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A Meta-Analysis of Reading Fluency Interventions for Students with Reading Difficulties

: Using IRD Index

읽기부진학생 대상 읽기유창성 중재에 대한 메타분석

: IRD 척도를 활용하여

2014년 2월

서울대학교 대학원

협동과정 특수교육전공

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Abstract

A Meta-Analysis of Reading Fluency Interventions for Students with Reading Difficulties
: Using IRD Index

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Reading is a process that involves word cognition and comprehension; therefore, it is an essential requirement for students. However, some students still have difficulties reading and cannot comprehend the texts they are presented. Hence, researchers should seek effective reading intervention methods for these students.

Until now, many researchers discussed what skills those students with reading difficulties must utilize to develop their reading abilities and what methods can enhance these skills. As a result, the importance of reading fluency has been emphasized. Reading fluency is the ability to read text rapidly, accurately, and with prosody. Significant research has suggested that reading fluency is one of the core characteristics. Thus, research related to reading fluency has been implemented both at home and abroad.

Meanwhile, the Response to Intervention (RTI) model is emerging as a diagnosis and intervention model for students with learning difficulties. One of the main features of the RTI model is the provision of interventions according to the

students' performance level from Tier 1 to Tier 3. The higher tier students are provided with more intensive interventional tools. Therefore, there may be a huge difference in intervention methods between Tier 1 and Tiers 2–3. In short, different instruction strategies can be applied to each tier.

The main purpose of this study is to identify effective intervention characteristics for the improvement of reading fluency, focusing on the intervention within Tiers 2 and 3. This study employed the meta-analysis method to derive the general and comprehensive conclusions from the individual studies, and tried to discover the effective instruction methods for small groups (or those learning in a one-to-one environment) by synthesizing the results of single-subject research on reading fluency for students with reading difficulties. Accordingly, the overall effects of the reading fluency intervention were calculated and each effect size was yielded according to student-related variables, intervention-related variables, implementation-related variables, and measurement-related variables.

In addition, in this meta-analysis, effect sizes were calculated using the IRD (improvement rate difference) index. Until now, the effect size has mainly been computed using the PND (percentage of non-overlapping data) index. However, recent research has proved that the IRD is a better index for calculating the effects of single-case research, since IRD can discriminate the effect sizes more exactly than the PND index and yield confidence intervals with effect size. Therefore, this study implemented the meta-analysis using the IRD index, presenting the results and suggesting the implications for reading fluency intervention.

Keywords: *Reading Fluency, Reading Difficulties, Learning Disabilities, Meta-Analysis, Improvement Rate Difference (IRD)*

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Ⅰ. INTRODUCTION

1. Purpose of the Study

Reading is the communicative process for interpreting letters and gaining knowledge; hence, appropriate reading abilities are essential for learners. However, not all school-age children are equipped with effective reading abilities. For example, according to the results of the National Assessment of Educational Achievement of Korea in 2009, 2.3% of 6th graders, 4.6% of 9th graders and 2.3% of 10th graders were categorized as being deficient in the Korean language. This included both reading and writing (Lee & Hwang, 2011). It has also been reported that 10–15% of students in the U.S. have difficulties in reading (Lee & Son, 2010).

To solve this problem, research has been conducted into helping those children with reading difficulties. The National Reading Panel (2000) in the U.S. categorized the studies for reading instructions into five reading skills and searched effective intervention methods for each skill. The skills are "phonemic awareness," "phonics," "fluency," "vocabulary," and "comprehension." Among these skills, comprehension is the ultimate objective of reading, the rest being fundamental skills that consist of low skills (such as phonemic awareness) and high skills (such as comprehension).

Among them, reading fluency, the ability to read rapidly and accurately, is

emphasized as a very important reading skill. The grounds that fluency is significant in reading comprehension stem from the argument that if children's word recognition is not automated, reading comprehension will be lacking because the energy that should be allotted to comprehension is used for decoding (LaBerge & Samuels, 1974). In addition, it has been revealed that reading fluency is a strong predictor of reading comprehension and an essential skill in enhancing high-level reading ability, covering aspects such as thinking skills and creativity (Lee & Kim, 2003).

However, in spite of the importance of reading fluency, little attention has been given to it. The main reason behind this lack of academic interest is that research on the definition and measurement method of reading fluency has not been implemented enough. Therefore, efficient interventions for reading fluency have not been widely researched and have not become public knowledge (Rasinsky, Blachowicz, & Lems, 2012). However, as stated above, reading fluency has become an important academic interest and many studies on reading fluency have been conducted. Reading fluency has begun to be considered a fundamental skill for successful reading. NCLB (No Children Left Behind) was implemented to rapidly increase academic interests on reading fluency instruction, emphasizing fluency as a vital skill to be a competent reader (Samuels & Farstrup, 2006).

Recently, the Response-to-Intervention (RTI) model was introduced to the field of learning disabilities and has since been established in the school system as a diagnosis and intervention model. Many studies have highlighted the limitations of the ability-achievement discrepancy model, which was used for a long time to

identify students with learning disabilities (Hallahan, Lloyd, Kauffman, Weiss, & Martinez, 2005). In particular, the ability-achievement discrepancy model precludes early intervention because it identifies students with learning difficulties, only after they experience achievement failure (Fuchs, Mock, Morgan, & Young, 2003). To overcome such serious defects, the RTI model appeared as an alternative method of identifying learning difficulties, observing students' responses to evidence-based instructions that have proven to be effective (Fuchs, Fuchs, & Speece, 2002; Vaughn & Fuchs, 2003).

The procedures and processes for RTI vary according to conditions such as researchers' point of view or regions implementing RTI, but RTI generally identifies students with learning disabilities through a three-tier process (Hallahan et al., 2005). Tier 1, known as the general education level, provides quality education to all students in a general learning environment. While under Tier 1 intervention, those students who consistently show significantly low levels of achievement are sent to Tier 2. In Tier 2, prevention or remediation plans designed especially for these students are implemented. Here, predominantly small-group instructions are used, providing students with a more intensive, prolonged intervention that is focused on their problem areas. If the Tier 2 students did not respond well to the interventions, they received more individualized and intensified interventions in Tier 3 (Davis, Lindo, & Compton, 2007; Vaughn & Fuchs, 2003). As such, the RTI model is a learner-centered model, which seeks to identify students who may be at risk of learning disabilities, offering them adequate educational services earlier (Brown-Chidsey & Steege, 2010; Hallahan et al., 2005).

In the RTI model, large group instruction, small group instruction, and one-to-one instruction are implemented at each tier. Therefore, since more intensive intervention is provided for a small number of students and more careful observations of their achievement and progress are required in Tier 2 and 3, appropriate research designs are needed to establish effective evidence-based interventions.

With this in mind, single subject research can be a highly useful research method to suggest the evidence reflecting the instructional features of Tiers 2 and 3 in the RTI model. Single subject research is a method of deriving conclusions from the change seen in a small number of students as time passes. It has been regarded as an appropriate research method in establishing evidence-based instructions (Horner et al., 2005). Therefore, single subject research as a research design will be emphasized according to an increase of the application of RTI models. The results from the studies will offer more reliable evidence of the effects of RTI models.

In addition, meta-analysis can be another competent research method to build research-based interventions. We can achieve more valid and reliable data by gathering related studies and calculating the effect size using meta-analysis (Kavale, 2001). Such meta-analytic syntheses have been performed consistently in regular intervention research in the U.S. and they are contributing to providing a theoretical basis of evidence-based instructions (Morgan, Siderridis, & Hua, 2012).

However, the reading fluency of students with learning difficulties has only been recently recognized as a significant problem in Korea (Lee, 2007). As a result,

meta-analytic research on reading fluency interventions has not been implemented to a great extent. Literature reviews on reading fluency instruction by Kim (2006), Kim, Jeong, and Park (2011), Lee (2007), and Lee (2012), are not meta-analyses, but reviews of papers or studies on research trends; they rarely contribute to the establishment of evidence-based practice. Lee and Son (2010) conducted a meta-analysis on reading fluency interventions as part of overall reading intervention, but they included only four groups of design research and two single subject investigations. In addition, Seo, Seo, and Park (2011) performed a study on single subject research on reading fluency, but they did not focus on reading fluency and did not analyze the related research in detail, dealing instead with interventions on all reading skills.

Therefore, in this paper a meta-analysis will be conducted on reading fluency interventions for students with reading difficulties to form evidence-based practices. In particular, it will focus on an analysis of a single subject study. This research will contribute to the building of interventions for Tiers 2 and 3 of the RTI model.

However, one emerging problem from the meta-analysis of single subject research is that the calculation method of effect size of these studies is still controversial. Until now, the Percentage of Non-overlapping Data (PND) index has generally been used in computing effect size of single subject studies (Seo et al., 2011; Maggin, O'keeffe, & Johnson, 2011). Nevertheless, this index has been criticized for its inaccuracy; therefore, Parker, Vannest, and Brown (2009) suggested the Improvement Rate Difference (IRD) index as an alternative method

to calculate effect size from single subject studies and proved its validity and reliability in their research. In this study, corresponding to this methodological trend, the IRD index was employed for calculation of effect size.

2. Research Questions

The purpose of this study is to search the features of effective instructions via a meta-analysis of single-subject research on a reading fluency intervention for students with reading difficulties. This was done to establish evidence-based practice. For this purpose, overall effect size will be computed by synthesizing related studies on reading fluency interventions for students with reading difficulties and a subgroup analysis will be conducted via student-related, intervention-related, implementation-related, and measurement-related variables in sequence. Finally, the features of effective interventions will be yielded as a result of this analysis process. Specific research questions are as follows:

Question1. What is the overall mean effect size of reading fluency interventions for students with learning difficulties?

Question2. To what extent do student-related, intervention-related, implementation-related, and measurement-related variables affect the improvement of reading fluency of students with reading difficulties?

Ⅱ. LITERATURE REVIEW

1. Reading Fluency

1) Concept of Reading Fluency

Reading fluency means the ability to read text rapidly, accurately, and with prosody (National Reading Panel, 2000). In this concept, rapid reading means the automaticity in reading and accurate reading means the precise interpretation of letters. On the other hand, reading with prosody means reading appropriately by emphasizing important words, pausing at proper moments, or changing intonation (Armbruster, Lehr, & Osborne, 2001; National Reading Panel, 2000).

This concept of reading fluency is the result of decades' worth of research and discussion. For instance, when the discussion on reading fluency began in 1974, LaBerge and Samuels was mainly focusing on word recognition as an automatic information process. However, lately the concept of reading fluency includes the process of comprehension as well as word recognition. In other words, the concept of reading fluency, at present, contains the process of grouping words into grammatical units (Rasinsky et al., 2012).

Theoretically, those students reading fluently are able to concentrate more on the comprehension of text than decoding letters (Labarge & Samuels, 1974; Perfetti,

Bell, & Delaney, 1988). Fluent readers may be excellent readers in that they can show better reading comprehension. According to research thus far, reading fluency has been proved to be a core component for efficient reading (Fuchs, Fuchs, Hosp, & Jenkins, 2001; National Reading Panel, 2000; Snow, Burns, & Griffin, 1998) and four theories related to reading fluency have been represented (Mercer & Mercer, 2005).

The first one is automaticity theory, as mentioned above. According to this theory, fluent readers are classed as readers with automaticity (Howell & Lorson-Howell, 1990). If the students are equipped with automaticity in reading, they can quickly perform their reading tasks (Howell & Lorson-Howell, 1990; Larberge & Samuels, 1974). This is because the automaticity in reading allows them to concentrate on the meaning of sentences rather than each letter of the word.

The second one is the theory of sight word efficiency (Torgesen, Rashotte, & Alexander, 2001). The sight words mean the vocabularies that are included in the learner's long-term memory and are readily available whenever they want to use them. Therefore, the more sight words they have, the more fluent they are. For example, Torgesen et al. (2001) discovered that sight words are significant predictors of fluent reading.

