

Students' Reading Engagement in Print and Digital Reading Achievement: Using a Multilevel Structural Equation Modeling¹⁾

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《 ABSTRACT 》

This study examined a structural relationship of motivational, cognitive, and behavioral engagement along with print and digital reading assessments based on a two-level structural equation modeling. The analysis was based on PISA 2009 data focusing on Korean students. The results showed that the effect of motivational engagement (reading enjoyment) on academic performance was mediated by cognitive, metacognitive and behavioral engagements, and these mediating engagement factors were positively predictive on both print and digital reading. Socio-economically disadvantaged students appeared to have lower levels of engagement, which led to lower levels of reading performance. Girls enjoyed reading more and had more knowledge on effective reading and learning strategies, which resulted in high performance in print reading. However boys better performed in digital reading than girls. Educational and practical implications were discussed.

Key Words : PISA, reading engagement, print reading, digital reading, metacognition

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I . Introduction

Reading is essential not only for educational success but participation in economic activities and having proper citizenship. In today's knowledge-based society, it is necessary to have ability to access, understand and reflect on all kinds of information (OECD, 2010a). As Cunningham and Stanovich (1997) claimed that, students should attain a certain level of reading skills that can be used as a foundation of learning for all kinds of subjects. Obviously, reading is an essential skill for higher education.

For the development of reading, not only the acquisition of skills and knowledge but cognitive, motivational and behavioral engagement are important (Guthrie & Wigfield, 2000). It is well-known that reading proficiency and reading engagement (e.g., attitudes, interests, and frequency/diversity in reading) are highly correlated (OECD, 2001). Guthrie and Wigfield propose that reading engagement model integrates attitudinal, cognitive, and motivational dimensions that can promote literacy achievement. PISA 2009 definition of reading literacy involves engagement in reading as an integral part of reading, explaining that “[R]eading literacy is...engaging with written texts, in order to achieve one's goals, to develop one's knowledge and potential...” (OECD, 2010a, p. 23).

This study notes that there has been a big discrepancy between cognitive and non-cognitive (motivational and affective) achievement for Korean students in international large-scale assessments (ILSAs) such as PISA and TIMSS (the Trends in International Mathematics and Science Study). Since participating in ILSAs, Korea has been consistently ranked in top tier in all major cognitive domains. For example, in PISA 2003, Korea was ranked the 3rd in math achievement but other non-cognitive or affective scores (e.g. enjoyment/ interest, self-confidence, values) were significantly lower than the OECD averages. The result is quite similar to PISA 2006 in which Korean students ranged between rank five to nine in cognitive domains among OECD countries, while they still reported lower interest, enjoyment, and instrumental motivation in learning science than the OECD average values.

Thus this study aims to investigate a more comprehensive model of reading engagement with different layers of affective factors, which induce better reading performance. Lack of research has been found in reading motivation or reading engagement focusing on Korean students in the literature, whereas studies on reading engagement have been conducted mostly using Western students. It is important for students and teachers to know

motivational and affective aspects of reading, given the fact that engagement in reading is indispensable to the acquisition of reading comprehension skills and reading achievement. This study thus helps educators to understand the role of reading engagement in relation to reading achievement.

Another important aspect of this study is related to students' ability to read both print and digital texts. Online reading using Internet becomes more popular in that it allows students' access to and retrieval of relevant information for learning. Students might read for the purpose of social communication as they are involved in reading and writing e-mails, text messaging, blogs and community bulletin boards (OECD, 2010a). The knowledge and skills on computer and information technology are notably vital not only in workplaces but schools. However, it has been rarely tested whether reading engagement models of print and digital reading can be differentiated.

Therefore, this study centers on one overarching question: "how does Korean students' reading engagement relate to reading assessment in both print and digital reading and what kinds of student- and school-level variables affect those engagement and reading achievement?"

II. Literature Review

1. Reading Engagement in Print and Digital Texts

Reading engagement model recognizes that reading literacy involves more than reading skills and knowledge but includes reading attitudes, motivation to read, active use of cognitive strategies, and so on (Guthrie & Wigfield, 2000; Guthrie, Wigfield, & VonSecker, 2000). Guthrie and Wigfield once suggested that engaged readers "...coordinates their strategies and knowledge (cognition) within a community of literacy (social) in order to fulfill their personal goals, desires, and intentions (motivation)" (p. 404). Thus, students who are engaged in reading tend to read for the sake of reading, and they are "energized, active, and effortful, and involved in reading" (p. 404). Wigfield, Cambria, and Ho (2012) also emphasized reading engagement and its enhancement of interaction with texts in ways that are strategic and motivated. The levels of students' reading engagement, in general, are highly positively correlated with their reading achievement (Baker, Dreher, & Guthrie, 2000;

Guthrie et al., 2004).

Reading engagement model proposes that motivational, cognitive, and behavioral components of reading are involved in both academic and recreational reading (Guthrie & Wigfield, 2000). First, one of the major motivational aspects of reading engagement is interests/enjoyment in reading. Interest and values of reading are associated with motivational engagement (Wigfield et al., 2012). Eccles and researchers (1993) originally defined interest as the inherent enjoyment of the activity. Engaged readers are inclined to read texts for enjoyment and the satisfaction of curiosity. Therefore, levels of interest and value of reading for enjoyment can be regarded as a state in which students are emotionally and motivationally involved in reading. Printich and DeGroot (1990) showed a positive relationship among interest, values, and achievement. PISA results have shown that interest and enjoyment index significantly predicted reading achievement for top-ranked countries (Korea, Shanghai-China, Finland, Singapore, New Zealand, Japan, Australia) (Cho et al., 2011). Lim (2013a) also reported that positive reading attitudes (measured by reading enjoyment and interest in reading) influenced the frequency of reading behavior, which in turn, affected reading performance.

