

The Mediating Role of Self-Regulation Between Digital Literacy and Learning Outcomes in the Digital Textbook for Middle School English

Jeongmin LEE*

Jiyeon MOON

Boram CHO

Ewha Womans University
Korea

Digital textbooks draw attention as a new format of educational material, using the advantages of information technology; this innovative learning tool requires consideration as a part of successful and effective learning. The main purpose of the article is to investigate the mediating role of self-regulation between digital literacy and learning outcomes (academic performance and learning motivation) when using digital textbooks as a learning tool in Middle School English. Both descriptive and regression analysis were used as data analyses methods. The main findings of this study were as follows: first, digital literacy and self-regulation significantly predicted academic performance and learning motivation; second, self-regulation fully mediated between digital literacy and academic performance; third, self-regulation partially mediated between digital literacy and learning motivation. The research results proved the effects of digital literacy and self-regulation on the learning outcomes and mediating role of self-regulation between digital literacy and learning outcomes. These results help to design and implement effective lessons when using a digital textbook in Middle school English.

Keywords : Digital Textbook, Digital Literacy, Self-Regulation, Academic Performance, Learning Motivation

* Ewha Womans University
jeongmin@ewha.ac.kr

Introduction

With the arrival of information communication technology in the field of education, there came an attempt to pursue a better learning environment and methods to raise the digital generation with creativity and professionalism. In order to create a new educational setting, digital textbooks are being developed and partially employed for designated demonstration middle schools in South Korea. These digital textbooks are defined as the digitalized forms of curriculum-based textbooks, which can be read, listened, and written by learners on various types of devices, such as desktop computers, notebooks, tablet computers, and portable devices through the Internet (Byeon et al., 2005). In addition, digital textbooks have many attractive features, for example: user friendly functions, attractive graphics and animations; cooperative learning communities, etc. (Hong et al., 2013). These features could encourage learners' creativity and engagement.

Especially, digital textbooks show the advantages of their use in language classes. They support richer learning content with a combination of textbooks, reference books, workbooks, and dictionaries, including multimedia content such as audio, 3D graphics, video, animation, and virtual or augmented realities. These functions help to overcome the limitation of teacher-centered learning environment (Han, 2014). Therefore, there have been continuous research efforts to gauge the usefulness and effectiveness of digital textbooks in the perspective of material collection, content delivery media, learning methods, accessibility, reusability, expandability, and so on (Kim & Jung, 2010). Furthermore, most research efforts have focused on the benefits of digital textbooks compared printed textbooks. By contrast, relatively few resources and little care are provided to increase learning effectiveness of digital textbooks. In addition, there was no research involving investigating factors that influenced the effectiveness of digital textbooks for middle school English.

In this study, we focused on two indicators showing effectiveness with the

cognitive and psychological aspects: academic performance and learning motivation (Lim, Morris & Yoon, 2006). In particular, learning motivation plays a key role in language learning to trigger learners' effort, choice, voluntary behavior and all the other phenomena when learning a second language learning (Crooks & Schmidt, 1991). With digital textbooks, achieving learner motivation is of utmost importance when designing individual lessons and whole curriculums.

Digital literacy can be regarded as a learner's ability to use digital devices and tools to locate, evaluate, use and create information (Mohammadyari & Singh, 2015). Instead of relying on the more limited information available in print, or a teacher's explanation in a traditional learning environment, learners can not only find but also create their own learning sources and content using their digital devices and applications in digital-textbook-based classrooms. Accordingly, the ability to know, judge, and effectively use the displayed information is required for prospective learners (American Association of Colleges & Universities, 2010).

When it comes to learning a second language, self-regulation plays an important role: students with a good ability to self-regulate could integrate multiple components of skills, attention, working memory, and inhibitory control. Generally, they are able achieve higher levels compared to students with lower self-regulation (Corno & Mandinach, 1983; Pintrich, 1995). While using digital textbooks as a learning tool, students' self-regulation affects academic outcome in monitoring, directing, and regulating their behaviors during the whole learning process (Winters, Greene, & Costich, 2008).

Thus, the main purpose of this study was not only to prove whether digital literacy and self-regulation could predict academic performance and learning motivation while using digital textbooks in middle school English, but also to investigate the mediating effect of self-regulation between digital literacy and learning outcomes (academic performance and learning motivation) using digital textbooks. Based on the previous research studies, self-regulation was regarded as a psychological part of the learner variables. Therefore, we designated self-regulation

as a mediator, referring to the self-directive process used by learners (Pintrich, 1995; Wolf, 2007).