The third one is the theory of cumulative deficit. Generally, the number of sight words of regular students rapidly increases from Grade 3 to 12, but the number of sight words of student with reading difficulties rarely develops, preventing them from reading fluently. Eventually, the amount of reading of the students is restricted and their reading skills, including reading fluency, continuously lag

behind their peers.

The last one is the theory of information processing speed. The result of Rapid Automized Naming (RAN) Tests, closely related to this theory, can predict word reading and comprehension of text (Denckla & Rudel, 1974). For example, Neuhaus and Swank (2002) identified that letter reading fluency predicts the accuracy of word reading.

With these theories, Chall's (1996) theory on reading development also provides a foundation to reading fluency interventions. According to her theory, reading fluency is mainly developed in the third stage of her development model, which corresponds to approximately the third grade level of elementary school. This stage is very important to identify the possibility of reading progress. This is because the students cannot experience high performance in reading until they think they can read fluently (Mercer & Mercer, 2005).

As discussed above, reading fluency is one of the key elements for reading comprehension as a goal of reading. From now on, the principles of reading fluency interventions will be discussed with the research that has so far been conducted on reading fluency intervention.

2) Principles of Reading Fluency Interventions

Typically, reading fluency means the number of words read accurately in a limited time, mainly measured per minute (Shinn, 1989). However, we should pay attention to the fact that the outcome of reading fluency assessment can be affected

by many factors. Reading fluency needs to be evaluated in reference to the conditions such as the genre of text, maturity of students, aim of reading, and school-grades. Nowadays, there are standard scores of each grade to measure the reading fluency. The Dynamic Indicator of Basic Early Literacy Skills (DIBELS) and the Curriculum-Based Measurement (CBM) are the commonly used assessment methods (Mercer & Mercer, 2005).

Meanwhile, the research studies that have been conducted so far consistently assert the importance of repeated reading for the enhancement of reading fluency. Hence, it is critical to give students the opportunity to read as much as possible in order to improve their reading fluency (Hallahan et al., 2005; Wolf & Katzir-Cohen, 2001). Accordingly, instructional methods for reading fluency should be developed with this basic rationale: the provision of opportunities for the students to be exposed to reading.

At first, Bender (2012) suggested student-adult reading, choral reading, reading using audiotapes, and peer reading as strategies for reading fluency instruction. In addition, Mastropieri, Leinart, & Scruggs (1999) recommended repeated reading, using CBM, class-wide peer reading, and using reading software programs. In particular, they contended that CBM has great merit because it informs us when the students do not progress by continuous assessment.

Ruddel (2009) also offered the repeated reading as a fundamental instructional method for reading fluency. In addition, he suggested teacher modeling, simultaneous reading (teacher and students), paired reading, and choral reading as approaches to support repeated reading. He contended that reading

aloud under adult supervision is more effective than silent reading alone.

Aside from these, the multi-component reading intervention, which typically sees a variety of reading skills and instructions applied, is also found to be effective in improving reading fluency (Chard, Vaughn, & Tyler, 2002; Mastropieri & Scruggs, 1997). As mentioned above, it was reported that interventions with RAN tasks were effective to enhance the reading fluency (Bower & Kennedy, 1993).

So far, intervention types and principles of reading fluency have been reviewed. It was found that the reading fluency interventions should be based on increased reading practices by repeated reading. From now on, the trend of research on reading fluency will be discussed both inside and outside Korea. The review of research trends will be implemented by examining the literature reviews, research syntheses, and meta-analytic research studies, rather than regular intervention research studies to achieve a comprehensive grasp of the trends.

3) Research Trends in Reading Fluency Interventions in the U.S.

With the importance of fluency emerging, several research syntheses and meta-analytic reviews have been conducted in the U.S. (Chard et al., 2002; National Reading Panel, 2000; Therrien, 2004; Wexler, Vaughn, Edmonds, & Reutebach, 2008). In this section, some representative meta-analytic research studies will be introduced.

The National Reading Panel (2000) performed a meta-analysis of a total of 77 reading fluency intervention research studies and yielded the weighted effect size,

d=0.41. According to the result, corrective feedback and guided repeated oral reading were effective for the regular students as well as the students with reading difficulties. In addition, this study indicated the fact that explicit instruction was important to enhance reading fluency.

Chard, Vaughn, and Tyler (2002) conducted a meta-analysis of a total of 24 reading fluency research studies on elementary students. As a result, the explicit modeling, corrective feedbacks, repeated reading of familiar texts, and appropriate goal setting should be included in strategies for the improvement of reading fluency.

Therrien (2004) implemented a meta-analysis of reading fluency interventions using repeated reading as a main instruction method. As a result, repeated reading was effective for reading both familiar materials and new materials. In addition, this study found that reading aloud was effective in reading familiar text, whereas reading with adults and corrective feedbacks were effective in improving overall reading fluency.

In addition, Wexler et al. (2008) conducted a research synthesis of reading fluency interventions on secondary students. The results showed that the strategies, including previewing activities, consistently improved reading fluency and there was only a slight difference in the effects between the repeated reading and non-repeated reading method for the older students.

Meanwhile, Morgan, and Sideridis (2006) performed a meta-analysis of single subject research studies on reading fluency interventions. They categorized the types of intervention into areas such as goal setting, repeated reading, word

recognition, and reinforcement. Subsequently, they measured the effect sizes and consistency of each intervention type by calculating the intercept and slope of these types, applying multilevel random coefficient modeling. According to the results of the study, reinforcement or motivation for learning (such as goal setting) was more effective in enhancing reading fluency than word-level practice such as word recognition. In addition, they implemented a meta-analysis of reading fluency interventions on students with all kinds of disabilities such as learning disabilities, intellectual disabilities, or behavioral disorders. The results were almost identical to their former meta-analysis in 2006; motivation was found to be the best way to improve reading fluency, while word-level training was much less effective (Morgan, Sideridis, & Hua, 2012).

3) Research Trends in Reading Fluency Interventions in Korea

Kim (2006), Kim et al. (2009), and Jeon and Kweon (2010) conducted literature reviews of general reading intervention research studies, while Lee (2007), Kim, Jeong, and Park (2011), and Lee (2012) carried out reviews of reading fluency intervention research studies. On the other hand, Lee and Son (2010), and Seo, Seo, and Park (2011) undertook meta-analytic reviews.

Kim (2006) reviewed 47 papers on interventions for students with learning difficulties. According to the results, reading intervention research was the most implemented, but the number of research studies on reading fluency interventions numbered only one.

Kim et al. (2009) analyzed 289 studies from 1999 to 2008, examining the trends of research studies on learning disabilities. Among them, research studies related to reading difficulties were categorized into domains such as word recognition, reading fluency, and reading comprehension. Out of these, only nine studies were concerned with reading fluency.

Jeon and Kweon (2010) reviewed studies on intervention methods for students with reading difficulties from 1997 to 2009. According to their research, 11 studies were conducted on students in the third stage of Chall's (1996) reading development, while eight studies dealt with reading fluency as an outcome of intervention. Eventually, the implication of this study on a reading fluency intervention did not amount to much, since the amount of research into it was limited.

Meanwhile, in their research on reading fluency intervention, Lee (2007) found 11 research studies on reading fluency interventions for students with learning disabilities. Based on the results of the review, she suggested fundamental resources and implications for a reading fluency intervention program.

Kim, Jeong, and Park (2011) studied the trend of experimental research on reading fluency interventions and evaluated the quality of the studies with a quality indicator. There were 21 research studies and they were composed of 12 single subject studies and 9 group studies. As a result, the single subject studies were of a higher quality, while the group studies were of an inferior quality. This was according to the quality indicator for research.

Lee (2012) examined the features of peer-reviewed research studies on

reading fluency interventions that have been implemented since 2000 in the U.S. Her study showed that the amount of research on reading fluency in Korea was much less than in the U.S. and asserted that research should be performed to account for the characteristics of the Korean language.

As a meta-analysis, Lee and Son conducted a study on reading interventions for students with learning disabilities. They analyzed 45 peer-reviewed articles on reading intervention, which had been published since 2000. In their study, the total effect size of group studies on reading fluency was more than a moderate effect (d=0.4) and the total effect size of single subject studies was very high (the percentage of non-overlapping data was more than 90%). However, since the number of group studies and single subject studies were four and two, respectively, the analysis was not performed in detail and few implications were suggested.

In addition, Seo, Seo, and Park (2011) reviewed a total of 84 single subject studies and examined how the interventions have been conducted. Among them, there were 19 research studies on reading fluency and the effect size of these studies was high (the percentage of non-overlapping data was more than 80%). However, a more specific analysis on reading fluency interventions was not implemented.

As reviewed above, the research on reading fluency interventions in Korea was lacking in both amount and quality. In addition, review studies in Korea were conducted as a form of literature review or trend research, rather than meta-analysis. As a result, specific analysis on reading fluency has not yet been implemented. Lee and Son (2010) performed a meta-analysis on reading fluency

interventions. However, since the amount of research was limited and, more importantly, only peer-reviewed articles were dealt with in their meta-analysis, a publication bias problem must be considered (Borenstein, Hedges, Higgins, & Rothstein, 2011; Shin & Park, 2011). With this in mind, more research on reading fluency interventions should be implemented and meta-analysis, with a variety of variables for analysis, should be performed on studies into reading fluency interventions for the establishment of evidence-based practice.

2. Meta-Analysis of Single Subject Studies

The purpose of this study is to yield comprehensive and general implications for small group instruction by a meta-analysis of single subject studies on reading fluency intervention. However, single subject studies have not been considered important for meta-analysis so far, since no agreement between researchers exists about the method to synthesize results of single-subject studies (Shadish & Rindskopf, 2007). In particular, since the single subject design has been widely applied in the field of special education (Horner at al., 2005), the lack of consensus on synthesis method has been a significant problem. Eventually, the lack of agreement made the conclusion from synthesis of the studies less reliable (Beretvas & Chung, 2008).

Meanwhile, such difficulties in consensus on synthesizing stem from the natural features of single subject design. Accordingly, visual analysis has been mainly applied for single-subject studies, while statistical analysis has not been

regarded as an important method (Parsonsosn & Baer, 1978). However, the importance of evidence for intervention has been emphasized recently and the researchers found that visual analysis is not enough to analyze the data precisely and reliably from the single subject studies. Therefore, the concept of effect size finally became the main issue in analysis of research (Kirk, 1996).

However, problems such as the lack of data and difficulties in calculation, data interpretation, and combination with visual analysis have been considered significant in calculating the effect size of single subject studies (Parker et al., 2009). In spite of these problems, research on effect size calculation has been performed consistently. As a result, some effect size indices were developed; these have been categorized into a regression-based index and a non-regression-based index. In regression-based indices, the effect size calculation method (devised using regression analysis by Allison & Gorman) (1993) is representative, whereas standard mean difference (SMD), percentage of non-overlapping data (PND), and percentage reduction measures are widely employed in studies as non-regression-based indices (Olive & Smith, 2010).

3. Promising Effect Size Index: IRD

As mentioned above, this study applied the IRD index to calculate the effect size of single subject studies. The IRD index was suggested by Parker et al. (2009) as an alternative to PND index and it has been widely used in effect size calculation so far.

Until now, the most frequently used effect size index has been the PND. According to Maggin et al. (2011), 47% of research syntheses of single subject studies from 1985 to 2009 have been implemented using the PND index. However, the PND has some fundamental drawbacks. Firstly, if there is an outlier in baseline phase, the PND cannot be used because it changes depending on the highest point of baseline. Secondly, statistical analysis cannot be performed with the PND index because it is impossible to yield sample distribution. Thus, the p-value and confidence interval (CI) cannot be calculated (Parker et al., 2009). However, despite such shortcomings, the PND index has been generally used because it is easy to calculate and well harmonized with visual analysis (Scruggs & Mastropieri, 2001).

