention-related variables		
U	title of intervention	
V	description of intervention	
W	type of intervention	cognitive and metacognitive strategies (1), text enhancement strategies (2), others (3)
X	key instructional components included ^b	word study (1), fluency (2), vocabulary (3), comprehension (4)
Y	motivation and engagement	Yes (1), No (0)
Z	metacognitive strategy or training	Yes (1), No (0)
AA	peer-mediated activity	Yes (1), No (0)
<hr/>		
Implementation-related variables		
AB	group size (no. of participants in a group)	
AC	duration of intervention (wks)	
AD	total number of sessions	
AE	frequency per week	
AF	length of each session (min)	
AG	interventionist	teacher (1), researcher (2), undergraduate or graduate student or paraprofessional (3)
AH	setting	self-contained or resource room (1), elective class (2), general education

classroom (3), others (4), nr
(5)

Measurement-related variables

AI	title of measurement	
AJ	type of measurement	standardized (1), researcher-developed (2)
AK	type of reliability	test-retest (1), Cronbach's α (2), interrater (3), alternative-form (4), others (5), nr (6)
AL	reliability coefficient	
AM	type of validity	criterion (1), construct (2), content (3), others (4), nr (5)
AN	validity coefficient	
AO	person implemented measurement	teacher (1), researcher (2), undergraduate or graduate student (3)

Quality indicator variables

AP	method of treatment-control group assignment	random (1), matching (2), others (3)
AQ	fidelity of intervention	Yes (1), No (0)
AR	quality information of interventionist	Yes (1), No (0)

Quantitative data

treatment, control group pretest, posttest mean
 treatment, control group pretest, posttest *sd*
 number of participants at pretest, posttest per treatment and control group

^anr=not reported, ^b=multiple choice allowed.

국 문 요 약

학습부진 학생의 읽기이해에 대한 읽기중재의 효과 메타분석

읽기는 모든 학습활동의 기초가 되는 능력이며, 특히 읽기 이해는 읽기의 목적이라고 일컬어질 만큼 핵심적인 활동이다. 따라서 텍스트를 이해하는 데 어려움이 있는 학습장애 또는 학습부진 학생들에게 적절한 도움을 제공하기 위해서는 효과적인 읽기이해 중재를 제공해야 한다. 이를 위하여 상당한 메타분석 연구가 읽기의 증거기반실체를 규명하고자 실행된 바 있다. 그러나 지금까지의 메타분석은 효과적인 중재의 일반적 요소들은 중요하게 짚어내었지만, 교사들이 실제 교실에서 실시할 수 있는 증거기반실체가 무엇인가에 대한 명확한 답을 제공할 수 없었다. 실질적인 증거기반실체에 초점을 맞추어, 본 연구는 읽기이해에 대한 읽기 중재 연구들의 효과성을 검증하고, 그 효과에 대한 학생관련변인, 중재관련변인, 실행관련변인, 검사도구관련변인 각각의 영향이 어떠한지 규명하고자 하였다. 이러한 변인들에 대한 분석 결과를 토대로, 교사 및 교육전문가들이 읽기를 어려워하는 학생들을 가르칠 때 직접 조작할 수 있는 변인과 그렇지 않은 변인을 나누어 제시하였다. 궁극적으로 본 연구 결과를 통해 교육전문가와 정책 입안자들이 학생들의 읽기이해 향상을 위하여 현실적인 증거기반실체를 반영한 읽기 프로그램을 고안하고 실행할 수 있도록

하고자 하였다.

주요어: 읽기이해, 메타분석, 읽기중재, 학습장애, 학습부진, 읽기곤
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