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Investigation of the Structural Relationship among Factors That Affect Digital Reading

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I. Introduction

The percentage of adolescents using media has been reported to be as high as 90% and 89% of adolescents in member countries of the OECD typically use several devices, such as desktop computer, laptop, mobile phones, or tablets (OECD, 2011). The advent of digital devices have changed the way text is presented and received by readers, which can affect their comprehension of the text and learning (Coiro, 2011; Leu, Kinzer, Coiro, & Cammack, 2004). An increasing body of research on reading has evolved and accounted for the complex nature of reading and our understanding of multifaceted aspect of reading is enlarged than ever before accordingly. As the reading environment becomes more digitalized, literacy scholars recognize the importance of digital reading research (Coiro & Doubler, 2007; Foltz, 1996; Leu et al., 2004). However, the majority of reading research still focuses on print-based reading and the reading research on digital reading is at the beginning stages.

The Organization for Economic Co-operation and Development PISA conducted a Digital Reading Assessment as an optional domain in PISA 2009 and PISA 2012 to especially examine students' digital reading competencies by reflecting the change of reading environ-

ment in digital era. It is precious because those DRA results are sole to evaluate the digital reading competencies of Korean students in global level. By using those data, our research analyzed DRA results (i.e., score & navigation indices) and questionnaires (i.e. student questionnaire & ICT familiarity) to gain insights into predictors involved in the comprehension process of digital text. Through this we were able to discover the main variables affecting Korean students' digital reading and investigate the structural relation between each of the variables.

What we seek to reveal in this study is as follows:

Research questions:

1. What factors (e.g., ICT factors, attitude, and navigation indices) affect Korean students'digital reading assessment scores in PISA 2012 DRA?
2. What structural relationships are identified among factors (e.g., ICT factors, attitude and navigation indices)?

II. Literature Review

This section provides an overview of the three key factors that relate to digital reading. According to literature review and PISA digital reading assessment framework, this study focus on to investigate three factors that is well known to affect digital reading competencies: 1) navigation skills and strategies related to individual's cognitive skills and strategies required in the digital space, 2) attitude toward ICT related to attitudes towards digital reading and 3) Experiences and familiarity with digital device related to digital reading experience and familiarity with digital media.

1. Navigation skills and strategies

The term of the navigation is defined as "move on, over, or through in a ship or aircraft" (Navigate, n.d.). As a metaphor in a digi-

tal literacy field, navigation means virtual movement through digital space (Lawless & Schrader, 2008). Contrary to print-based reading of linear reading sequences, digital reading on hypertexts has no fronts or backs (Foltz, 1996). It is upon for readers' decision where to begin and end in endless nodes (documents) and links (hyperlinks) of the hypertext system. Researchers identify that there are individual differences of navigation patterns in the digital environment (Cromley & Azevedo, 2009; Cho, 2014). For instance, Lawless and Kulikowich (1996) categorized three types of navigators such as knowledge seeker, feature explorers, and apathetic hypertext users. MacGregor (1999) classified three different internet users such as sequential studier, video viewer, and concept connector. These studies indicate that readers use different navigation patterns, skills and strategies when they explore websites and hypertexts. Some readers comprehend hypertexts as if they read papers, while others focus more on digital features (e.g., videos, hyperlinks). Still others show idiosyncratic navigating patterns.

Readers dive into the digital sea with their own purposes (van den Broek & Kendeou, 2015). Navigation skills and strategies help readers achieve the readers' goal. Without navigation skills and strategies, readers may wander about digital space because they may not know which information, text, and/or website is what they want to seek for. When they lost in the digital space, adequate navigation skills and strategies help them return to the right path to the goal. For that reason, navigation is one of the critical elements for readers to possess in the digital reading.