Second, cognitive engagement in reading concerns students' effort to adopt various strategies when they read texts to gain knowledge or information. The importance of learning strategies is that they allow students to control their learning and achieve academic goal. Self-regulatory learners often utilize planning, monitoring and evaluating useful learning strategies. Effective cognitive and metacognitive strategies are found to have positive correlations with reading proficiency (Brown & Palincsar, 1984; Zimmerman, 1990). The link between cognitive strategies and achievement in middle and high school years has been well recognized (Fredricks et al., 2004). Those strategies involve elaboration, memorization, and control. Elaboration is transfer and integration of material, where students relate what they have learned to other context, and memorization is the process of forming verbal representations and storing them in memory through repetition (Marsh et al., 2006). Control strategies are more like a metacognitive aspect of students' ability in that they are used for students to self-regulate the learning process and ensure that goals are reached. These cognitive strategies were found to moderately predict student-reported reading grades (Lim, 2013b).

Third, we are specifically interested in metacognition which is closely connected to cognitive engagement in reading. Recently, Veenman, Van Hout-Wolters, and Afflerbach (2006) stressed the concept of metacognitive awareness as understanding and regulation of

their own cognition. Planning, regulating, monitoring and evaluating are the main processes of metacognition in reading. PISA reading framework states that “cognitive and metacognitive knowledge concern the use of cognitive strategies in general and reading strategies in particular.” (OECD, 2010a, p.72) They are both related to mental and behavioral effort that helps students achieve learning outcome (Flavell, Miller, & Miller, 1993).

Noticeably, metacognition is specifically important in reading achievement (Baker & Brown, 1984; Schneider & Pressley, 1997). Pressley and Ghatala (1990) proposed that skilled readers monitor their comprehension during reading and subsequently use this metacognitive information. They argued that the usage of such strategies during reading represents “self-regulated information processing,” which entails knowledge of important concepts, knowledge of effective cognitive strategies (e.g. elaboration, control, organization), and metacognitive knowledge on how and when to use such strategies for learning outcomes. Also, Wyatt et al. (1993) acknowledged the metacognition in reading involves three categories such as strategies, monitoring, and evaluative reactions. That is, metacognitive readers 1) understand the reading tasks based on contextual demands, 2) coordinate a number of reading strategies, 3) monitor their use of strategies (i.e. adopting new strategies and changing them when they recognize miscomprehension), and 4) evaluate what they read and relate the new ideas to their prior knowledge (Brown & Pressley, 1994; Zhang, 2001). Choi (2010) identified Korean students' metacognition in reading, such as global reading strategies, problem-solving strategies, and support reading strategies, was on “Average” level.

Lastly, PISA 2009 framework also includes behavioral engagement in reading and it refers to “the self-reported frequencies of participating in reading activities with diverse content in various media.” (OECD, 2010a, p. 70) Engaged readers are found to read frequently in a variety of topics (Guthrie & Wigfield, 2000). Kim (2005) analyzed PISA 2000 data and reported the mediating role of reading behavior (amount of time spent in reading) between reading interest and reading achievement.

2. Factors Influencing Reading Engagement

Gender and socioeconomic status (SES) are two important factors concerning a reading engagement model. Girls generally show higher reading performance than boys, across all school age groups (Kush & Watkins, 1996). Not only do girls achieve more than boys, they

also possess higher motivation to read (Swalander & Taube, 2007). Girls more favor reading outside school than boys (e.g. recreational reading, Logan & Johnston, 2009).

With respect to the influence of SES, results from the Progress in International Reading and Literacy Study (PIRLS; Mullis et al., 2007) consistently demonstrate that students from low-SES families have little literacy resources and fewer educational materials at home compared to their high-SES peers. Students and parents from low-SES communities are less likely to read for enjoyment at home, to use library, or to read magazines and newspapers. These differences in the home literacy environment lead to significant differences in reading achievement (van Schooten, deGlooper, & Stoel, 2004).

Finally, it is highly plausible that classroom and school climates directly and indirectly influence student engagement and achievement. For classroom contexts, teacher support, classroom structure and autonomy support can help student increase engagement (Fredricks et al., 2004). Teacher support and caring have been correlated with behavioral engagement (e.g. higher participation in learning and on-task behavior) and emotional engagement (e.g. positive attitudes toward school) (Skinner & Balmont, 1993). Moreover, classroom learning climates that support students' autonomy can increase engagement (Assor, Kaplan, & Roth, 2002; Jang et al., 2009). Specifically, autonomy-supportive classroom structures are characterized by choice, shared decision making and the absence of external control (Connell, 1990). Positive effects of autonomy support have been reported to occur in behavioral (Assor et al., 2002) and cognitive engagement (Vansteenkiste et al., 2005).

Lastly, school climates that are conducive to learning are also related to the lower frequency of students' problematic behavior (e.g. absenteeism, disruption of classes, lacking respect for teachers, etc). Cho et al. (2011) analyzed the effect of this student-induced school climate on achievement and found that this variable in Asian countries (Korea, Shanghai, Singapore, Japan) collectively predicted reading performance.

Until recently, however, little research has been conducted in the area of school contexts affecting reading engagement. Lee and Smith (1995) reported that schools that have more communal structures encourage students' engagement through shared responsibility, commitment to common goals, and lateral decision making. Linked to the school structure, the type of school (e.g. vocational and academic track) is one of the school-level factors since different types of school provide different contexts and cultures that have impacts on learning environment.

In this study, reading engagement captures the multidimensional aspects of students' motivation (interest and enjoyment), cognition (learning and metacognitive strategies), and

behavior (amount of time spent in reading) when they interact with print and digital texts. We hypothesized that engaged motivation and cognition heighten the active involvement in reading, leading to the better performance. The direction from motivation to behavior was proposed by other engagement researchers (Clore, 1994; Ladd, Buhs, & Seid, 2000; Li, Lerner & Lerner, 2010) who insisted that positive emotions enhance approach behavior and continued action (Li & Lerner, 2013). We also examined the effects of student- and school-level factors in the framework of proposed reading engagement model, focusing on Korean students.

III. Method

1. Data

The analyses focused on Korean student performance based on PISA 2009 data, which are publicly available from the OECD website (<http://pisa2009.acer.edu.au/>). PISA data provide rich information regarding affective domains such as student engagement. The outcome of interest was reading literacy, which was the main domain in PISA 2009.