Meanwhile, the IRD index was recently developed as an alternative to the PND index. IRD is a method of calculating effect size based on the difference of improvement rates in each baseline and treatment phase. IRD has long been used under the name “risk difference” or “risk reduction” in the field of medical research, because the it is easy to calculate and is reliable (Parker et al., 2009; Waddell, Nassar & Gustafson, 2011). Parker et al. (2009) found that the IRD index had many merits, such as a better discrimination ability for effect size, simple calculation, and production of forest plot, and CI in calculation of effect size.

The calculation process of IRD is as follows: First, the improvement rate (IR) should be computed. The IR can be calculated as the formula below:

$$\text{IR(Improvement Rate)} = \frac{\text{Improved Data Points}}{\text{Total Data Points}}$$

As the formula above shows, IR is the value of the number of improved data points divided by the total data points at each phase. Meanwhile, improved data of baseline phase refers to the data that is the same or above the highest data of treatment phase, while improved data of treatment phase indicates the data above the highest data of baseline phase. Accordingly, the IRD is equal to the difference of IR of treatment phase (minuend) to the IR of baseline phase (subtrahend).

$$\text{IRD} = \text{IR}_\text{T} - \text{IR}_\text{B}$$

In particular, a "robust IRD" index was utilized in this study. Developed from the IRD index, robust IRD has been found to discriminate effect sizes more effectively than the regular IRD index. The way to calculate robust IRD is as follows (Parker et al., 2011):

First, remove the minimum number of overlapping data points between baseline phase (B) and treatment phase (T). Second, divide the number of overlapping data points in half. Divide the number by the total data number of each phase. Each value IR_T and IR_B from the phases refers to their improvement rates. Lastly, subtract IR_B from IR_T. The difference is the robust IRD.

In the IRD index, the maximum value is one and the minimum value is -1. A negative IRD indicates that the intervention deteriorated the outcome. In addition, there is a benchmark of IRD to evaluate the effect size. Very small or no effects have

IRD scores of around 0.50 and below. Moderate effects have IRD scores from 0.5 to 0.7. Large or very large effects indicate IRD scores of 0.70 or higher (Parker et al., 2009; Yang & Park, 2012). In addition, CI is produced when IRD is calculated. The more data point it has, the narrower the CI becomes, increasing the accuracy. Effect size and CI is easily produced with a forest plot by using a related website (www.phsim.man.ac.uk/risk/) or computer programs such as NCSS or SPSS.

Meanwhile, Parker et al. (2009) compared validity of PND and IRD by analyzing 166 data examples. The study showed that the IRD index could not discriminate the high effect sizes as effectively as PND, but that it was effective in differentiating little or moderate effect sizes.

As the IRD index was introduced late to the field of special education, there were just a few meta-analysis studies using the IRD index. Now, however, the use of IRD is gradually increasing. One of the representative meta-analyses employing the IRD index is a study conducted by Ganz et al. (2012). They performed an analysis of 24 studies on intervention, using augmentative and alternative communication systems for students with autism. On the other hand, in Korea, Yang and Park (2012) conducted a meta-analysis of eight intervention studies on a picture exchange communicative system, using the IRD index.

Ⅲ. METHOD

1. Inclusion and Exclusion Criteria

To select studies for analysis, evident criteria for inclusion and exclusion should be established. The inclusion and exclusion criteria used in this meta-analysis are as follows:

First, this study refers to the studies on reading fluency intervention research implemented in Korea and includes both published and unpublished articles to prevent publication bias (Borenstein et al., 2011; Cooper, 2009).

Second, only intervention studies for elementary or secondary students were included, because the purpose of this analysis is to examine the effects of intervention on school-age students.

Third, only the students identified as having reading disabilities or difficulties are included. These are the students diagnosed as having disabilities by the related institutes, or those who consistently show low academic performance and little progress in teacher's monitoring. Therefore, IQ scores are not indicated and studies on the students with other disabilities such as sensory defects, intellectual disabilities, and emotional disturbances were excluded.

Fourth, only single subject studies are included according to the purpose of this meta-analysis. Therefore, group studies, qualitative studies, and literature

reviews were excluded.

Fifth, the studies containing statistical figures were involved. In other words, only studies clearly showing information as scores or progress graphs were included.

Finally, the studies showed that assessment was implemented at least 3 times in the baseline phase to maintain the quality of meta-analysis (Horner et al, 2005).

2. Data Collection

Research collection was mainly conducted using the electronic database website, Research Information Sharing Service, hosted by KERIS (www.riss4u.net). In addition, the Naver Information Center (http://academic.naver.com/), Nurimedia DBpia (http://www.dbpia.co.kr/), and the Hakjisa Information Center (http://newnonmun.com/) were used. Since the research on reading fluency interventions has only been conducted recently, publication dates were not considered.

Initially, searching was conducted using the Research Information Sharing Service website of KERIS (www.riss4u.net). In total, 460 studies were searched, with "disabilities" and "fluency" being used as keywords, and 101 studies were retrieved with the keywords "underachievement" and "fluency." The overlapping studies were then searched and studies that were not related to the subject of this meta-analysis were excluded after reviewing titles and abstracts.

In sequence, research collection was implemented using the Naver

Information Center (http://academic.naver.com/), the Nurimedia DBpia (http://www.dbpia.co.kr/), and the Hakjisa Information Center (http://newnonmun.com/). Overlapping data was excluded, compared with the results of initial search using KERIS' Research Information Sharing Service (www.riss4u.net). As a result, 63 experimental research studies were selected, which were composed of 35 group studies and 18 single subject studies. Since a hand search was conducted with references of the studies, but there was no newly added study, 18 single subject studies were finally selected for the meta-analysis.

3. Variables of Intervention for Meta-Analysis

One of the main questions of this meta-analysis is to yield an overall effect size of a reading fluency intervention and examine if the effect sizes change according to student-related, intervention-related, implementation-related, and measurement-related variables. The explanation of each variable is as follows.

First, student-related variables are to examine how the effect of intervention changes according to the features of students. Elbaum and Vaughn (2001) and Wexler et al. (2008) showed that, in spite of the same intervention, the effects may differ in relation to students' age. Accordingly, the participants were classified into 1–2 graders, 3–4 graders, and 5–6 graders in this meta-analysis, and the effect size of each group was calculated and compared with each other. Meanwhile, McIntosh, Reinke, Kelm, and Sadler (2013) contended that the gender difference should be considered in reading instruction. They investigated the gender difference in

reading, using a longitudinal study. Gender difference and its effects on reading fluency instruction were examined.

Second, intervention-related variables find how the effect changes, depending on the types of intervention. In the classification of intervention types, Chard, Vaughn, and Tyler (2002) divided reading interventions into repeated reading, word practice intervention and, in sequence, categorized repeated reading into repeated reading with modeling, and repeated reading without modeling. In addition, Morgan et al. (2012) classified reading interventions into ①keywords, previewing, listening, and repeated reading, ②goal setting with or without reinforcement, ③reinforcement contingent on student responding, ④word-level or phonological, and ⑤peer tutoring. Unlike the studies mentioned above, Swanson and Sachse-Lee (2000) conducted a meta-analysis of single subject studies on interventions for all academic areas and assorted the intervention types into four categories: direct instruction (DI), strategy instruction (SI), combined instruction (DI+SI), and both non-direct and non- strategy instruction.

This study applied the classification criteria used by Swanson and Sachse-Lee (2000). The reason why the criteria was selected is that since this meta-analysis contains a relatively small number of articles (N=18) and participants (N=55), it was difficult to employ many categories to classify. In addition, because the studies include various kinds of intervention such as instruction with video contents, newspapers, or digital textbooks, their classification method on diverse subjects seemed more appropriate. In addition, it was easy to categorize the intervention types since they suggested a checklist to discriminate them as Table Ⅲ–1.

Meanwhile, in the classification of intervention types, if the type is revealed evidently in title or content, the study was readily categorized into the type. However, when the intervention type is vague, the checklist was used to ensure accurate classification.

Table Ⅲ-1. Checklist for Identification of Intervention Type

Direct Instruction(DI)	Strategy Instruction(SI)
When a study includes at least four of the components below	When a study includes at least three of the components below
① classifying a task into small steps ② probing ③ repetition of feedback ④ presenting a pictorial or chart ⑤ admitting independent practice and individually paced intervention ⑥ resolve the intervention down into simpler phases ⑦ small group intervention ⑧ modeling of skill or behavior by teacher ⑨ offering material set promptly ⑩ individual instruction ⑪ offering new materials by teacher	① detailed explanation ② verbal modeling by teacher (questioning or verification by teacher) ③ hints to use some strategy of procedure ④ prompts or multi-process interventions ⑤ communication between teacher and student ⑥ questions asked by the teacher ⑦ providing help by teacher only when necessary

Third, the implementation-related variable is for investigating how the effect can be differentiated depending on the conditions of implementation. Since most of the studies included in this meta-analysis were conducted by schoolteachers in

regular elementary school classrooms, there was little difference in providers and places of intervention. Meanwhile, Tran, Sanchez, Arellano, and Swanson (2011) found the intensity of intervention (the number of sessions) as a variable that was capable of changing the effects. According to the number of sessions, the research in this study was classified into two groups: the studies including above 20 sessions and the studies including below 20 sessions.

Lastly, the measurement-related variable is to examine if there is a difference relying on the types of measurement. Scammacca et al. (2007) found that the performance score tended to be more highly evaluated when using researcher-developed tests rather than standardized tests. From this point of view, this study examined the influence of test types on test results.

4. Data Analysis

As mentioned above, a meta-analysis was conducted using the IRD index. Therefore, the effect sizes and CIs of each participant were yielded. Since the overall explanation and calculation method of the IRD index were already presented, they will not be covered in this section.

Meanwhile, IRD and its CI can be easily calculated using a certain website (www.phsim.man.ac.uk/risk/) or computer software such as NCSS, SPSS, or WinPepi. In this study, NCSS 9 was used. This program automatically provides weighted IRD values, according to the number of data. Therefore, the IRD values included in this study are weighted effect sizes. Parker et al. (2009) contends that

appropriate CI for most clinical decision-making is 85% or 90%, while 90% or 95% CI is preferred for publishing. However, Ganz et al. (2012) conducted a meta-analysis with 84% CI, demonstrating that 84% CI is liberal enough to allow decision-making in a clinical setting if the decisions are not high-stakes. More importantly, comparing two 84% CI corresponds to a statistical inference testing with p=0.05. In this study, according to the argument of Ganz et al. (2012), meta-analysis was performed with 84% CI. Subsequently, comparisons between subgroups discriminated by each variable were conducted. To contrast the subgroups, the mean and CI of each subgroup were compared with visual analysis. The Mann-Whitney test and the Kruskal-Wallis test were used to achieve a more accurate comparison of the subgroups with the SPSS 19.0 program.

To maintain the accuracy and objectivity in categorizing the interventions and calculating the effect sizes, two master's students, specializing in Special Education, participated in the data coding process and analysis. Firstly, they learned about the calculation method of the IRD. Subsequently, 18 studies were distributed to each student. Each student analyzed nine studies according to coding form. The inter-rater reliability is calculated as below:

$$\text{Inter-rater reliability} = \frac{N_1}{N_1 + N_2}$$

N_1=the number of cases agreed by inter-raters

N_2=the number of cases disagreed by inter-raters

The average inter-rater reliability was 92%. The discordant data between

raters was found to come from the classification of intervention types and the visual analysis of progress graphs in the single subject studies. Therefore, the analysts discussed the cause of the different results and eventually reached an agreement. As a result of this, 100% Inter-rater reliability was produced.