Empirical evidence supports that navigation skills and strategies are closely linked to the digital reading performance. OECD's PISA report (OECD, 2015) generally supported the idea that navigation skills were one of the crucial factors that accounted for digital reading performance. In addition, individual studies found that navigation skills played a bridging role between print-based reading performance and digital reading. Naumann and Salméron (2016) revealed that readers'

navigation skills, measured by relevant page selection, were related to digital reading when readers were good comprehenders. Analyzing the PISA data, Hahnel and her colleagues (2016) also identified that navigation skills accounted for the digital reading performance while the navigation played a mediation role between print-based reading and basic computer skills.

2. Attitude toward ICT

In the reading research and reading education area, attitude toward reading was defined as "a system of feelings related to reading which causes the learner to approach or avoid a reading situation" (Alexander, & Filler, 1976). Attitude toward reading was considered as crucial factors to explain reading achievement because positive attitude toward reading prompts readers to engage in reading while negative attitude is likely to keep readers away from reading (Petscher, 2010). Research evidence showed that positive reading attitude increased the amount of reading, which contributed to the reading achievement (Wang, & Guthrie, 2004).

Unlike the ample evidence of reading attitude, there is a relative lack of research evidence of how ICT related attitude impact on students' digital reading performance. However, it is not a harsh assumption that attitude toward ICT plays a similar role in digital reading, as if attitude toward reading does in reading performance. In other words, positive attitude toward ICT may engage readers in digital reading, while negative attitude may lose readers an opportunity for digital reading (Keith, Richter, & Naumannn, 2010). Lee and Wu (2012) showed that attitude toward ICT significantly explained both online reading and PISA reading performance when analyzed PISA 2009 reading literacy data. In an analysis of 2012 PISA data on German students, Naumann and Sälzer (in press) also revealed that attitude toward ICT accounted for 7% of the variance of the digital reading performance. Combined together, these studies showed that

positive attitude toward ICT plays a positive role in performing digital reading. Nevertheless, a more theoretical explanation with empirical evidence needs to explain the why and how attitude toward ICT influence students' digital reading performance.

3. Experiences and familiarity with digital device

Educational scholars have pointed out that difference of educational resources and socioeconomic status are sources of educational inequality. Digital divide also designates educational inequality of opportunities between those who have to access information and communication technologies and those who have not (Hargittai, 2003). In the digital era, the differential opportunities of ICT availability at home and school become a source of digital divide. Thus, a common conjecture is derived that the more ICT availability brings the higher digital reading performance.

Against the common expectation, the effect of experience and familiarity with computer for digital reading is inconclusive and sometimes negative. Lee and Wu's study (2012) revealed that ICT availability at home provided positive correlation with 2009 PISA reading literacy scores, while ICT availability at school showed nonsignificant result. On the other hand, Naumann and Sälzer's (2015) study result reported that both ICT availability at home and school showed significant negative correlations with 2015 PISA reading scores. In an OECD report (OECD, 2015), ICT use at school in PISA 2012 showed a curvilinear ("a hill shape") relationship with digital reading, meaning that below the average computer use resulted in the highest performance in digital reading. Students' reading performance decreased when they were exposed to more computer use (ICT availability). The ICT availability is like a small dose of medicine. To some degree ICT availability and digital experience would be helpful for digital reading performance. Beyond some point, more exposure of the ICT may hinder students' digital reading performance. To analyze and interpret why

such results happen, further investigation needs to conduct, including students and teachers' perception of internet use and school curricular on the internet (Kolikant, 2012).

III. Research Method

1. Data sources and sample

Subjects were those 5,033 students who were sampled from 156 schools in Korea. Of these, 2,675 (1,251 male) participated in the computer-based assessment were analyzed for this study. The PISA targets 15-year-old students in grade 7 or higher. A multistage sampling procedure was implemented to ensure high representativeness of the data.

2. Measure and variables

1) Dependent variable

The dependent variable is constructed on the basis of the five plausible values (PVs) for students' digital reading achievements. This is due to complex survey design to estimate students' proficiency. CBA in PISA 2012 consist of 24 test form composed of different problem units. Students took a different type of tests randomly. Since all item response was not observed, it must be inferred from the observed item responses.