This study was guided by the following four research questions:

- a. Do digital literacy and self-regulation predict academic performance?
- b. Do digital literacy and self-regulation predict learning motivation?
- c. Does self-regulation have a mediating role between digital literacy and academic performance?
- d. Does self-regulation have a mediating role between digital literacy and learning motivation?

Theoretical background

Digital Textbooks in Schools

In the 21st century, revolutionary change in the field of technology poses a challenge for the existing education system. Leaders and educational specialists have issued a ‘paradigm shift’ (Partnership for 21st Century Skills, 2003), which widens the gap between one’s own life and learning. Young generations will not be prepared for future society’s accelerating pace of technological change from paper and pencil. The Ministry of Education made a step to allow this ‘paradigm shift’ to meet the needs of the 21st century by introducing digital textbooks into classrooms.

Digital textbooks can bring changes to teaching practices in South Korean schools, and are now becoming a trend throughout the world. Digital textbooks allow students to have access to learning content that is tailored to their abilities and interests. In addition to all the best features provided by printed textbooks, digital textbooks also offer various interactive functions, and provide learners with reference books, workbooks, dictionaries, and multimedia content such as video

clips, animation, and virtual reality (Byun, Choi, & Song, 2006). They can help individual learners highlight important parts, take notes, and ultimately combine the presented content with high-quality and reliable knowledge of their own.

Especially, digital textbooks show a number of advantages in language learning. According to the previous studies, using digital textbooks help language students to overcome the limitations of their learning environment and increase the possibility of effective language learning (Han, 2014; Rickman et al., 2009). First, rich sources of input can be provided as a model. Second, various kinds of multimedia provide a learning situation and context for meaningful learning; thus, better input occurs. Third, a combination of those language-use contexts and technologies for communication results in an ability to use the language in reality, which enables to produce language output naturally and authentically. Fourth, the exposure of rich sources connects to natural culture acquisition.

Digital Literacy

Digital literacy is defined as critical thinking that requires users to evaluate information from the internet properly. It is an ability to understand many forms of existing information and combine it with new information (Gilster, 1997). There are many different terms like digital literacy to measure how students use this information, such as: digital competence, digital skills, technology literacy, information literacy, and community literacy. However, the focus of this study is the use of digital textbooks, including how students can take advantage of them during classes and other learning activities. Digitally literate students are those who can find the information needed for their questions or decisions, acquire quality information from a variety of sources, and also gauge the importance of said information (California Media and Library Educators Association, 1994).

The importance of digital literacy has increased recently, due to the active acquisition and utilization of information from the internet. Previous research

studies regarding digital literacy have been mainly focused on the effectiveness of digital textbooks compared to printed textbooks (Song & Kang, 2011; Byeon, Kim, Song & Lee, 2010) or as a measurement tool for learning (Kim & An, 2003). However, the adoption of the digital textbook in secondary schools throws questions; their basic knowledge of ICT, their communicative abilities, how much they accept from multiple sources, and how they can use as their learning tool.

Moreover, Korean educational government have regarded digital textbooks and smart learning as a solution for rural areas, bridging the gap created by economic and developmental divides (Byun, Choi, & Song, 2006). For language learning, it allows isolated students to encounter opportunities to study through indirect learning, a wide access to content and a digital learning environment. Therefore, solving a problem of digital literacy could be a key to relieve inequality of educational opportunity (Besser, 2002).

Self-Regulation

Self-regulation is defined as the ability to recognize one's own learning and take control of the whole process of learning behavior (Pintrich & De Groot, 1990), which enables to study effectively and strategically with metacognition (Zimmerman & Martinez-Ponz, 1986; Vohs & Baumeister, 2005). Since the self-regulated learning emphasize effective and strategic learning, learning behaviors like monitoring, directing, and regulating actions toward goals of information acquisition, expanding expertise, and self-improvement are observed for this study (Paris and Paris 2001).