Ⅳ. RESULTS

1. Descriptive Analysis

Eighteen single subject studies were selected and 55 effect sizes were included in the studies. As Table Ⅳ-1 reveals, 72.2% of the studies were master´s theses and 27.8% were published articles.

Table Ⅳ-1. Publication Type

		N	%
Publication type	Thesis	13	72.2%
	Published Article	5	27.8%
	Total	18	100

In Table Ⅳ-2, although the single subject studies on reading fluency interventions are not great in number, they have been continuously published every year from 2004.

Table Ⅳ-2. State of Publication by Year

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
N	1	1	4	2	1	4	1	1	2	1	18
%	5.6	5.6	22.2	11.2	5.6	22.2	5.6	5.6	11.1	5.6	100

The characteristics of students as participants are shown in Table Ⅳ–3. All of the students included in this meta-analysis were elementary students, comprised of 1–2 graders of 25.5%, 3–4 graders of 43.6%, and 5–6 graders of 30.9%. In addition, boys numbered 67.2%, while girls numbered 32.8%. They were identified as students with reading difficulties based on the discrepancy standard model.

Table Ⅳ–3. General Features of the Participants

		N	%	Total
Grade	Lower(1–2)	14	25.5	55(100)
	Middle(3–4)	24	43.6	
	Higher(5–6)	17	30.9	
Gender	Male	37	67.2	55(100)
	Female	18	32.8	

Lastly, the quality of the studies was evaluated by investigating intervention fidelity, inter-rater reliability, social validity, and maintenance and generalization of each study. The results are shown below in Table Ⅳ–4.

Table Ⅳ–4. Features Related to Quality of Research

		N	%	Total
Intervention fidelity	Yes	5	27.8	18(100)
	No	13	72.2	
Inter-rater reliability	Yes	4	22.2	18(100)
	No	14	77.8	

Social validity	Yes	2	11.1	18(100)
	No	16	88.9	
Maintenance	Yes	16	88.9	18(100)
	No	2	11.1	
Generalization	Yes	2	11.1	18(100)
	No	16	88.9	

Lastly, Table Ⅳ–5 shows an overall description of the studies. An analysis will be conducted with the aforementioned variables.

Table Ⅳ-5. Overall Description of Studies

	Author	Instruction	Grade		Intervention	Implementation (sessions)	Measurement	Weighted Robust IRD	CI [84%]	
			M	F						
1	Kwon (2005)	Appreciation of audio-visual story	3rd	-	SI	20	Unstandardized (C-IRC)	0.95	0.88	1.00
			3rd	-				0.79	0.62	0.96
			-	3rd				0.83	0.65	1.00
2	Ki (2006)	Partner reading strategy	6th	-	SI	21	Standardized (BASA)	0.81	0.50	1.00
			-	6th				0.85	0.62	1.00
			-	6th				0.81	0.50	1.00
			5th	-				0.85	0.62	1.00
3	Kim, Song, & Byun (2009)	Rapid automated naming	5th	-	DI	21	Standardized (BASA)	0.85	0.62	1.00
			4th	-				0.62	0.23	1.00
			5th	-				0.62	0.23	1.00
4	Kim (2009)	Balanced reading instruction	4th	-	DI+SI	13	Unstandardized (C-IRC)	0.79	0.48	1.00
			-	5th				0.86	0.66	1.00
			4th	-				0.72	0.45	1.00

5	Kim, Lee, and Kim (2012)	Direct instruction	1st	-	DI	16	Standardized (BASA)	0.85	0.61	1.00
			1st	-				0.90	0.75	1.00
			-	1st				0.93	0.83	1.00
6	Kim, Choi,, and Chang (2006)	Research-based Reading intervention	5th	-	DI+SI	20	Unstandardized (researcher-developed)	0.43	0.01	0.84
			-	4th				0.29	0.01	0.59
			4th					0.23	0.05	0.52
7	No (2009)	Direct instruction	2nd	-	DI	18	Standardized (BASA)	0.85	0.61	1.00
			2nd	-				0.90	0.76	1.00
			2nd	-				0.92	0.81	1.00
8	Park (2012)	Newspaper in education	-	6th	SI	11	Unstandardized (researcher-developed)	0.89	0.74	1.00
9	Park (2010)	Visual contents Intervention	2nd	-	SI	18	Unstandardized (C-IRC)	0.61	0.22	1.00
			2nd	-				0.61	0.22	1.00
			-	3rd				0.42	0.00	0.83
10	Park (2007)	Repeated reading program	4th	-	DI	20	Standardized (BASA)	0.85	0.61	1.00
			-	4th				0.88	0.68	1.00
			-	3rd				0.89	0.73	1.00
11	Yang (2008)	Multi-component intervention	4th	-	DI+SI	14	Standardized (BASA)	0.84	0.60	1.00
			4th	-				0.84	0.60	1.00
			4th	-				0.46	0.12	0.79
12	Oh (2006)	Category-based vocabulary teaching	4th	-	DI	11	Standardized (BASA)	0.58	0.17	0.98
			4th	-		9		0.46	0.08	0.84
			3rd	-		8		0.84	0.61	1.00
13	Lee (2009)	Repeated reading and question strategy	-	3rd	DI+SI	21	Unstandardized (researcher-developed)	0.85	0.62	1.00
			-	2nd		13		0.86	0.66	1.00
			1st	-		20		0.89	0.73	1.00
14	Lee (2011)	Scaffolding strategy	-	5th	SI	30	Standardized (BASA)	0.88	0.69	1.00
			5th	-				0.90	0.74	1.00
			5th	-				0.88	0.69	1.00

15	Chang (2006)	Multi-component intervention	-	4th	DI+SI	20	Unstandardized (researcher-developed)	0.62	0.23	1.00
			-	4th				0.70	0.39	1.00
			4th	-				0.63	0.33	0.92
16	Jeong (2007)	Sentence pause reading strategy	-	5th	SI	20	Unstandardized (researcher-developed)	0.85	0.61	1.00
			-	4th				0.88	0.68	1.00
			4th	-				0.89	0.73	1.00
17	Joo and Shin (2013)	Balanced literacy instruction	1st	-	DI+SI	15	Unstandardized (researcher-developed)	0.68	0.37	1.00
			-	1st		15		0.89	0.72	1.00
			1st	-		20		0.89	0.73	1.00
			1st	-		20		0.78	0.56	1.00
18	Hur, Jeong (2004)	Story retelling strategy	5th	-	SI	20	Standardized (BASA)	0.40	0.04	0.76
			5th	-		18		0.89	0.72	1.00
			6th	-		16		0.81	0.63	1.00
			5th	-		14		0.71	0.48	0.93
							Mean	0.85	0.82	0.88

2. Results of Analysis for Variables

As stated above, meta-analysis was conducted using the IRD index. This was done in accordance with student-related, intervention-related, and intervention-related and measurement variables. To compare the subgroups, effect size and CI were examined. To achieve a more specific comparison, the Mann-Whitney test and the Kruskal-Wallis test were implemented, with 95% CI using SPSS 19.0. Above all, overall effect sizes and CIs measured by the IRD index were presented as a forest plot, Figure Ⅳ–1. The mean effect size of all studies is 0.85, representing a high effect. The mean of the CIs is 0.82–0.88.

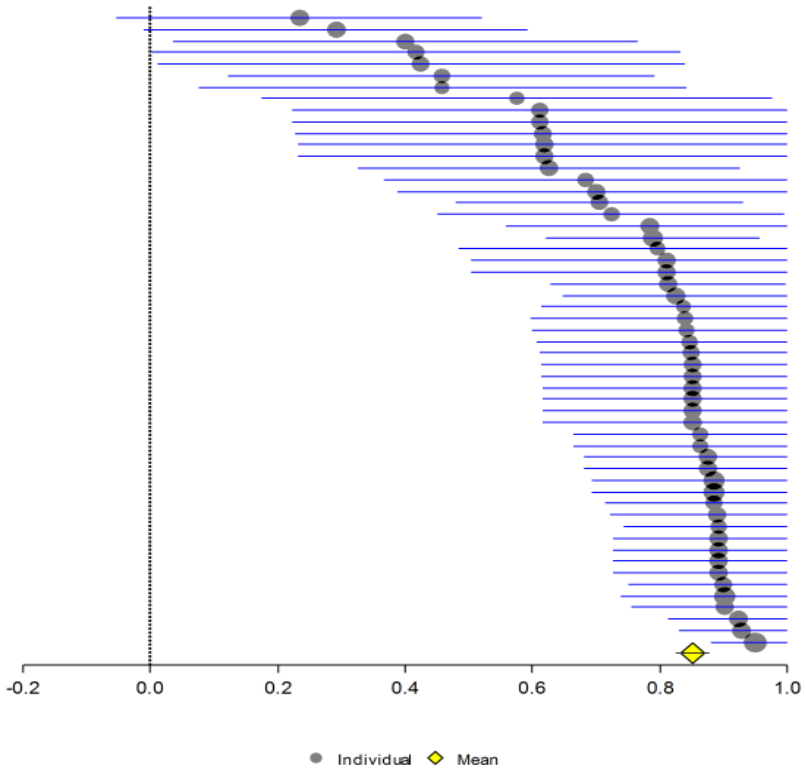

Figure Ⅳ-1. Overall Effect Sizes and CIs

1) Result of Analysis for Student-related Variable

Figure Ⅳ–2 shows the results of the analysis according to grades. First, the mean effect size of 1–2 graders was 0.89 and CI was 0.84-0.93. Second, the mean effect size of 3–4 graders were 0.83 and CI was 0.79-0.87. Lastly, the mean effect size of 5–6 graders were 0.84 and CI was 078–0.89. In conclusion, the reading fluency intervention was highly effective, regardless of grades, and there was little difference between grades since the CI was mostly overlapping.

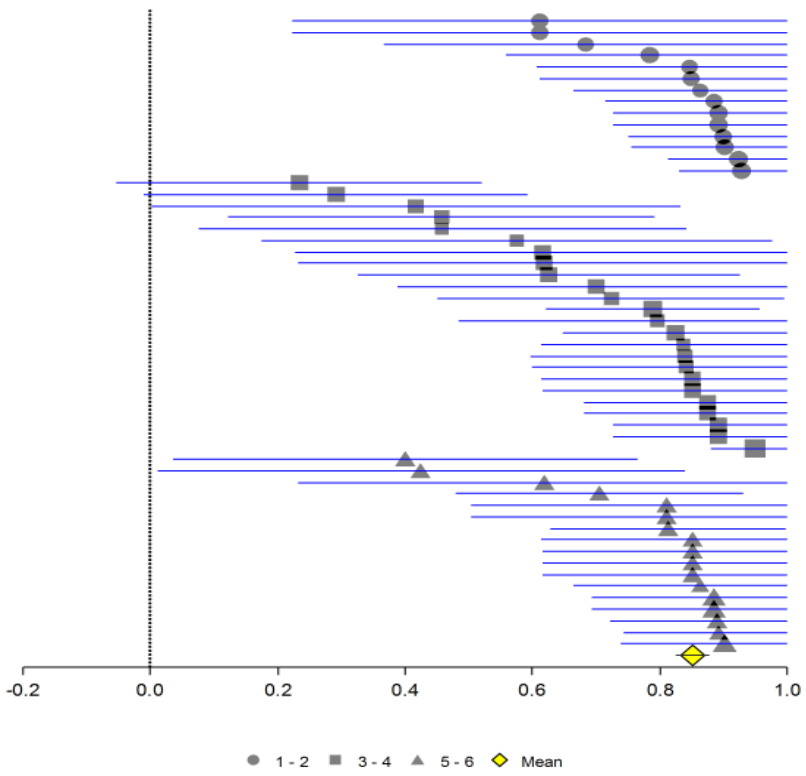

Figure Ⅳ-2. Effect Sizes and CIs (Grade)

In sequence, the Kruskal-Wallis test (95% CI) was implemented to identify any differences between the groups. AS Table Ⅳ–6 shows, there was no significant difference (p-value=0.064).