To reasonably deduce, PISA generates PVs of the 5 sets in each domain by applying the imputation methodology to missing data. More detailed PVs can be found in PISA 2012 technical report (OECD, 2012, pp. 146-147).

2) Independent variable

ICT usage (at home for school, at school, for entertainment)

ICT usages were measured by PISA 2012 information and communication technology familiarity (ICT) questionnaire. Students were asked to indicate how often use a computer for some activities outside of school or at school (1 = Never or hardly ever, 2 = Once or twice a month, 3 = Once or twice a week, 4 = almost every day, 5 = every day). See OECD (2014), 340p, table 16.53, 16.54 and 16.55 for items and parameters.

- ICT usage at home for school: It was measured by seven items. Some sample statements are: "Browsing the Internet for schoolwork.", "Using email for communication with other students about schoolwork." Cronbach's alpha was .84.
- ICT usage at school: It was measured by nine items. Some sample statements are: "Posting my work on the school's website." and "Playing simulations at school." Cronbach's alpha was .88.
- ICT usage for entertainment: It was measured by ten items. Some sample statements are: "Playing one-player games.", "Participating in social networks." Cronbach's alpha was .74.

Positive attitude toward computer

Positive attitude toward the computer was measured by PISA 2012 ICT questionnaire, which slightly revised from the Computer Literacy Inventory (Richter, Naumannn, & Horz, 2010). Students were asked to indicate to what extent agree with some statements when thinking about experience with computers (1 = strongly agree, 2 = agree, 3 = disagree, 4 = strongly disagree). Since all items were reversing coding, these data were rearranged by the researcher through recording. See OECD (2014, p. 341), table 16.57 for items and parameters. It was measured by three items. Some sample statements are: "The computer is a very useful tool for my schoolwork.", "Doing my homework using a computer makes it more fun." Cronbach's alpha was .81.

Webpage navigation index

In order to describe students' navigation behavior, the sequence of pages visited by students in the process of solving each task was extracted from the log files recorded by the test administration platform (OECD, 2015, p.108). In this study, three measures were used for webpage navigation index. That are number of relevant pages visited (N_rp), number of page visits to relevant pages (N_pvr) and number of page visits (N_pv). More specifically, N_rp computed from how many of the pages judged to be relevant to a task were accessed while the student worked on that task. N_pvr computed from how often students accessed a page that contains task-relevant information, has to be accessed to find task-relevant information or can be assumed to contain task-relevant information. Lastly, N_pv computed from visits to any pages, regardless of their relevance to the task, and regardless of whether each is a first visit to the page or a revisit (OECD, 2011). To account for possible effects of test composition and the order of cluster presentation on navigation, the navigation indices are centered on the test forms and countries (OECD, 2011).

Economic, social and cultural status (ESCS)

ESCS combines information on the highest educational level of parents (PARED) and home education resources (HEDRES) and cultural possessions (CULTPOS). ESCS is used as a control variable for the socio-economic status of students. See OECD (2014, pp. 316-318, 351-352) for detailed PARED, HEDRES and CUPTPOS.

3. Data analysis

Since PISA uses PVs of the 5 sets, researchers have to use appropriate analytical methods to get an unbiased estimate. When working with PVs, OECD (2014) recommends that estimate the variance for each plausible values and then average the results for testing the significance. This method is known to produces consistent estimators

of population parameters (Mislevy, & Sheehan, 1987; Mislevy, Beaton, Kaplan, & Sheehan, 1992; Rubin, 1987). Hence, this study analyzes the PVs of the 5 sets based on the imputation theory. Also, to secured representative of the population, used final student weight variable (w_fstuwt) provided at student level (OECD, 2014).

The Mplus 7.4 program was used for the data analysis. For model fit criteria, multiple indices were used. These included the chi-square statistic, the root mean square error of approximation (RMSEA), the comparative fit index (CFI), and the Tucker-Lewis index (TLI). With large sample size, the chi-square test is not a reliable method for assessing model fit (Bentler, 1990). Thus, we relied on standard cutoff recommendations for the RMSEA, CFI, and TLI. For the RMSEA, values approximating .08 indicate reasonable fit and for the CFI and the TLI, values greater than or equal to .90 suggest a model with proportionate improvement in fit from the baseline model (Brown, & Cudeck, 1993; Tuker, & Lewis, 1973).