Both print and digital reading assessment scores were used as outcome measures, which were scaled based on a mean of 500 with a standard deviation of 100. As the digital reading scale results were constructed to match the print reading results, the comparisons between the two media can be validated (OECD, 2011). This study used five plausible values (PVs) as an outcome measure by creating a latent factor in each print and digital reading assessments (hereafter PRA and DRA, respectively). Because plausible values provided by PISA 2009 data were random numbers drawn from the marginal posterior distribution of individual student's ability in each domain that was measured based on the item response theory (IRT) (OECD, 2011), individual plausible values included random error variance and should not be treated as regular test scores (OECD, 2012). Thus we decided to use a latent variable representing student academic performance rather than spontaneously use one of the plausible values.

Originally 4,989 Korean students from 157 schools participated in PRA, and out of 4,989 sampled students, 1,477 students took the DRA. PISA provides plausible values for all students including those who were not subsampled for DRA (OECD, 2012), which enabled

us to include the entire sample of Korean students in PISA 2009 for analyses.

2. Variables

Based upon the literature review in the previous section, student characteristics of interest in this study include gender and SES levels. This study examined how students' gender and social and economical status can directly and indirectly influence on reading engagement factors as well as academic performance on reading literacy.

For behavioral engagement, reading enjoyment time (RTIME) and library use (LIBUSE) were selected. Amount of time spent in reading is often used to assess behavioral dimensions of reading engagement (Guthrie & Wigfield, 2000). We included a variable of library use for constructing behavioral engagement because of two reasons. First, while reading enjoyment time captures mere "quantity" of reading in leisure time (students are asked to respond from "never" to "more than 2 hrs a day" about their reading time), library use encapsulates the "quality" of reading activities in and out of school. Seven questions of LIBUSE include reading activities when students engage for different purposes (for pleasure and for school work). Second, this variable also contains aspects of students' engagement in digital reading (e.g. "use of internet"). Since our objective in this study is to analyze the effects of variables of interest on both PRA and DRA, we decided to use RTIME and LIBUSE together.

For motivational engagement, JOYREAD was assessed using the response scale ranged from 1 (strongly disagree) to 4 (strongly agree). Eleven items tapped into students' positive attitudes and motivation to read, including interest, value, and social reasons for reading. All the items that are negatively phrased (e.g. "For me, reading is a waste of time") were reversely scored for IRT scaling such that positive scores on this index indicate higher levels of motivation to read.

For cognitive engagement, memorization (MEMO), elaboration (ELAB) and control (CONT) strategies represent cognitive strategies that students use in their learning in general. Positive scores on these indices indicate higher frequencies that students reported in the given learning strategy. Four items each for memorization and elaboration strategies and five items for control strategies were used, based on a 4-point Likert scale ranging from 1 (almost never) to 4 (almost always) in each item.

Metacognitive engagement consists of understanding and remembering (UNDREM) and

summarizing (METASUM), and students were asked to rate the usefulness of the strategy, using a 6-point Likert scale from 1 (not at all useful) to 6 (very much useful). Metacognition was assessed by presenting vignettes in which students are asked to evaluate the quality and effectiveness of different reading strategies for reaching the intended goal. For this measure, the rank order of strategies for each vignette is compared with an “optimal” rank order developed by reading experts. The rate of correspondence between the rankings of experts and students is reflected in this score indicating the degree to which students are actually aware of the best ways of memorize text information and understanding intended goals (OECD, 2010a; 2010b).

School-level characteristics included student-related aspects of school climate (STUDBEHA), and the school mean of disciplinary climate (DISCLIMA). STUDBEHA and DISCLIMA measured classroom learning climates (e.g. absenteeism, disruption, noise, etc.). The items in these measures were reversely coded (i.e. higher scores indicate a better disciplinary climate and lower ones a poorer disciplinary climate). We also tested teachers' stimulation of reading and teaching strategies (STIMREAD), measuring how teachers stimulate reading engagement and reading skills, and teachers' use of structuring and scaffolding strategies (STRSTRAT), measuring how teachers use the structuring and scaffolding strategies in reading lessons. Higher scores indicate greater use of stimulation and structuring strategies in PISA scales. To tap into the school-level influences, we computed the means of the students' scores and created school-average scores of these four variables (STUDBEHA, DISCLIMA, STIMREAD, STRSTRAT). We assume that these scales, along with the vocational track of high school (HIGHVOC), might capture the important aspect of learning environment, as suggested in school-effectiveness research (Opdenakker & Damme, 2006).

Table 1 includes details and descriptive statistics of key variables in the analysis. Except FEMALE, RTIME, and metacognition measures among the student-level characteristics, all the variables in Table 1 are scaled indices, which represent estimates of latent traits based on IRT scaling. Metacognition measures are standardized sum scores for a set of positive responses (having an OECD mean of 0 and SD of 1).

3. Analytic Methods

In order to investigate a causal relationship among engagement variables and reading literacy, we used a two-level structural equation modeling (SEM), to reflect the data

structure that students were nested within school. The benefit of multilevel SEM over multilevel itself is that the multilevel SEM techniques allow us to take into account measurement error in covariates and test linear structural relationships with latent variables as well as observed variables under the SEM framework (Muthen & Asparouhov, 2011). For analyses, M-Plus version 6.11 was used.

IV. Results

We conducted two analyses in print and digital reading assessment, respectively. The same model was applied in both print and digital reading domains to examine whether and to what extent the associations between reading engagement domains and reading performance differ depending on the medium used for assessing reading literacy.

1. Descriptive analysis

This preliminary analysis aimed to explore which variables were more likely to be associated with the reading outcome measures. Table 1 shows descriptive statistics of key variables, and Table in Appendix includes the correlation coefficients between each achievement score in print (PVPRA) and digital (PVDRA) tests and variables of interest in this study. The descriptive statistics only included the first plausible values in each print and digital reading.