Table Ⅳ–6. Result of Kruskal-Wallis Test (Grade)

Ranks

	Grade	N	Mean Rank
IRD	1–2	14	34.50
	3–4	24	22.90
	5–6	17	29.85
	Total	55	

Test Statistics

N	IRD
Chi-Square	5.483
df	2
Asymp. Sig	.064

In addition, an analysis of gender variables was conducted. The results of this are shown in Figure Ⅳ–3. According to the result, the effect size and CI of male and female students was, respectively, 0.86[0.82-0.88] and 0.85[0.81-0.90]. This shows that the effects of reading fluency interventions are commonly high in both male and female students.

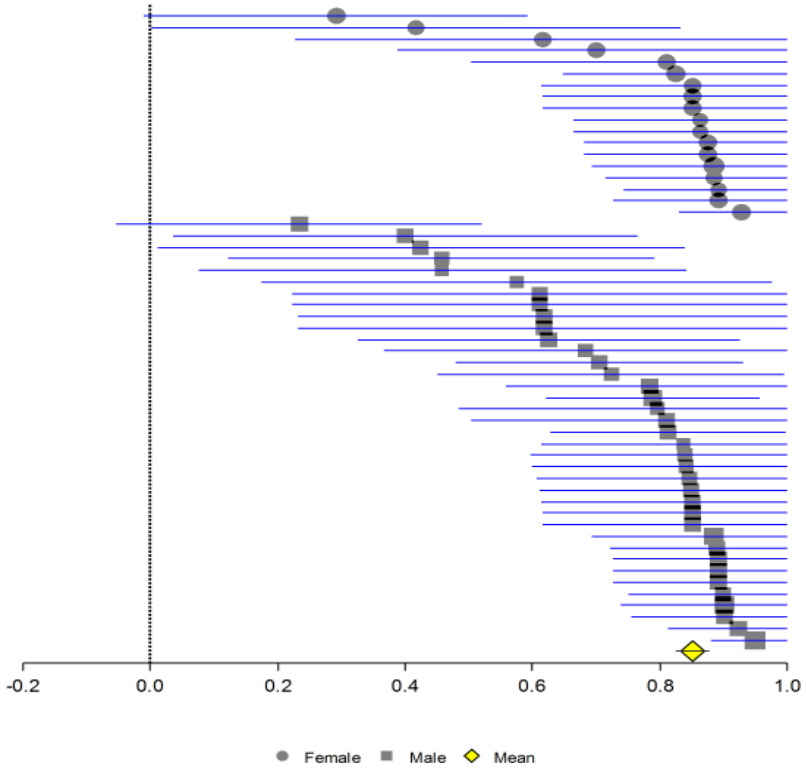

Figure Ⅳ–3. Effect Sizes and CIs (Gender)

To examine if there is significant difference between the two groups, the Mann-Whitney test was performed. According to the results shown in Table Ⅳ–7,

the difference between genders was not significant (p-value=0.139).

Table Ⅳ-7. Result of Mann-Whitney Test (Gender)

Ranks

	Gender	N	Mean Rank	Sum of Ranks
IRD	Male	37	25.88	957.50
	Female	18	32.36	582.50
	Total	55		

Test Statistics

N	IRD
Mann-Whitney U	254.5
Wilcoxon W	957.5
Z	-1.479
Asymp. Sig. (2-tailed)	.139

2) Result of Analysis for Intervention-related Variable

As aforementioned, the intervention types were categorized into four domains for an analysis of the intervention-related variables. However, since there was no study that included SI or DI, the interventions were categorized into three domains: DI, SI, and DI+SI. Figure Ⅳ–4 shows the results of an analysis of intervention-related variables.

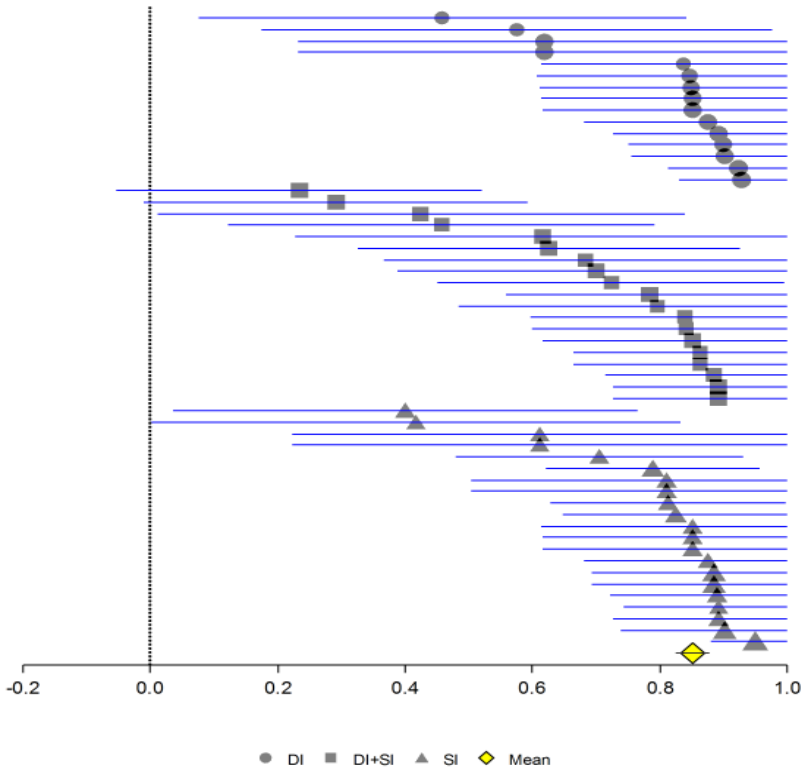

Figure Ⅳ-4. Effect Sizes and CIs (Intervention-1)

As a result, mean effect size and CI of DI, SI, and DI+SI were, respectively, 0.88[0.83-0.93], 0.87[0.83-0.91], and 0.77[0.71-0.83]. Therefore, the effect of each intervention type was very high. In addition, according to the Kruskal-Wallis test, in Table Ⅳ-8, there was no significant difference between the intervention types (p=0.227).

Table Ⅳ–8. Result of Kruskal-Wallis Test (Intervention-1)

Ranks

	Intervention-1	N	Mean Rank
IRD	DI	15	33.07
	DI+SI	19	24.00
	SI	21	28.00
	Total	55	

Test Statistics

N	IRD
Chi-Square	2.963
df	2
Asymp. Sig	.227

Even though there were no significant differences between intervention types by the Kruskal-Wallis test, the effect size of DI+SI was found to be relatively lower than other instructions. Hence, a follow-up analysis was carried out to determine whether there was a difference in applying mainly DI or SI, and applying DI+SI. Figure Ⅳ–6 shows the results.

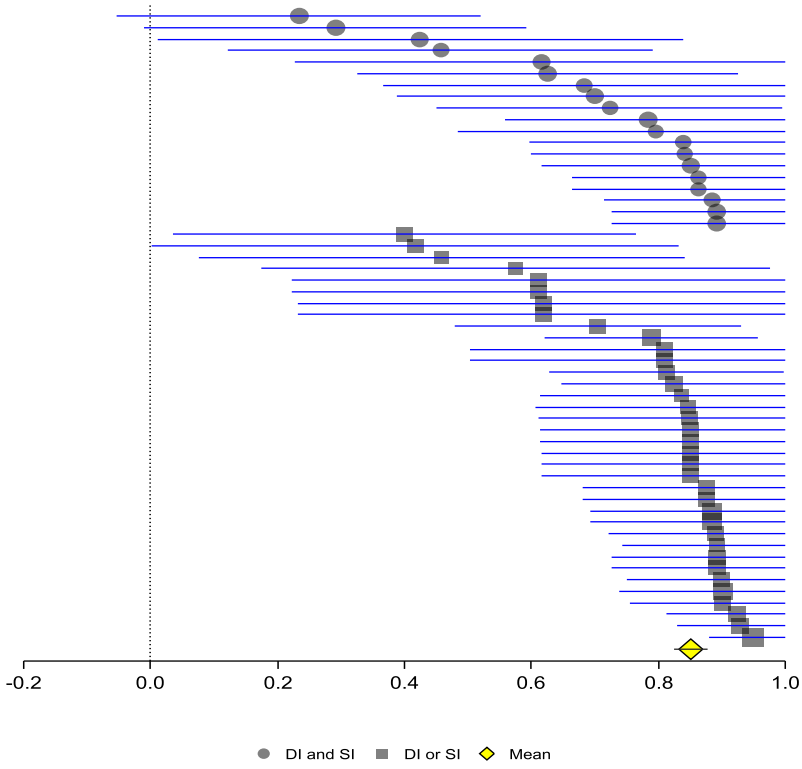

Figure Ⅳ–5. Effect Sizes and CIs (Intervention-2)

As a result, the effect sizes and CIs of interventions applying mainly DI or SI, and interventions employing DI+SI was, respectively, 0.87[0.84-0.90] and

0.77[0.72-0.83]. Since there were remarkable differences between the two intervention types and the CI was not overlapping, we can conclude that focusing on DI or SI is more effective than applying DI+SI. However, as Table Ⅳ–9 shows, the result of the Mann-Whitney test indicate that there were no significant differences between the two groups (p=0.158).

Table Ⅳ-9. Result of Mann-Whitney Test (Intervention-2)

Ranks

	Intervention-2	N	Mean Rank	Sum of Ranks
IRD	DI and SI	19	24.00	456.00
	DI or SI	36	30.11	1084.00
	Total	55		

Test Statistics

N	IRD
Mann-Whitney U	266.0
Wilcoxon W	456.0
Z	-1.413
Asymp. Sig. (2-tailed)	.158

In addition, an analysis was carried out to examine whether the effect changes according to the instructional objectives of each study. As Figure Ⅳ–5 shows, the effect size and CI of studies dealing with reading fluency and lower level reading skills such as word-level instruction, shows 0.85 and 0.82-0.88. On the other hand, instruction, including reading fluency and higher-level skills such as reading comprehension, shows an effect size of 0.84 and CI of 0.81–0.87. In brief, the effect was extremely high, regardless of the instructional objectives.

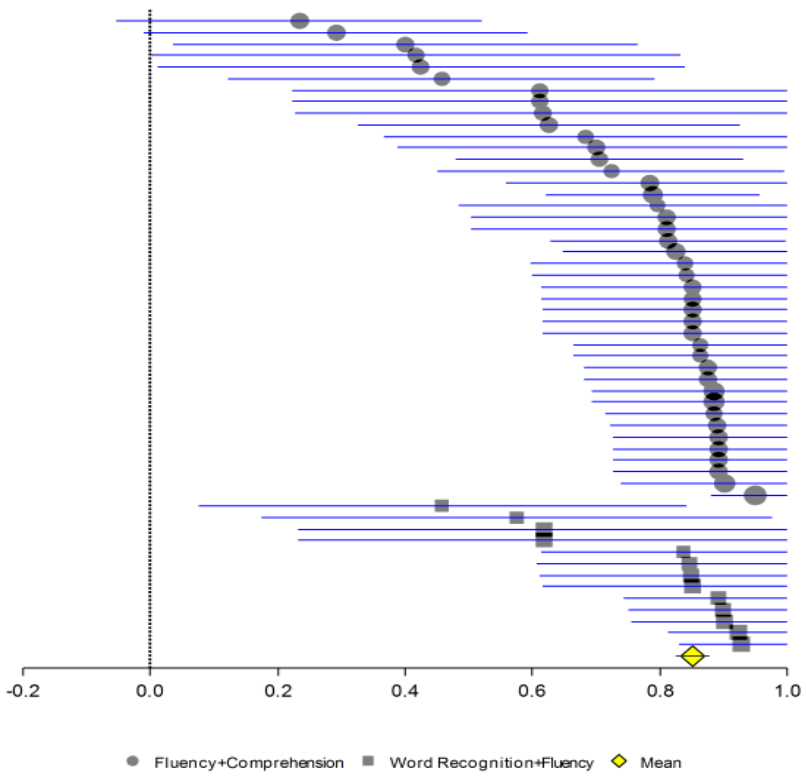

Figure Ⅳ–6. Effect Sizes and CIs (Objective)

In addition, as Table Ⅳ–10 shows, the results of the Mann-Whitney test indicate that there is no significant difference between the two groups (p-value=0.103).