For the test significance of mediation effect, bootstrapping method was used. This method does not need the normal distribution process for the distribution of the mediating effect; hence it has the advantage of producing more accurate results compared to the often used Sobel verification method for pre-existing mediating effect (Bollen, & Stine, 1990; Mallincrodt, Abraham, Wei, & Russell, 2006).

IV. Results

1. Descriptive statistics

Descriptive statistics were calculated to examine basic characteristics of the data and bivariate relations among study variables. These statistics included means, standard deviations, and intercorrelations among variables as reported in Table 1. The degree of correlation varied across study variables, ranging from zero to high correlation. With

regard to the ICT usages factors, ICT usages were negatively associated with DRA achievement and webpage navigation index except for ICT usage at home for school, illustrating that Koreas student's ICT usage does not relate to academic tasks. Unlike this, positive attitude toward ICT and webpage navigation index were positively associated with DRA achievement. Especially number of page visits to relevant pages, which is one of the webpage navigation indexes showed a strong correlation with DRA achievement. Table 1 also shows that ESCS were positively related to most of the variables.

Table 1. Intercorrelations among study variables

variable	1	2	3	4	5	6	7	8	9
1. ICT usage at home for school	—	.40**	.38**	.34**	.01	.01	.02	.16**	.19**
2. ICT usage at school		—	.21**	.13**	-.13**	-.17**	-.14**	-.15**	.02
3. ICT usage for entertainment			—	.18**	-.08**	-.07*	-.06*	-.02	.08**
4. Positive attitude				—	.06*	.10**	.09**	.20**	.12**
5. Number of relevant pages visited					—	.84**	.82**	.47**	.11**
6. Number of page visits to relevant pages						—	.85**	.61**	.13**
7 Number of page visits							—	.49**	.11**
8. DRA achievement								—	.29**
9. ESCS									—
Mean	1.76	1.19	2.33	2.64	.00	.00	.00	554.10	.01
SD	.59	.41	.64	.70	21.45	8.30	14.10	77.57	.74

Note. * $p < .05$. ** $p < .01$.

2. Measurement model

The measurement model component of structural equations refers to the relations between measured variables and their proposed latent constructs. The literature highlights the importance of ensuring an adequate measurement model before proceeding with the simultaneous analysis of measurement and structural parameters of the model (Anderson, & Gerbing, 1988; Bollen, 1989). For three ICT usage latent constructs measured by at least seven items, we used item parceling techniques whereby; responses to two or three items were summed

and averaged. Measurement model results are provided in Table 2. As shown, fit statistics indicated a very good fit for the measurement model ($\chi 2$ = 699.27, df = 92; CFI = .966; TLI = .955; RMSEA = .050; SRMR = .040, and all parameter estimates were statistically significant at $p<.001$. Indicator loadings across all constructs ranged from .43 to 1.06 (see Table 2 for loadings specific to each indicator and construct).

Table 2. Latent variable and unstandardized (standard error) and standardized factor loadings from final measurement model

Parameter estimate	*b*	(SE)	β
ICT usage at home for school			
Parcel 1: Internet for school +Email students	1.00	.00	.78
Parcel 2: Email teachers + Download from School	1.01	.03	.81
Parcel 3: Announcements +Homework + Share school material	1.01	.03	.84
ICT usage at school			
Parcel 1: Chat on line +Email + Browse for schoolwork	1.00	.00	.82
Parcel 2: Download from website + Post on website + Simulations	0.76	.04	.84
Parcel 3: Practice and drilling + Homework + Group work	0.95	.04	.83
ICT usage for entertainment			
Parcel 1: One player games +Collaborative games +Use email	1.00	.00	.43
Parcel 2: Chat on line + Social networks +Browse the Internet for fun	1.88	.14	.62
Parcel 3: Read news + Obtain practical information from the Internet	1.88	.15	.62
Parcel 4: Download music + Upload content	1.56	.10	.63
Positive attitude			
Useful for schoolwork	1.00	.00	.80
Homework more fun	0.91	.03	.72
Source of information	0.97	.03	.79
Webpage navigation			
Number of page visits	1.00	.00	.68
Number of page visits to relevant pages	0.76	.10	.78
Number of relevant pages visited	0.40	.10	1.06