The correlation matrix showed that print reading scores were highly correlated with digital reading scores ($r=0.79$). Joy of reading (JOYREAD), use of control (CONT), and metacognition variables (UNDREM and METASUM) showed relatively higher positive correlations with student performance in PRA and DRA ($r>0.36$). With respect to background variables, students' SES ($r=0.33$) and a better disciplinary climate at the school level were positively associated with the outcome ($r=0.32$ and $r=0.27$ in print and digital reading, respectively), whereas students in vocational school appeared to score lower in reading than those in regular school ($r=-0.42$ and $r=-0.41$ in PRA and DRA respectively).

〈Table 1〉 Descriptive Statistics (N=4,521)

	Variables	Labels	Mean	SD
Outcome	PV1PRA	Plausible value 1 in print reading assessment (PRA)	543.3	76.1
	PV1DRA	Plausible value 1 in digital reading assessment (DRA)	572.4	64.8
Student-level characteristics	FEMALE	Female=1, male=0	0.49	0.50
	SES	Index of economic, social and cultural status (ESCS)	-0.14	0.82
Behavioral engagement (BE)	LIBUSE	Library use	0.39	0.89
	RTIME	Time spent reading for enjoyment (ST23Q01)	2.10	1.12
Motivational engagement (ME)	JOYREAD	Joy of reading	0.14	0.81
Cognitive engagement (CE)	MEMO	Use of memorization strategies	0.10	0.93
	ELAB	Use of elaboration strategies	0.11	0.98
	CONT	Use of control strategies	-0.24	0.98
Metacognition (META)	UNDREM	Understanding and remembering	0.07	0.99
	METASUM	Summarizing	0.07	1.01
School-level characteristics	STUDBEHA	Student-related aspects of school climate	0.43	0.93
	HIGHVOC	Vocational highschool	0.23	0.42
	STIMREAD	Teachers' stimulation of reading engagement (school mean)	-0.43	0.28
	STRSTRAT	Use of structuring and scaffolding strategies (school mean)	-0.63	0.25
	DISCLIMA	Disciplinary climate (school mean)	0.39	0.30

2. Multilevel SEM

Based on the results of our preliminary analyses, some of the aforementioned variables were deleted (e.g. STIMREAD, STRSTRAT, STUDBEHA) because there was neither statistical nor substantial significance in our reading engagement model. Our decision was based on as follows: first, in Korean educational contexts, schools in terms of learning climates seem to be relatively homogeneous. Previous work (Cho et al., 2011) analyzed the contextual effects on PISA 2009 PRA and DRA for different countries and revealed that almost all school-level variables were not statistically significant. Second, two teacher-related school climates, such as average levels of teachers' reading strategies and scaffolding skills, were assessed by the 'students' perceptions' on their teachers' reading

practices during classes. Students' perceptions on teachers might be quite subjective and often tend to be tampered with other confounding variables, especially with their attitudes toward school in general, and subject-matter in particular.

For the measurement model, cognitive engagement was expressed as a latent factor that was indicated by MEMO, ELAB, and CONT measures that were already validated by the PISA questionnaire framework. Behavioral engagement was constructed by two indicators (LIBUSE, RTIME). Also we used UNDREM and METASUM for the metacognition, which were also validated by the PISA.

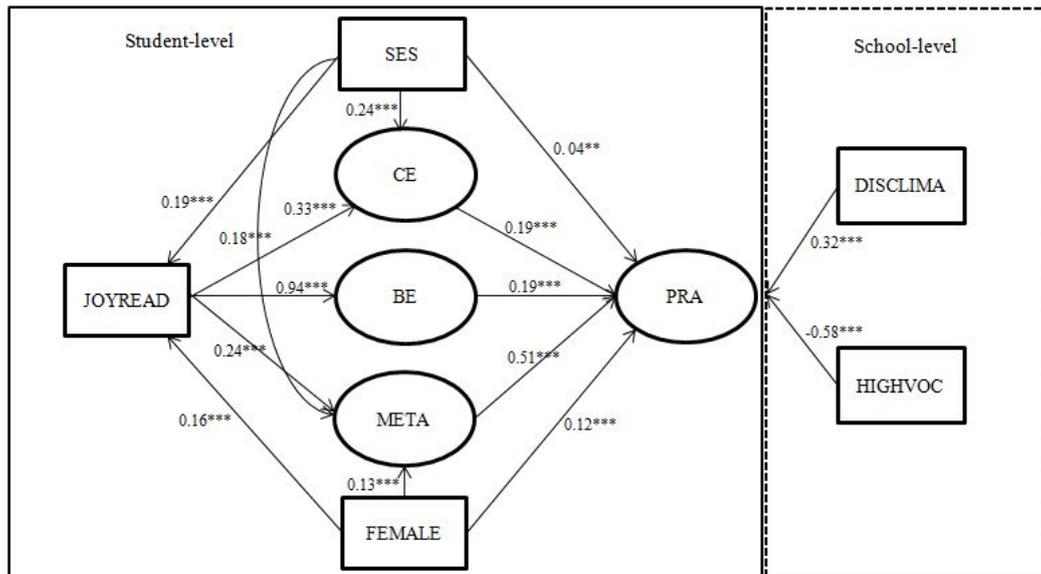
For the development of a structural model among reading engagement factors and the reading outcome, exploratory SEM analyses were advanced. The results indicated that motivational engagement (JOYREAD) was found to be highly positively correlated with behavioral engagement, whereas cognitive engagement showed no significant relationship with behavioral engagement. Since we assessed students' use of cognitive strategies (i.e. memorization, elaboration, control) during learning in general, it seems to have little connection with "reading" behavior itself, which was represented by "time spent reading" and "use of library". Moreover, motivational engagement was associated with all other mediating engagement factors (behavioral, cognitive, and metacognitive aspects of reading), and thus the relationships were addressed in the final model. Eventually, we hypothesized that 1) the effect of motivational engagement on academic performance would be mediated by cognitive, meta-cognitive and behavioral engagements, and 2) the effects of student's SES level and gender would be mediated by reading engagement factors on reading performance, in addition to the direct effect on reading performance (see Figures 1 and 2). In the analyses, PISA final weights were standardized so that the sum of the weights was equal to the number of sample used in the final analysis.