Table Ⅳ–10. Result of Mann-Whitney Test (Objective)

Ranks

	Objective	N	Mean Rank	Sum of Ranks
IRD	Fluency+Comprehension	42	27.24	1144.00
	Word+Fluency	13	30.46	396.00
	Total	55		

Test Statistics

N	IRD
Mann-Whitney U	285.0
Wilcoxon W	636.0
Z	-1.629
Asymp. Sig. (2-tailed)	.103

3) Result of Analysis for Implementation-related Variable

Figure Ⅳ–7 shows the results of an analysis of implementation-related variables as the number of sessions. As a result, when intervention is performed in below 20 sessions, the effect size and CI was 0.85 and 0.81–0.88. Similarly, interventions implemented in above 20 sessions showed an effect size of 0.85 and CI of 0.82–0.89. Therefore, the effect size was found to be high, regardless of the number of sessions.

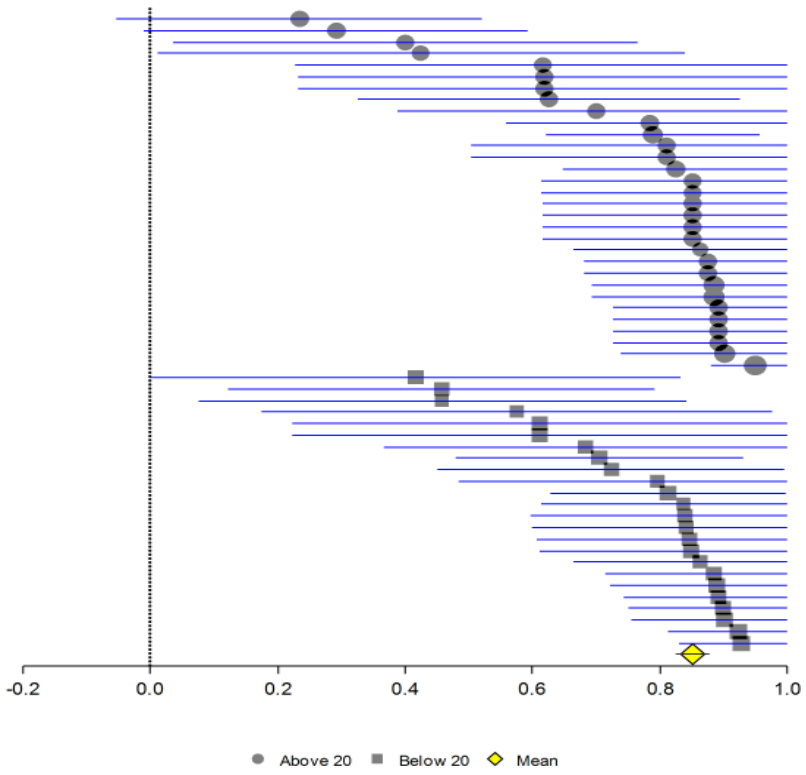

Figure Ⅳ–7. Effect Sizes and CIs (Session)

The results of the Mann-Whitney test did not indicate a significant difference between the groups (p-value-0.81), as Figure Ⅳ–11 shows.

Table Ⅳ–11. Result of Mann-Whitney Test (Session)

Ranks

	Session	N	Mean Rank	Sum of Ranks
IRD	Above 20	31	29.16	904.00
	Below 20	24	26.50	636.00
	Total	55		

Test Statistics

N	IRD
Mann-Whitney U	336.0
Wilcoxon W	636.0
Z	-.642
Asymp. Sig. (2-tailed)	.805

4) Result of Analysis for Measurement-related Variable

In the analysis for measurement-related variables, studies are divided into two groups: studies applying the standardized test and studies applying the unstandardized test. The results of the analysis are revealed in Figure Ⅳ–8.

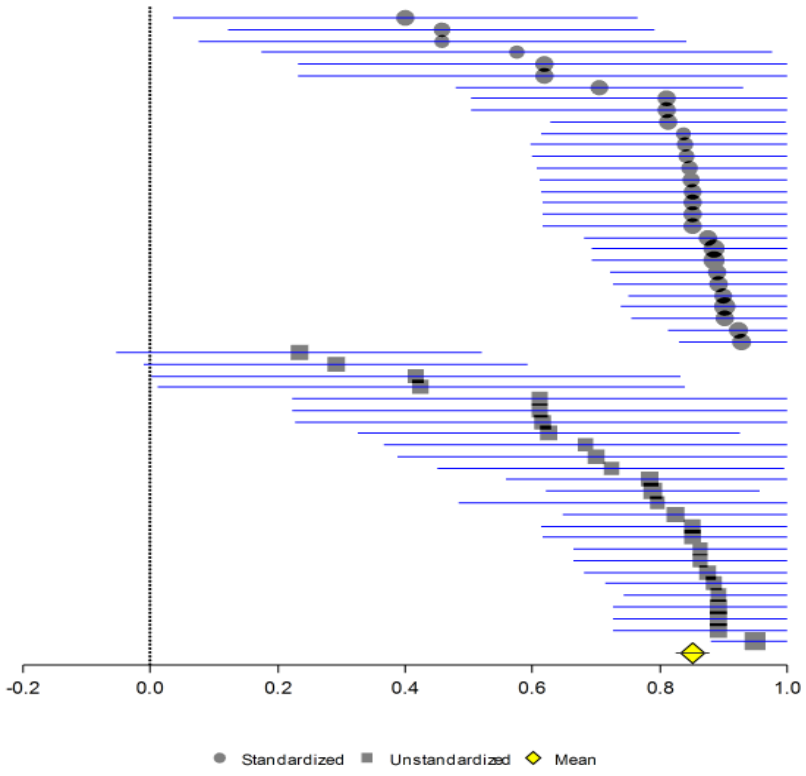

Figure Ⅳ–8. Effect Sizes and CIs (Test)

As a result, those studies using the standardized test showed an effect size of 0.86 and CI of 0.82–0.90. Similarly, those studies that used an unstandardized test

indicated an effect size of 0.84 and CI of 0.80–0.88. The overall effect size was very high, regardless of the type of test. The results of the Mann-Whitney test also showed that there was no significant difference between the groups, as Table Ⅳ–12 demonstrates (p=0.10).

Table Ⅳ–12. Result of Mann-Whitney Test (Test)

Ranks

	Test	N	Mean Rank	Sum of Ranks
IRD	Standardized	29	31.17	904.00
	Unstandardized	26	24.46	636.00
	Total	55		

Test Statistics

N	IRD
Mann-Whitney U	285.0
Wilcoxon W	636.0
Z	-1.629
Asymp. Sig.(2-tailed)	.103

Ⅴ. CONCLUSION

1. Research Findings and General Discussions

In this research, 18 reading fluency intervention studies and 55 effect sizes for students with reading difficulties were meta-analyzed using the IRD index. From now on, the overall results of the analysis and results of the analysis according to the variables will be presented. A discussion of the results will follow. The matters to be discussed are the results of the analysis below.

First, the studies included in this meta-analysis were comprised of 13 master's theses and five published journal articles. Therefore, journal papers made up only around 28% of the studies. According to the annual status of publication, 18 papers on reading fluency interventions were published (on average) per year from 2004. As mentioned above, the single subject studies are particularly advantageous and make it possible to conduct a visual analysis as time goes by, for small group instruction. However, since the studies on reading fluency instruction have not yet been effectively implemented, the researchers and practitioners should pay more attention to reading fluency instruction in order to contribute to the establishment of evidence-based intervention.

Second, 3–4 graders took up 43% of all the participants, while 1–2 graders and 5–6 graders, respectively, made up 26% and 31%. This shows that a lot of research

on reading fluency interventions is performed based on Chall's (1996) reading development model. According to this model, reading fluency is mainly enhanced in the 3–4 grades.

As a result of research quality, evaluated based on intervention fidelity, inter-rater reliability, social validity, and maintenance and generalization, the studies covering intervention fidelity, inter-rater reliability, social validity, and generalization took up only 27.8%, 22.2%, 11.1%, and 11.1%, respectively. Therefore, the studies should be implemented with high quality in the future. Since a quality indicator for single-subject research was already developed by Horner et al. (2005), using the indicator will make it possible to maintain the research quality.

So far, a discussion of the overall features of this research has been carried out. Subsequently, a discussion of the results of the analysis of each variable will develop.

First, the overall mean effect size of intervention was 0.85, achieved using the robust IRD index. If the IRD is greater than 0.75, the effect is regarded as very high and the reading fluency intervention so far, can be considered very effective. In addition, because the CI was relatively narrow, at 0.82-0.88, the result was reliable.

Second, in the analysis for student-related variables, very high effects were shown in all students, regardless of their grades. To be specific, the CIs of the groups were similar and the results of Kruskal-Wallis test did not indicate significant difference between groups. This result implies that if appropriate interventions are provided, the students' reading fluency can be enhanced, regardless of grade. In relation to the effects according to gender, both male and

female participants indicated very high effects because of the intervention. The result of the Mann-Whitney test also could not find significant differences between genders. Recently, McIntosh, et al. (2013) studied gender differences in reading skills. Using longitudinal research, it was revealed that there was only a slight difference in gender. In light of this, differentiated instructions for each gender may not be needed. Since this study did not find important differences in the context of gender in reading fluency, gender may not need to be considered much in reading fluency intervention.

Third, in the analysis for intervention-related variables, SI was highly effective, as was DI. So far, training or drilling (such as repeated reading) has been mainly emphasized as an intervention method for reading fluency. Such methods have been largely teacher-centered direct instruction. However, the results of this study show that SI can also be effective in achieving reading fluency for those students with reading disabilities. In particular, Wexler et al. (2008) found that repeated reading may make secondary students bored and may not be effective in improving reading fluency. In addition, Morgan et al. (2012), as a result of their meta-analysis on reading fluency intervention, found goal setting or reinforcement to be much more effective in enhancing reading fluency than training methods such as word recognition. Therefore, researchers need to apply a variety of strategies to reading fluency interventions and repeated reading training. They should also examine the effects.

For a more specific analysis of intervention types, the effects of the interventions were examined by mainly applying the DI or SI and the DI+SI. As a

result, the former showed an effect size of 0.87 and CI of 0.84–0.90, while the latter revealed an effect size of 0.77 and CI of 0.72–0.83. Since the CIs did not overlap, we can see that applying one instruction type is more effective in enhancing reading fluency. Even though high effects were yielded in all instruction types on reading fluency interventions, it is worthy to note that applying more than one instruction type to intervention is less effective. Meanwhile, the reason why the interventions were less effectual might be due to the fact that most of the interventions were multi-component interventions, which included overall reading skills and various reading strategies. Wexler et al. (2008) pointed out that if the reading fluency intervention covers too wide a range of skills and strategies, the students with reading difficulties might suffer from compounded difficulties under more academic pressure. Therefore, the results of this study suggest that focusing on one academic objective and instruction type may be more effective for those students with reading difficulties.

Meanwhile, in the analysis for academic objective as intervention-related variable, the effect size and CI was, respectively, 0.84 and 0.81–0.87. In the context of reading fluency with lower reading skill (word recognition) they were, respectively, 0.85 and 0.82-0.88, when with higher reading skill (reading comprehension). Consequently, the reading fluency intervention was highly effective, regardless of combining reading skills. It is important to note that the older the students became, the weaker the correlation between reading fluency and comprehension (Paris & Stahl, 2005) became. When importance is placed on the function of background knowledge and working memory and when a reading

fluency intervention is combined with reading comprehension, noticeable benefits can be seen in higher graders (Wexler et al., 2008).