3. SEM analysis

Figure 2 and table 3 show the results from the SEM analysis of the hypothesized mediation model. For simplicity in presentation, the paths from control variable (e.g. ECSE) to the mediators and outcome variables and the correlations are not shown in Figure 2. Statistically

significant mediation paths are boldfaced in Figure 2. The hypothesized mediation model fit the data adequately, using the full information maximum likelihood (FIML) estimation, $\chi 2$ (117) =952.77, CFI = .958, TLI = .944, RMSEA = .052.

After adjusted for ESCS, ICT usage at home for school had a significant positive impact on positive attitude towards computer and DRA achievement, whereas ICT usage at school had a significant negative impact on webpage navigation index and DRA achievement. ICT usage for entertainment had a significantly negative impact on DRA achievement. Positive attitude towards computer had a significant positive impact on webpage navigation and DRA achievement. Webpage navigation had a significant positive impact on DRA achievement. To summarize with regard to variables that affect DRA achievement, ICT usage at home for school, positive attitude towards the computer, webpage navigation had a significantly positive impact on DRA. On the other hand, ICT usage at school and ICT usage for entertainment had a significant negative impact.

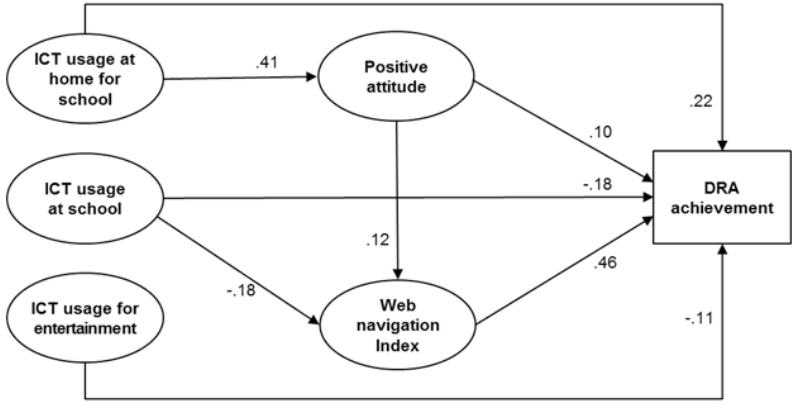

Figure 1. SEM analysis results

* The model designed to test ICT attitude and webpage navigation as mediators between ICT usage factors (at home for school, at school, for entertainment) and DRA achievement. ESCS was included as covariate, although their paths to other variables are not shown.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 3. Parameters, Standard errors for direct paths

effect			Unstandardized coefficient	S.E.	Standardized coefficient
ICT usage at home for school	→	Positive attitude	0.498***	0.043	0.413
ICT usage at school	→	Positive attitude	-0.084	0.053	-0.053
ICT usage for entertainment	→	Positive attitude	0.078	0.068	0.040
ICT usage at home for school	→	Webpage navigation	2.523	1.857	0.064
ICT usage at school	→	Webpage navigation	-8.991**	2.018	-0.175
ICT usage for entertainment	→	Webpage navigation	-3.616	2.785	-0.057
Positive attitude	→	Webpage navigation	3.780**	0.963	0.117
ICT usage at home for school	→	DRA achievement	32.120***	4.744	0.218
ICT usage at school	→	DRA achievement	-35.342***	5.389	-0.182
ICT usage for entertainment	→	DRA achievement	-25.894***	6.56	-0.109
Positive attitude	→	DRA achievement	12.682***	3.159	0.104
Webpage navigation	→	DRA achievement	1.741***	0.086	0.462