1) Print reading assessment

Table 3 represents the two-level SEM results using PRA as the dependent variable. PRA is a latent factor constructed by five plausible values in print reading assessment. Figure 1 shows the structural relationships among the engagement factors and academic performance in print reading, and how student and school background variables of interest are associated with engagement factors and reading performance.

Model fit indices indicate an excellent fit to the data. The RMSEA (the root mean square error of approximation) and TLI (the Tucker-Lewis index) values were 0.045 and 0.976,

respectively. The RMSEA and TLI account for a lack of model parsimony, and the RMSEA values of less than .05 or the TLI values of greater than .95 reflect a good fit (Marsha et al., 2006).



(Figure 1) Standardized path coefficients for PRA model
(Covariance and disturbance terms were excluded for clarity)

The main results from Table 2 can be summarized as follows. First, both gender and SES levels showed direct and indirect effects on reading. It turns out that girls ($\beta_{std}=0.19$), and students in socio-economically advantaged households ($\beta_{std}=0.16$), tend to read more for enjoyment in their daily lives. At the same time, gender and SES variables still had statistically significantly direct effects on print reading. Particularly, girls better performed than boys, even controlling for all other variables ($\beta_{std}=0.12$). On the other hand, the direct effect of SES on PRA appeared insubstantial from the practical point of view ($\beta_{std}=0.04$), whereas SES had positive and meaningful associations with engagement factors ($\beta_{std}=0.19$ for JOYREAD, $\beta_{std}=0.24$ for CE, $\beta_{std}=0.18$ for META). That is, there is a tendency that socio-economically advantaged students read more for enjoyment, more frequently use learning strategies (memorization, elaboration and control), and have more knowledge on which meta-cognitive strategies are more effective in reading, which eventually leads to improvement in reading.

Second, reading for enjoyment (JOYREAD) was positively associated with behavioral, cognitive, and metacognitive engagement in reading activities. The associations between JOYREAD and other engagement factors present that students who are more motivated to read tend to acknowledge more effective reading strategies ($\beta_{std}=.24$ for META), use more learning strategies ($\beta_{std}=.33$ for CE), and do more reading activities ($\beta_{std}=.94$ for BE). Particularly, motivational engagement represented by JOYREAD was highly predictive in behavioral engagement (time spent in reading and library use).

With respect to the effect of reading engagements on print reading achievement, the estimated coefficients (β_{std}) of CE, BE, and META were 0.19, 0.19, and 0.51, respectively. Noticeably, metacognition was the most predictive among the variables/factors tested at the student level. It is interesting to note that strategies in CE and the ones in META appeared to measure similar aspects of reading engagement, which were both based on students' self-reports. However as mentioned earlier, a unique way of measuring students' metacognition levels - students' responses on reading strategies were evaluated by experts - could reduce bias of self-reported measures (OECD, 2010b), which could, in turn, better address the nature of association between reading strategies and outcome.

Two school-level variables were included in the final model. The analysis results showed that the atmosphere in classrooms and schools played an important role in student academic performance. In detail, students who reported that they attended to schools with less disciplinary problems performed better in reading ($\beta_{std}=0.32$ for PRA), whereas students in vocational school appeared to underperform on average than students in regular school ($\beta_{std}=-0.58$ for PRA).

<Table 2> Two-level SEM analysis results in print reading

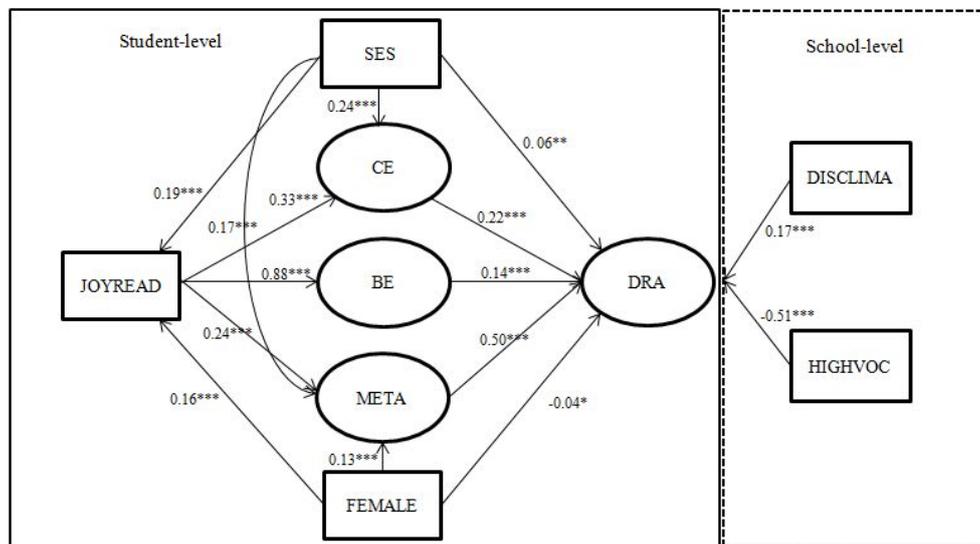
Parameter	Estimate	SE	Est./SE	p-values	StdYX
<i>Within Level</i>					
CE by					
MEMOR	1.00	0.00	-	-	0.62
ELAB	1.13	0.05	23.81	0.000	0.67
CSTRAT	1.60	0.07	23.80	0.000	0.94
BE by					
RTIME	1.00	0.00	-	-	0.64
LIBUSE	0.44	0.02	25.49	0.000	0.35
META by					
METASUM	1.00	0.00	-	-	0.77
UNDREM	0.81	0.03	27.13	0.000	0.63