Fourth, the results of the analysis for the implement-related variable show that effect size was very high and that there was no significant difference between groups below 20 sessions and above 20 sessions. This means that the critical component to determine the success of intervention is not the number of sessions, as intensity of intervention, but other factors such as intervention type.

Lastly, in the analysis of the measurement-related variable, those studies using the standardized test showed an effect size of 0.86 and CI of 0.82–0.90, while those using an unstandardized test showed, respectively, 0.84 and 0.80–0.88. Scammacca et al. (2007) found that effect size of studies using the standardized test was generally less than those applying the unstandardized test. However, in this study there was no significant difference in the effect size between the standardized test and the unstandardized test. In particular, all the studies included in this meta-analysis used the Basic Academic Skills Assessment-Reading (BASA-Reading) test as a standardized test. These studies showed stable and reliable outcome data on students' performance. Above all, since BASA is the sole standardized test in examining reading fluency based on the principles of CBM, the validity and reliability has been proven in many intervention studies. BASA needs to be applied more widely for the establishment of evidence-based practice for reading fluency instruction, rather than other unstandardized tests.

2. Limitations

The limitations of this study can be considered from the perspectives of view of research content and research method. In terms of the content, the limitations are as follows:

The participants of the studies were characterized variously, with labels such as "reading disabilities," "reading difficulties," "learning disabilities," or "low-achiever" being used. However, according to the profile of participants in each study, the difference between them was not evident to discriminate. Since there was no choice but to include those studies for an analysis, without accurate classification, it was difficult to suggest the features of intervention appropriate for the specific type of difficulties.

In the analysis of the intervention-related variable, instruction types were categorized into DI, SI, and DI+SI, according to the criteria suggested by Swanson and Sachse-Lee (2000). However, some studies were difficult to distinguish because they contained instruction types that were either too complex or lacking in the relevant information necessary to make an informed judgment. The analyst strived to minimize errors and accurately classify the instruction types, using a checklist provided by Swanson and Sachse-Lee (2000). The analyst also searched for further information on instruction, based on the overall context of the study.

The limitations, in terms of the research method, are as below:

First, most of the studies included in this meta-analysis were master's theses. In principle, a variety of papers should be included in the meta-analysis to avoid

publication bias (Cooper, 2009). However, if this were done, low-quality studies could potentially infiltrate the analysis, leading to the "garbage in, garbage out" problem (Borenstein et al., 2009). Therefore, much attention should be paid to interpreting the result of this study.

Second, the number of studies included in this meta-analysis was relatively small, with 18 studies and 55 effect sizes used. In principle, although it is possible to conduct a meta-analysis if the number of studies are above two (Cooper, 2009), the fewer the studies included in the meta-analysis, the less reliable the results. In addition, since the effect sizes produced in this analysis were not proved with multiple studies, the results of this meta-analysis are not enough to act as solid evidence for effective reading fluency intervention.

Lastly, the IRD index is more discriminative than the PND index, but it is still weak in its discrimination of high effect sizes such as PND (Parker et al., 2009). This study yielded very high effect sizes. Thus, the difference between subgroups according to the variables was not significant overall.

3. Implications for Research and Practice

The implications of this study can also be presented in terms of the research content and research method.

With regard to the content, this meta-analysis was conducted on the single subject studies on reading fluency interventions for those students with learning difficulties. Therefore, this study can provide implications on small groups or one-

to-one instruction groups, mainly using Tiers 2 and 3 of the RTI model. Meanwhile, studies on reading fluency interventions have been implemented only for elementary students so far in Korea, while in the U.S. the importance of reading fluency has been emerging in all school ages. Therefore, intervention methods for secondary students or adults have been developed (Wexler et al., 2008). Hence, in line with the U.S., the Korean participants should engage in more diverse reading fluency intervention methods.

In regards to the research method, the IRD index was applied to the field of learning disabilities for the first time in Korea. In the field of learning disabilities, a few meta-analyses were performed, but PND was the effect size index mainly used. In comparison with PND, the IRD index is more advantageous, providing better discriminative ability and provisions of CI as well as effect size (Parker et al, 2009). Therefore, the IRD was applied in this study and statistical analysis was implemented with the produced statistical figures. However, as stated above, high effects are not discriminated well with the IRD index. Accordingly, future research should use alternative effect size indices and analysis methods should be developed to achieve a more accurate analysis.

REFERENCES

Note: References denoted with asterisks (*) were included in this meta-analysis.

Allison, D. B., & Gorman, B. S. (1993). Calculating effect sizes for meta-analysis: The case of the single case. *Behaviour Research and Therapy, 31*(6), 621-631.

Armbruster, B., Lehr, F., & Osborn, J. (2001). *Put reading first*. Ann Arbor, MI: Center for the Improvement of Early Reading Achievement (CIERA).

Bender, W. N. (2012). *Differentiating Instruction for Students With Learning Disabilities: New Best Practices for General and Special Educators*. SAGE.

Beretvas, S. N., & Chung, H.(2008) A review of meta-analyses of single-subject experimental designs: Methodological issues and practice, *Evidence-Based Communication Assessment and Intervention, 2*(3), 129-141.

Borenstein, M., Hedges, L. V., Higgins, J. P., & Rothstein, H. R. (2011). *Introduction to meta-analysis*. Wiley. com.

Bowers, P. G., & Kennedy, A. (1993). Effects of naming speed differences on fluency of reading after practice. *Annals of the New York Academy of sciences, 682*(1), 318-320.

Brown-Chidsey, R., & Steege, M. W. (2010). *Response to intervention: Principles and strategies for effective practice*. (2nd ed.). NY: The Guilford Press.

Chall, J. S. (1996). *Stages of Reading Development*. Harcourt Brace College Publishers.

*Chang, D. (2006). *The effects of a multicomponent reading intervention on the reading fluency and comprehension of students with reading disabilities* (Master's thesis). Graduate School of Education, Yosu National University, Korea.

Chard, D. J., Vaughn, S., & Tyler, B. J. (2002). A synthesis of research on effective interventions for building reading fluency with elementary students with learning disabilities, The *Journal of Learning Disabilities*, *35(5)*, 386–406.

Cooper, H. (2009). *Research synthesis and meta-analysis: A step-by-step approach (Vol. 2)*. Sage.

Davis, G. N., Lindo, E. L., & Compton, D. L. (2007). Children at Risk for Reading Failure. *Teaching Exceptional Children, 39*(5), 32-37.

Denckla, M. B., & Rudel, R. (1974). Rapid "automatized" naming of pictured objects, colors, letters and numbers by normal children. *Cortex, 10*(2), 186-202.

Elbaum, B., & Vaughn, S. (2001). School-based interventions to enhance the self-concept of students with learning disabilities: A meta-analysis. T*he Elementary School Journal,* 303-329.

Fuchs, D., Mock, D., Morgan, P. L., & Young, C. L. (2003). Responsiveness-to-intervention: Definition, evidence, and implications for the learning disabilities construct. *Learning Disabilities Research & Practice, 18*(3), 157-171.

Fuchs, L. S., Fuchs, D., Hosp, M. K., & Jenkins, J. R. (2001). Oral reading fluency as an indicator of reading competence: A theoretical, empirical, and historical analysis. Scientific studies of reading, 5(3), 239-256.

Fuchs, L. S., Fuchs, D., & Speece, D. L. (2002). Treatment validity as a unifying construct for identifying learning disabilities, *Learning Disability Quarterly, 25*(1), 33-45.

Ganz, J. B., Earles-Vollrath, T. L., Heath, A. K., Parker, R. I., Rispoli, M. J., & Duran, J. B. (2012). A meta-analysis of single case research studies on aided augmentative and alternative communication systems with individuals with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 42*(1), 60-74.

Hallahan, D. P., Lloyd, J. W., Kauffman, J. M., Weiss, M. P., & Martinez, E. A. (2005). *Learning Disabilities: Foundations, Characteristics, and Effective Teaching* (3rd ed.). Pearson Education.

Horner, R, H., Carr, E. G., Halle, J., Mcgee, G., Odom, S., & Wolery, M. (2005). The use of single-subject research to identify evidence-based practice in special education. *Exceptional Children, 71*(2), 165-179.

Howell, K. W., & Lorson-Howell, K. A. (1990). What's the Hurry?: Fluency in the Classroom. *Teaching Exceptional Children, 22*(3), 20-23.

*Hur, S., & Jeong, J. (2004). Effects of story retelling strategy on the reading comprehension and fluency of students with learning disabilities. *The Journal of Special Education: Theory and Practice, 5*(1), 369-387.

Jeon, B., & Kweon, H. (2010). An analytic review of the research tendency on methods and results of reading instruction for Korean children with reading disabilities, *Asian Journal of Education, 11*(2), 265-296.

*Jeong, S. (2007). *The effects of the meaning-centered sentence pause reading*

strategy on the reading fluency and comprehension of students with reading disabilities (Master's thesis). Graduate School of Education, Chonnam National University, Korea.

*Joo, J., & Shin, H. (2013). Effects of balanced literady instruction based on the mother culture in reading ability of multicultural students: For children of Filipino Women, *Journal of Special Education, 20*(1), 67-95.

Kavale, K. A. (2001) Meta-Analysis: A Primer, *Exceptionality, 9*(4), 177-183.

*Ki, H. (2006). *The effects of partner reading strategy on reading fluency and comprehension of students with learning disabilities* (Master's thesis). Graduate School of Education, Yosu University, Korea.

Kim, A. (2006). Interventions for students with learning disabilities in Korea: A research synthesis. *The Journal of Special Education: Theory and Practice, 7*(2), 265-299.

*Kim, D. (2009). *Effect of balanced reading instruction on the reading skills of children with reading disabilities* (Master's thesis). Graduate School of Education, Daegu University, Korea.

Kim, D., Kou, E., Jeong, S., Lee, Y., Lee, K., Park, J., & Kim, I. (2009). Learning disabilities in Korea: A synthesis of researches from 1999 to 2008. *Asian Journal of Education, 10*(2), 283-347.

*Kim, G., Song, C., & Byun, C. (2009). Effects of the rapid automated naming training on naming speed and reading fluency for children with learning disabilities. *The Korea Journal of Learning Disabilities, 6*(2), 151-171.

*Kim, S., Lee, D., & Kim, S. (2012). The effects of a direct instruction Han-Geul

reading program on word reading and reading fluency of the multicultural students with reading difficulties. *The Journal of Special Education: Theory and Practice, 13*(4), 415-445.

Kim, T., Jeong, E., & Park, Y. (2011). A review of experimental studies on reading fluency. *The Journal of Special Education: Theory and Practice, 12*(3), 475-506.

*Kim, U., Choi, H., & Chang, D. (2006). The effects of research-based reading instruction on the reading fluency and reading comprehension of students with learning disabilities. *Journal of Special Education, 13*(2), 247-274.

Kirk, R. E. (1996). Practical significance: A concept whose time has come. *Educational and Psychological Measurement, 56*(5), 746-759.

*Kwon, K. (2005). *The effects of response-centered appreciation of audio-visual story on reading ability of children with reading disability* (Master's thesis). Graduate School of Special Education, Daegu University, Korea.

LaBerge, D., & Samuels, S. J. (1974). Toward a theory of automatic information processing in reading. *Cognitive Psychology, 6*, 293-323.

Lee, D., & Hwang, M. (2011). *Understanding of low-achievers and instructions*. Seoul: Kyoyookgwahaksa.

*Lee, H. (2009). *The effect of repeated reading and question strategy intervention on comprehension and fluency of elementary students with learning disabilities* (Master's thesis). Graduate School of Dankook University, Korea.