We used the bootstrapping procedure to determine the statistical significance of the mediation effects of positive attitude and webpage navigation. Bootstrapping (i.e., resampling from the original sample to create a sampling distribution; Efron, & Tibshirani, 1994) can be used to calculate less biased standard errors and create confidence intervals (CIs) around the estimate of a parameter under non-normal data conditions. If zero is included in the CI, it means that the mediation effect is not significant. Standardized Estimate, standard errors, and bootstrapped 95% CIs are reported in Figure 4. In the testing of the medication effects between ICT usages and DRA achievement, the three paths indirect effects were significant. Specifically, the mediation effects between ICT usage at home for school and DRA achievement, indirect effects through positive attitude only and including webpage navigation were positively significant. In contrast, the mediation effects between ICT usage at school and DRA achievement, indirect effects through webpage navigation was negatively significant. Other indirect effects were not significant.

Table 4. Parameters, Standard Errors, and 95% Confidence Intervals (CIs) for Indirect Paths

effect					Standardized Estimate	S.E.	95% CI - Bootstrap Percentile
Effects from ICT usage at home for school to DRA achievement							
ICT usage at home for school	→	Positive attitude	→	Webpage navigation → DRA achievement	0.023***	0.006	0.013, 0.032
ICT usage at home for school	→	Positive attitude		→ DRA achievement	0.044***	0.011	0.026, 0.062
ICT usage at home for school			→	Webpage navigation → DRA achievement	0.029	0.020	-0.005, 0.062
Effects from ICT usage at school to DRA achievement							
ICT usage at school	→	Positive attitude	→	Webpage navigation → DRA achievement	-0.003	0.002	-0.006, .000
ICT usage at school	→	Positive attitude		→ DRA achievement	-0.006	0.004	-0.012, 0.001
ICT usage at school			→	Webpage navigation → DRA achievement	-0.084***	0.019	-0.115, -0.053
Effects from ICT usage for entertainment to DRA achievement							
ICT usage for entertainment	→	Positive attitude	→	Webpage navigation → DRA achievement	0.003	0.002	-0.001, 0.006
ICT usage for entertainment	→	Positive attitude		→ DRA achievement	0.005	0.004	-0.002, 0.011
ICT usage for entertainment			→	Webpage navigation → DRA achievement	-0.028	0.019	-0.060, 0.004

V. Discussion and Conclusion

Two research questions were hypothesized in this study. The hypothesis was examined by SEM analysis and identified as follows:

Factors (e.g., ICT factors, attitude, and navigation indices) affect Korean students'digital reading achievement.

ICT factors, attitude and navigation indices have structural relationships.

In this research an investigation has been made as to whether or not the ICT usage, positive attitude toward ICT, and navigation index are variables that impact a student's DRA achievement. In addition to these variables, there was an attempt to analyze the structural relationship of the Digital Reading Assessment. According to the research results, all three factors (ICT usage, positive attitude, navigation index) impact DRA achievement. When ranking the most influential variable, navigation index (.46) scored the highest followed by ICT usage at home for school (.22) and then positive attitude toward ICT (.10).

Out of the pre-determined variables that affect digital reading achievement, navigation index showed to have the greatest impact. Navigation refers to the reading activity when one searches the internet with a goal for specific information. This process also includes entering search words, utilizing navigation pathway, evaluation of appropriate data and others. The results of this current research also coincides with previous research conclusions which considers navigation as an important skill in finding appropriate answers to questions through online reading assessment (OECD, 2011; Hahnel et al., 2015; Naumannn et al., 2008; Naumannn, 2015). This current study results showed that navigation effectiveness (i.e. appropriateness of web pages searched, frequency of related web pages, the number of overall web pages searched) was an indirect representation of a student's comprehension and engagement level. Thus the fact that navigation effectiveness is an important factor that can provide proof to predict digital reading achievement is a significant contribution of this research.