Parameter	Estimate	SE	Est./SE	p-values	StdYX
PVW by					
PV1PRA	1.00	0.00	-	-	0.93
PV2PRA	1.00	0.01	104.73	0.000	0.93
PV3PRA	1.00	0.01	106.66	0.000	0.93
PV4PRA	1.00	0.01	112.17	0.000	0.93
PV5PRA	1.00	0.01	112.33	0.000	0.93
JOYREAD on					
SES	0.19	0.02	11.91	0.000	0.19
FEMALE	0.25	0.03	8.69	0.000	0.16
CE on					
SES	0.17	0.02	11.11	0.000	0.24
JOYREAD	0.24	0.02	12.84	0.000	0.33
BE on					
JOYREAD	0.83	0.02	44.61	0.000	0.94
META on					
SES	0.17	0.02	8.00	0.000	0.18
FEMALE	0.19	0.04	4.68	0.000	0.13
JOYREAD	0.23	0.02	12.08	0.000	0.24
PVW on					
BE	15.66	2.02	7.76	0.000	0.19
CE	19.97	1.73	11.53	0.000	0.19
META	39.59	1.93	20.52	0.000	0.51
FEMALE	14.45	2.36	6.13	0.000	0.12
SES	3.23	1.07	3.03	0.002	0.04
<i>Between Level</i>					
PVB by					
PV1PRA	1.00	0.00	-	-	1.00
PV2PRA	1.00	0.02	52.94	0.000	1.00
PV3PRA	1.00	0.02	58.54	0.000	1.00
PV4PRA	1.02	0.02	45.75	0.000	1.00
PV5PRA	1.00	0.02	56.53	0.000	1.00
PVB on					
HIGHVOC	-36.14	4.60	-7.86	0.000	-0.58
DISCLIMA	28.80	6.23	4.63	0.000	0.32

2) Digital Reading Assessment

As shown in Figure 2, the same model used in print reading was applied to the analysis for digital reading to examine whether the associations between variables of interest (including both latent and observed variables) and students' reading performance were different, depending on the medium used for reading assessment.

The RMSEA and TLI values in the DRA model were 0.046 and 0.970 respectively, showing a good model fit. These values were similar to the corresponding ones in the PRA model.



(Figure 2) Standardized path coefficients for DRA model
(Covariance and disturbance terms were excluded for clarity)

Table 3 includes the SEM analysis results for digital reading. Overall, the results were similar to the results for print reading in terms of the associations between JOYREAD and other engagement factors and the influence of SES on engagement in reading, and the associations of HIGHVOC and students' reading performance. However, compared with the results based on PRA, some noticeable results were found. The association between gender and reading performance in digital reading was no longer substantially meaningful ($\beta_{std} = -0.04$). Additionally, it appears not crucial, but the association between BE and DRA slightly reduced in digital reading (from $\beta_{std} = 0.22$ to $\beta_{std} = 0.19$), whereas the association between CE and DRA somewhat increased (from $\beta_{std} = 0.14$ to $\beta_{std} = 0.19$). At the school level, the influence of DISCLIMA on digital reading was still statistically significantly positive, but

the magnitude of the coefficient of the variable became smaller ($\beta_{std}=0.32$ for PRA vs. $\beta_{std}=0.17$ for DR).

〈Table 3〉 Two-level SEM analysis results in digital reading

Parameter	Estimate	SE	Est./SE	p-values	StdYX
<i>Within Level</i>					
CE by					
MEMOR	1.00	0.00	-	-	0.62
ELAB	1.13	0.05	23.56	0.000	0.67
CSTRAT	1.59	0.07	23.45	0.000	0.94
BE by					
RTIME	1.00	0.00	-	-	0.68
LIBUSE	0.44	0.02	26.39	0.000	0.37
META by					
METASUM	1.00	0.00	-	-	0.78
UNDREM	0.78	0.03	24.92	0.000	0.62
PVW by					
PVIDRA	1.00	0.00	-	-	0.89
PV2DRA	0.99	0.01	84.12	0.000	0.88
PV3DRA	1.01	0.01	80.23	0.000	0.89
PV4DRA	1.00	0.01	86.30	0.000	0.88
PV5DRA	1.02	0.01	84.36	0.000	0.89
JOYREAD on					
SES	0.19	0.02	12.02	0.000	0.19
FEMALE	0.26	0.03	8.57	0.000	0.16
CE on					
SES	0.17	0.02	11.10	0.000	0.24
JOYREAD	0.24	0.02	12.62	0.000	0.33
BE on					
JOYREAD	0.83	0.02	44.14	0.000	0.88
META on					
SES	0.17	0.02	7.99	0.000	0.17
FEMALE	0.20	0.04	4.75	0.000	0.13
JOYREAD	0.23	0.02	12.34	0.000	0.24
PVW on					
BE	8.35	1.35	6.21	0.000	0.14
CE	17.54	1.40	12.58	0.000	0.22
META	29.54	1.42	20.81	0.000	0.50
FEMALE	-3.77	1.89	-2.00	0.045	-0.04
SES	3.62	0.87	4.17	0.000	0.06

Parameter	Estimate	SE	Est./SE	p-values	StdYX
<i>Between Level</i>					
PVB by					
PVIDRA	1.00	0.00	-	-	1.00
PV2DRA	1.02	0.02	46.64	0.000	1.00
PV3DRA	0.97	0.02	48.35	0.000	1.00
PV4DRA	1.00	0.02	43.75	0.000	1.00
PV5DRA	0.99	0.02	57.12	0.000	1.00
PVB on					
HIGHVOC	-34.14	5.55	-6.15	0.000	-0.51
DISCLIMA	16.61	7.73	2.15	0.032	0.17

Table 4 summarizes the direct, indirect and total effects of key factors of interest in this study on both print and digital reading. Overall, joy of reading and metacognition were the most influential on students' reading performance in the model, and it was found that students' social and economical status indirectly affected on reading performance via the impact of students' reading engagement. The direct effect of gender appeared no longer substantially influential in digital reading.