*Lee, H. (2011). *The effects of utilizing digital textbooks based on scaffolding strategies in class on reading ability of students with reading disabilities*

(Master's thesis). Graduate School of Daegu University, Korea.

Lee, I., & Kim, D. (2003). The Relationship between Reading Fluency and Reading Comprehension in Primary Grades. *The Korean Journal of Educational Psychology, 17*(4), 1-24.

Lee, S. (2012). A literature review on reading fluency. *The Phonetics and Speech Sciences, 4*(4), 129-138.

Lee, W. (2007). A review of naming speed and reading fluency intervention for children with learning disabilities. *Journal of Special Education & Rehabilitation Science, 46*(2), 35-57.

Lee, Y., & Son, S. (2010). Meta-analysis of reading intervention for evidence-based practice in RTI. *The Korea Journal of Learning Disabilities, 7*(2), 119-143.

Maggin, D. M., O'keeffee, B. V., & Johnson, A. H. (2011). A quantitative synthesis of methodology in the meta-analysis of single subject research for students with disabilities: 1985-2009. *Exceptionality, 19*, 109-135.

Mastropieri, M. A., Leinart, A., & Scruggs, T. E. (1999). Strategies to increase reading fluency. Intervention in school and clinic, 34(5), 278-283.

Mastropieri, M. A., & Scruggs, T. E. (1997). Best practices in promoting reading comprehension in students with learning disabilities 1976 to 1996. *Remedial and Special Education, 18*(4), 198-213.

McIntosh, K., Reinke, W. M., Kelm, J. L., & Sadler, C. A. (2013). Gender Differences in Reading Skill and Problem Behavior in Elementary School. *Journal of Positive Behavior Interventions, 15*(1), 51-60.

Mercer, C. D., & Mercer, A. R. (2005). *Teaching students with learning problems*.

Merrill Publishing Co.

Morgan, P. L., & Sideridis, G. D. (2006). Contrasting the Effectiveness of Fluency Interventions for Students with or At Risk for Learning Disabilities: A Multilevel Random Coefficient Modeling Meta-Analysis. *Learning Disabilities Research & Practice, 21*(4), 191-210.

Morgan, P. L., Sideridis, G., & Hua, Y.(2012). Initial and over-time effects of fluency interventions for students with or at risk for disabilities. *The Journal of Special Education*, *46(2)*, 94–116.

National Reading Panel (US), National Institute of Child Health, & Human Development (US) (2000). *Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction: Reports of the subgroups.* National Institute of Child Health and Human Development, National Institutes of Health.

Neuhaus, G. F., & Swank, P. R. (2002). Understanding the relations between RAN letter subtest components and word reading in first-grade students. *Journal of Learning Disabilities, 35*(2), 158-174.

*No, Y. (2009). *The effects of direct instruction on the reading ability of children with low achievement* (Master's thesis). Graduate School of Education, Gwangju National University of Education, Korea.

*Oh, H. (2007). *The effects of category-based vocabulary teaching on the reading abilities of children with reading underachievement* (Master's thesis). Graduate School of Education, Gwangju National University of Education, Korea.

Olive, M. L. & Smith, B. W., (2010). Effect size calculations and single subject designs. *Educational Psychology, 25*(2-3), 313-324.

Paris, S. G., & Stahl, S. A. (Eds.). (2005). Children's reading comprehension and assessment. Routledge.

*Park, S. (2010). *The effects of visual contents intervention on the reading ability of children with reading disabilities* (Master's thesis). Graduate School of Education, Inje University, Korea.

*Park, S. (2012). *The effects of newspaper in education (NIE) on the receptive vocabulary, reading fluency, and writing of student with learning disabilities* (Master's thesis). Graduate School of Education, Inje University, Korea.

*Park, Y. (2007). *The Effects of the repeated reading program on reading fluency and reading comprehension of students with reading disabilities* (Master's thesis). Graduate School of Education, Chonnam National University, Korea.

Parker, R. I., Vannest, K. J., & Brown, L. (2009). The improvement rate difference for single-case research. *Exceptional Children, 75*(2), 135-150.

Parker, R. I., Vannest, K. J., & Davis, J. L. (2011). Effect size in single-case research: A review of nine nonoverlap techniques. *Behavior Modification, 35*(4), 303-322.

Parsonson, B. S., & Baer, D. M. (1978). The analysis and presentation of graphic data. *Single subject research: Strategies for evaluating change,* 105-165.

Perfetti, C. A., Bell, L. C., & Delaney, S. M. (1988). Automatic (prelexical) phonetic activation in silent word reading: Evidence from backward masking. *Journal of Memory and Language, 27*(1), 59-70.

Rasinsky. T.,. Blachowicz, C., & Lems, K. (2012). *Fluency instruction: Research-based best practices.* NY: The Guilford Publication.

Ruddell, R. B. (2009). *How to teach reading to elementary and middle school students : practical ideas from highly effective teachers*. Boston : Pearson/Allyn & Bacon.

Samuels, S. J. & Farstrup, A. E. (2006). What research has to say about fluency instruction. DE: International Reading Association.

Scammacca, N., Roberts, G., Vaughn, S., Edmonds, M., Wexler, J., Reutebuch, C. K., & Torgesen, J. K. (2007). Interventions for Adolescent Struggling Readers: A Meta-Analysis with Implications for Practice. *Center on Instruction*.

Scruggs, T. E., & Mastropieri, M. (2001). How to summarize single-participant research: Ideas and applications. *Exceptionality, 9*(4), 227-244.

Seo, W., Seo, H., & Park, H. (2011). A literature review of single-subject design research for reading intervention for tudents with learning disabilities. *The Korea Journal of Learning Disabilities, 8*(3), 53-80.

Shadish, W. R., Rindskopf, D. M., & Hedges, L. V. (2008). The state of the science in the meta-analysis of single-case experimental designs. *Evidence-Based Communication Assessment and Intervention, 2*(3), 188-196.

Shin, I., & Park, E. (2011). Review of the meta-analysis research in special education and related field. *Korean Journal of Physical and Multiple Disabilities, 54*(4), 157-176.

Shinn, M. R. (Ed.). (1989). *Curriculum-based measurement: Assessing special children*. Guilford Press.

Snow, C. E., Burns, M. S., & Griffin, P. (Eds.). (1998). *Preventing reading difficulties in young children*. National Academies Press.

Swanson, L. & Sachse-Lee, C. (2000). A meta analysis of single subject design intervention research for students with LD. *Journal of Learning Disabilities, 33*(2), 114-136.

Therrien, W. J. (2004). Fluency and comprehension gains as a result of repeated reading a meta-analysis. *Remedial and special education, 25*(4), 252-261.

Torgesen, J. K., Rashotte, C. A., & Alexander, A. (2001). Principles of fluency instruction in reading: Relationships with established empirical outcomes. *Dyslexia, fluency, and the brain,* 333-355.

Tran, L., Sanchez, T., Arellano, B., & Swanson, H. L. (2011). A meta-analysis of the RTI literature for children at risk for reading disabilities. *Journal of learning disabilities, 44*(3), 283-295.

Vaughn, S. & Fuchs, L. S. (2003). Redefining learning disabilities as inadequate response to instruction: The promise and potential problems. *Learning Disabilities Research and Practice, 18*(3), 137–146.

Waddell, D. E., Nassar, S. L., & Gustafson, S. A. (2011). Single-Case Design in Psychophysiological Research: Part II: Statistical Analytic Approaches. *Journal of Neurotherapy, 15*(2), 160-169.

Wexler, J., Vaughn, S., Edmonds, M, & Reutebuch, C. K. (2008). A synthesis of fluency interventions for secondary struggling readers, *Read Writ, 21*, 317-347.

Wolf, M., & Katzir-Cohen, T. (2001). Reading fluency and its intervention. *Scientific studies of reading, 5*(3), 211-239.

Yang, H., & Park, W. (2012). A meta-analysis of PECS interventions using the improvement rate difference. *The Journal of Special Education, 14*(2), 73-90.

*Yang, S. (2008). *The effects of a multi-component reading intervention on the reading fluency and reading comprehension of students with reading disabilities* (Master's thesis). Graduate School of Education, Chonnam National University, Korea.

국 문 초 록

읽기는 문자의 해독과 이해의 과정으로서, 학습을 하는 사람에게는 반드시 요구되는 필수적인 능력이라 할 수 있다. 그러나 여전히 어떤 학생들은 읽기에 어려움을 느끼고 있으며, 그 결과 읽기의 궁극적 목적이라 할 수 있는 읽기 이해에 도달하지 못하는 경우가 발생하기도 한다. 따라서 연구자들은 이러한 학생들을 위한 효율적인 읽기 중재 방안을 모색해야 할 필요가 있다.

그 동안 많은 연구자들은 읽기 곤란 학생들이 읽기를 발달시키기 위하여 갖추어야 할 기능은 무엇이며, 이러한 기능을 향상시킬 수 있는 방법에는 어떠한 것이 있는지에 대하여 논의해 왔다. 그 결과 읽기유창성의 중요성이 부각되고 있는데, 이는 텍스트를 빠르고, 정확하고, 적절한 표현에 맞게 읽는 능력을 의미한다. 읽기 유창성은 능률적인 읽기 이해를 위한 핵심적인 특성으로 확인되어 왔으며, 이에 발맞추어 국내외에서는 이러한 읽기유창성에 대한 중재 관련 연구들이 꾸준히 이루어져 오고 있다.

한편, 오늘날에는 학습부진 학생들을 위한 중재에 있어서 중재반응모형이 대두되고 있다. 이러한 중재반응모형은 Tier1에서 Tier3에 이르는 단계별 교수를 제공하는 것을 그 특징으로 하고 있으며, 단계가 높아질수록 보다 개별화된 교수가 이루어지게 된다. 따라서 일반 교실에서 집단적으로 이루어지는 Tier1의 중재와, 소집단 교수가 이루어지는 Tier 2, Tier3의 중재는 분명 다른 특성을 지닐 수 밖에 없으며, 서로 다른 중재 방법이 적용될 가능성이 높다.

본 연구의 목적은 이러한 Tier 2,3단계의 교수에 주목하여, 그러한 소집단 교

수에 적합한 읽기유창성 중재의 특성을 탐색하는 것이다. 이를 위하여 본 연구에서는 읽기 부진 학생을 대상으로 이루어진 읽기유창성 중재 단일대상연구에 대하여 메타분석을 실시함으로써, 소집단 교수에 효과적인 읽기유창성 중재의 특성을 발견하고자 하였다. 따라서 먼저 이들 연구들의 전체 효과크기가 산출되었고, 이어서 학생 관련 변인, 중재 관련 변인, 실행 관련 변인, 평가 관련 변인에 따라 분석이 이루어졌다.

한편, 본 메타분석에서 효과크기는 개선율 차이(improvement rate difference: IRD)를 활용하여 산출되었다. 그 동안 단일대상 연구의 효과크기 계산에는 주로 비중복 비율(percentage of non-overlapping data: PND)이 활용되어 왔으나, 최근의 몇몇 연구들은 IRD가 PND에 비하여 보다 변별력있게 효과크기를 분류할 수 있고, 효과크기와 동시에 신뢰구간도 제공하므로 통계적인 측정이 가능하다는 점에서 더욱 우수한 척도임을 증명한 바 있다. 따라서 본 연구에서는, 이러한 IRD를 활용하여 읽기 유창성 중재에 대한 전체적인 분석 및 변인 별 분석을 실시한 후 그 결과를 제시하고, 이러한 분석 결과가 읽기 유창성 중재에 줄 수 있는 교육적 의의와 시사점들에 대하여 논의해 보았다.

주요어: 읽기유창성, 읽기부진, 학습장애, 메타분석, 개선율 차이(IRD)

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