Following navigation, the next most influential factor affecting digital reading achievement was ICT usage at home for school. Since ICT usage is related to digital reading familiarity, an attempt was made to observe the direct and indirect effects of how ICT usage variables influence a student's digital reading achievement. Interestingly enough, research results revealed that internet usage pertaining to

only ICT usage at home for school, such as searching information or for homework purposes had a static effect on DRA achievement (.22). The other two factors—ICT usage at school (-.18) and ICT usage for entertainment (-.11)—had a negative influence. The only difference in ICT at home and at school was the change of location since the purpose was consistently school related work. As a result, there is a high chance that these two factors have both a direct and indirect effect on DRA achievement. However, whereas ICT usage at home for the purpose of school work has a positive impact on DRA achievement, why does ICT usage at school have a negative influence? There is a need to understand ICT related to Korea's situation and the school environment.

Firstly, there is a possibility that the quantity and quality of ICT usage in Korean schools is not very effective. According to the OECD reports analyzing the results of PISA 2012 computer usage and computer based assessment achievement (OECD 2015, p.53), Korea's ICT usage at school ranks at the bottom in comparison to other participating countries. In addition, reports of the actual usage of ICT in Korean schools by Kim et al. (2017) indicates that although the ICT infrastructure is highly developed outside of school, the hardware for school ICT classes are lacking. Even the ICT usage lecture content needs much improvement. Considering the environmental and class lecture aspects, the lack of ICT usage has reduced the effectiveness of ICT usage for school. As a result, it can be predicted that this factor may not have a positive impact on DRA.

Secondly, there may be a difference in DRA achievement between students who use ICT for school work at home and students who use ICT for school in school. In other words, in Korean junior and high school environments where ICT classes are not effectively carried out or students who are exam-oriented based on paper examination, the content of ICT usage at school such as 'chatting during school class hours' or 'emailing' may not be the normative student behavior. Instead, there is a high chance that this is an 'exceptional' behavior

for students who generally have high academic achievement and are compliant to the teacher. On the other hand, ICT usage at home for school are students who are actively engaged with school homework and are special behavioral, cognitive and affective characteristics of students who generally have high academic achievement.

In summary, we empirically discovered that ICT usage, attitude toward ICT, webpage navigation and digital reading achievement are interconnected each other. Also, attitude toward ICT mediates between ICT usage and webpage navigation skills. Additionally, webpage navigation skills mediate between a positive attitude toward ICT and digital reading achievement. Based on these empirical evidences, a deliberate and thoughtful educational approach and policy should be made so to enhance students' digital reading competencies.

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ABSTRACT

Investigation of the Structural Relationship among Factors That Affect Digital Reading

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The purpose of the study was to examine the structural relationship among factors that affect digital reading. PISA DRA data was analyzed to reveal 1) what factors (e.g., ICT factors, attitude, and navigation indices) affect Korean students'digital reading assessment scores in PISA DRA?; 2) What structural relationships are identified among factors (e.g., ICT factors, attitude and navigation indices)?. According to the research results, all three factors (ICT usage, positive attitude, navigation index) impact DRA achievement. When ranking the most influential variable, navigation index (.46) scored the highest followed by ICT usage at home for school (.22) and then positive attitude toward ICT (.10). Out of the pre-determined variables that affect digital reading achievement, navigation index showed to have the greatest impact. Following navigation, the next most influential factor affecting digital reading achievement was ICT usage at home for school. Since ICT usage is related to digital reading familiarity, an attempt was made to observe the direct and indirect effects of how ICT usage variables influence a student's digital reading achievement. In summary, we empirically discovered that ICT usage, attitude toward ICT, webpage navigation and digital reading achievement are interconnected each other. Also, attitude toward ICT mediates between ICT usage and webpage navigation skills. Additionally, webpage navigation skills mediate between a positive attitude toward ICT and digital reading achievement. Based on these empirical evidences, a deliberate and thoughtful educational approach and policy should be made so to enhance students' digital reading competencies.

KEYWORDS Digital Reading, Factor, PISA, DRA, Navigation