〈Table 4〉 Direct, indirect, and total effects (standardized coefficients)

	PRA			DRA		
	Direct	Indirect	Total	Direct	Indirect	Total
JOYREAD	-	0.35	0.35	-	0.31	0.31
CE→PVs		0.06			0.07	
BE→PVs		0.17			0.12	
META→PVs		0.12			0.12	
SES	0.04	0.20	0.24	0.06	0.20	0.26
CE→PVs		0.05			0.05	
JOYREAD→CE→PVs		0.01			0.02	
JOYREAD→BE→PVs		0.03			0.02	
JOYREAD→META→PVs		0.02			0.02	
META→PVs		0.09			0.09	
FEMALE	0.12	0.12	0.24	-0.04	0.11	0.07
JOYREAD→CE→PVs		0.01			0.01	
JOYREAD→BE→PVs		0.03			0.02	
JOYREAD→META→PVs		0.02			0.02	
META→PVs		0.06			0.06	
CE	0.19	-	0.19	0.22	-	0.22
BE	0.19	-	0.19	0.14	-	0.14
META	0.51	-	0.51	0.50	-	0.50

V. Discussion and Conclusion

In this study, we investigated the complex relationships in variables among reading engagement and achievement, along with student and school characteristics. We analyzed the DRA model with the same variables with the PRA one. We assumed the essence of reading literacy (and its connection to motivation, cognition, and behavior) could be similar in processing both print and digital texts. The results of two models confirmed our expectation except the path from gender to reading achievement, suggesting that the effective strategies, reading motivation, and the active behavior required for print and digital reading are identical (OECD, 2011).

We also utilized a methodologically advanced approach (ML-SEM) that takes into account not only a nested structure of the data but also measurement errors in covariates, resulting in a good fit to address linear structural relationships among both latent and observed variables.

1. The role of motivation and metacognition in reading

First, motivational engagement was found to be positively related to cognitive and metacognitive engagement. Motivational reading enjoyment was especially highly correlated with behavioral engagement, which was consistent with the previous research (Guthrie & Wigfield, 2000; Guthrie et al., 2004). In other words, the more students have values, interests, and enjoyment in reading, the more they are willing to participate in academic and recreational reading. OECD (2011) provided the six profiles of readers and one of the adaptive groups of students are “[d]eep and wide readers” who represent 1) higher enjoyment in reading (*motivation*), 2) higher level of learning strategies (*cognitive*), and 3) more frequencies in reading (*behavior*). These students are expected to attain the highest achievement in reading.

Our results showed that all kinds of engagement were positively predictive in print and digital reading achievement, and metacognition showed the highest correlation. It is previously reported that metacognition and reading proficiency had a moderate to high positive correlation ($r=.51$) in PISA 2000 (Artelt, Schiefele, & Schneider, 2001). The effective metacognitive strategies were found in many studies (Baker & Brown, 1984). “[T]he

awareness of and ability to use a variety of appropriate strategies when processing texts” are especially important for students to self-regulate in their reading by making inferences, filling in gaps, and organizing structures, and so forth (OECD, 2010a, p. 72). Thus, it is expected that students who activate knowledge about cognitive resources, the nature of task, and strategies that facilitate understanding, remembering, and recalling of information are more likely to have higher scores in reading. Our results support the emphasis of the PISA 2009 that ‘approaches to learning’ matters. In other words, enjoying reading or reading a lot is not sufficient, but students should understand what effective reading strategies are and how to use them (OECD, 2010b). In addition, it is noted that metacognition scale in this study is a more robust measure in that a rater-scoring system was adopted (See Method and Results sections). It has been reported that students who received the metacognitive reading skills were more likely to achieve better performance in Korean (Kim, 2008). Baek and Choi (2012) further demonstrated the effectiveness of teaching monitoring skills in reading for Korean elementary students.

2. The effects of gender, SES, and school characteristics

For student background characteristics, gender was a significant predictor of reading achievement. The results are expected and consistent with other international comparison studies such as PISA 2000 (OECD, 2001) and 2003 (OECD, 2004). One recognizable difference between PRA and DRA results is, however, the gender effect on reading performance. Girls are more likely to perform better in print-based assessment, while boys did better in digital-based one. OECD (2011) reported that the gender gap in reading became disappear when digital assessment is used in almost all OECD countries. Interestingly, boys often outperform girls in DRA. This result may lead to conclude that gender gap in reading can be attributed to boys’ being less engaged in reading than girls, but the gap tends to narrow down when the medium for assessment changed. It is partly because of the boys’ possession of better “navigation skills” than girls (OECD, 2011), suggesting that we need to pay more attention to the modality of reading and the role of gender-specific preference. Boys can be encouraged to read more in digital texts, resulting in greater reading engagement.

Additionally, SES measure was significantly correlated with cognition, motivation, and behavior in reading. We can infer from the results that socio-economic inequalities in

engagement in reading exists, and such disparities in engagement in reading eventually have an impact on low-levels of reading achievement.

Finally, for school background characteristics, schools in a vocational track demonstrated lower reading achievement. In Korea, the achievement gap between academic and vocational track has been documented. Students who intend to go to the postsecondary institution are willing to put more efforts, which relates to higher achievement than students who do not. One of the unexpected findings in our study is, though, that teacher-related reading strategies in school were not significantly correlated with reading outcome. A similar result was found in a previous work (Cho et al., 2011), which reported that school-level variables such as background, resources, climate and curriculum did not significantly predict achievement in seven top-performing OECD countries. We deleted these school-level variables from our final model. Instead, a positive link between disciplinary climate and reading outcome was found. Notably, classroom (and school) contexts related to reading instruction are important for successful reading achievement. The orderliness of the classroom is one of the features of desirable learning climate. The positive effects of disciplinary climates on the classroom management and student achievement has been found in much of the educational effectiveness research (Opdenakker & Damme, 2006).

Based on the results, we conclude that educational practitioners and teachers should pay attention to the role of engagement in reading and learning strategies and need to put more efforts on helping students improve knowledge and skills in learning strategies, particularly targeting boys and socio-economically disadvantaged students to tackle gender and socio-economical disparity in reading.

3. Implications and limitations

First, as mentioned earlier, Korean students have shown the high performance in academic domains while they consistently reported “undesirable” affective characteristics - low interest, self-doubts, and low motivation in learning. Motivation to read is critical for adolescents' adaptive reading development. The amount of time and variation in topics in recreational reading have a strong predictive power in all academic achievement. Organizing book clubs, providing interesting and relevant reading materials, and encouraging students to read after school as extracurricular activities can facilitate them to read for pleasure. As they read more (behavioral engagement), they find it enjoyable to read (motivational

engagement) or vice versa.

Second, teachers need to particularly pay more attention to the importance of students' awareness of metacognition in reading. Metacognitive strategies can and should be taught explicitly, since the execution of those skills is not easy for students when they have no prior knowledge. Reading teachers need to prepare students to become effective readers by providing strategies of articulation, reflection, and exploration (OECD, 2011).

One limitation of this study entails that reading motivation and reading practices in our research model were not fully measured as is in the theories of reading engagement. The PISA data has advantages to investigate models of reading engagement since it contains many valuable and robust measures (i.e. metacognition) validated and standardized in large, nationally representative samples of students (Williams & Williams, 2010). It has, however, disadvantages in using and analyzing secondary data. Only a limited number of variables were available for reading engagement in the database. For example, extrinsic motivation to read, which was not available in PISA 2009, was one of the major reasons that students read in school (Guthrie & Wigfield, 2000). For the same reason, school-level characteristics were limitedly used, although structures and cultures of school related to teachers and school communities could be meaningful in the development of a reading engagement model.

Finally, digital reading assessment shares the specific features such as “nonlinearity, navigation, intertextuality, and uncertainty of the quality of information” (OECD, 2011, p. 37) with student performance. However information and communication technologies (ICT) related variables did not include in our model, because our first objective of this study was to test whether the reading engagement model of print reading was applicable to the one of digital reading. Future research needs to develop and test digital reading engagement model including more ICT-related variables.

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Appendix. Zero-Order Correlation Coefficients among Observed Variables in Reading Assessment

	PV1PRA	PV1DRA	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PV1DRA	0.79															
1. Female	0.20	0.10														
2. SES	0.33	0.33	0.02													
3. LIBUSE	0.06	0.03	0.07	0.09												
4. RTIME	0.17	0.16	-0.03	0.11	0.28											
5. JOYREAD	0.42	0.36	0.16	0.20	0.32	0.60										
6. MEMOR	0.27	0.28	0.09	0.15	0.14	0.10	0.22									
7. ELAB	0.28	0.27	-0.03	0.24	0.21	0.19	0.31	0.39								
8. CSTRAT	0.41	0.40	0.05	0.28	0.18	0.18	0.35	0.59	0.63							
9. UNDRAM	0.41	0.36	0.10	0.14	-0.01	0.08	0.20	0.16	0.13	0.23						
10. METASUM	0.49	0.45	0.13	0.17	0.00	0.08	0.21	0.17	0.17	0.28	0.49					
11. STUDBEHA	0.21	0.19	0.01	0.16	0.05	0.03	0.10	0.08	0.09	0.13	0.07	0.12				
12. HIGHVOC	-0.42	-0.41	-0.05	-0.36	-0.05	-0.08	-0.18	-0.16	-0.16	-0.25	-0.21	-0.26	-0.31			
13. STIMREAD	0.19	0.19	0.02	0.15	0.08	0.04	0.11	0.10	0.11	0.14	0.11	0.12	0.12	-0.22		
14. STRSTRAT	0.11	0.10	0.03	0.10	0.10	0.06	0.10	0.07	0.07	0.09	0.08	0.08	0.12	-0.08	0.75	
15. DISCLIMA	0.33	0.27	0.10	0.19	0.06	0.06	0.17	0.12	0.12	0.18	0.16	0.17	0.28	-0.38	0.38	0.24

국문요약

다층 구조방정식 모형을 활용한 읽기 참여와 인쇄 및 디지털 읽기 성취와의 구조적 관계

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본 연구는 OECD PISA 2009 자료 분석을 통해 읽기 참여와 읽기 성취도의 구조적 관계를 밝혀보고자 학생과 학교의 2수준 다층 구조방정식 모형을 적용하였으며, 인쇄물 읽기성취도와 디지털 읽기성취도 검사 점수를 결과 변수로 활용하였다. 국제 학업성취도 평가 연구들에서 공통적으로 나타나는 점은 한국 학생들의 높은 인지적 성취와 낮은 정의적 성취의 불균형이며, 이로 인해 학생들의 동기, 태도와 같은 정의적 특성을 함양시키는 정책들에 대한 관심이 이어져왔다. 읽기참여(reading engagement) 이론은 인지-동기-행동의 다차원적인 참여를 포함한 포괄적인 모형으로, 특히 새로운 디지털매체 읽기를 중심으로 관련변수들의 관계들을 경험적으로 검증한 연구는 거의 없는 편이다. 본 연구에서는 학생 수준에서는 인지적 참여(학습전략, 메타인지), 동기참여(읽기흥미, 즐거움, 가치 등), 행동참여(읽기시간, 도서관활용)의 요인들을 사용하였으며, 학교수준에서는 진학계열과 규율정도를 포함하였다. 분석 결과, 동기참여는 인지와 행동참여 모두와 정적인 상관을 보였다. 이러한 인지적, 행동적 참여는 읽기점수와 정적인 관련성을 보였으며, 특히 메타인지전략의 효과가 두드러지게 나타났다. 또한 사회경제적 지위가 낮은 학생들은 전반적으로 읽기 참여 정도가 낮았으며, 이러한 낮은 참여 정도가 결과적으로 낮은 읽기 성취의 요인으로 파악된다. 학교 수준에는 일반고일수록 바람직한 규율 분위기일수록 읽기 성취도가 높았으며, 이러한 구조적관계는 인쇄물과 디지털 성취모형에서 유사하게 나타났다. 한 가지 다른 점은 성별의 차이였는데, 인쇄물 읽기모형에서는 여학생의 경우 읽기 즐거움이나 읽기 전략을 좀 더 효과적으로 사용하는 것으로 나타났으며, 결과적으로 인쇄매체 읽기 소양 점수가 좀 더 높았다. 반면 디지털 읽기모형에서는 남학생이 여학생보다 높은 읽기성취를 보였다.

주제어: PISA, 읽기참여 이론, 인쇄물 읽기성취, 디지털 읽기성취, 초인지 전략