With the change of learning environment, self-regulation has been emphasized for the effectiveness and influences (Park, 2006). Self-regulation has an important role in the enhancement of self-efficacy and self-concept building. It affects academic performance, social adjustment, and one's emotional state (Mischel, Shoda, & Peake, 1988). With consideration to the learning environment, using a

variety of digital devices as digital textbooks allows students to learn freely; this may not be the traditional way of learning with lessons taught by a teacher, but it also removes the inherent boundaries that come with traditional teaching methods.

During the class in digital-textbook-based classrooms, learners are required to perform actions like ‘finding’ and ‘creating’ their own learning sources and content. By directing and regulating their own actions, they know, judge, and finally use the information; the whole management modulation operates toward their learning goals.

Especially in second language learning, self-regulation plays an important role: second language learners who developed effective self-regulation skills are better to integrate multiple components of skills, attention, working memory, and inhibitory control (Corno & Mandinach, 1983; Pintrich, 1995). Usually, the beginners have limited amount of language sources, thus, the use of monitoring, elaboration, and inferencing is key to successful language learning. While using digital textbooks as a learning tool, students’ self-regulation affects academic outcome in monitoring, directing, and regulating their behaviors during the whole learning process (Winters, Greene, & Costich, 2008).

Learning Motivation

Motivation is defined as what degree of effort people will make in regard to what experiences or goals they choose to undertake or avoid (Crooks & Schmidt, 1991). In the digital textbook setting, achieving learner motivation is itself of special significance in designing lessons and curriculum. In this study, learning motivation is based on Keller’s ARCS theory (Keller, 1987) since motivation seems to be a key factor in determining successful learning when implementing digital textbooks. For teachers, there are several reasons to use digital textbooks: first, to adapt diverse learning styles, second, to boost student motivation and third, to enhance the material quality. Among these given reasons, motivation itself is the

ultimate goal of learning, and the ACRS model helps to stimulate and sustain learner motivation.

In particular, learning motivation plays a key role in language learning, triggering the learners' effort, choice, voluntary behavior and all the other phenomena in the field of second language learning (Crooks & Schmidt, 1991).

Relationships among Digital Literacy, Self-Regulation, and Digital Textbook Learning Outcomes

There have been a few research studies performed to help understand the relationship between digital literacy, academic performance, and learning motivation in a digital textbook setting. However, previous research used similar circumstances with digital literacy, such as ICT. Also, there exist various concepts of digital literacy including competence, skills, technology literacy, and information literacy. Since the focus of this study is about how students can take advantage of digital textbooks in classes and other learning activities, we look over all similar experiments using the concept of digital literacy and ICT circumstances that can be observed in a digital textbook.

By focusing on internal factors, literacy engagement has been found to involve the integration of cognitive strategies and motivational goals during literary activities (Verhoeven & Snow, 2001). Firstly, the previous results indicated that digital literacy had a positive effect on academic performance (Hitomi & Kazuhisa, 2007; Kang, Lee, Kim, Yun, 2011; Kang, Song, Lee, Ku, 2010; Westhuizen & Jones, 2010; Vrana, 2014). According to Kahne et al. (2012), digital media literacy education can be associated with increased online political engagement and increased exposure to diverse perspectives in high school and college settings.

Other researchers expressed positive opinions toward the relationship between digital literacy and learning motivation. According to previous studies, bidirectional relationships exist between motivation and literacy (Becker et al, 2010). The

Cross-Aged Literacy Program has supported the motivation toward literacy learning for low-achieving ninth-grade students (Boyd, 2011). Based on the previous research, we supposed that digital literacy could predict academic performance and learning motivation.

Studies on the interconnectedness between literacy skills and self-regulation have shown that self-regulated students are more literate. (Wolf, 2007; Boekaerts & Niemivirta, 2000). There is a correlation between the digital literacy and self-regulated learning skills of students in a University e-learning environment (Yang & Kim, 2014).

In the case of self-regulation, previous research studies have reported that it could predict academic performance and learning motivation (Sim, 2013). A number of studies have revealed that self-regulation can predict academic performance in an ICT environment (Schunk & Ertmer, 1999; Steffens, 2008; Delfino et al, 2008). Positive opinions regarding the relationship between self-regulation and learning motivation have also been reported (Bandura, 1991, Bell et al., 2008; Auld et al., 2010).

Considering the definition of self-regulation, self-regulated learners are able to control their cognitive functions in the process of learning. Given that digital literacy might reflect socio-economic status (Zillien & Hargittai, 2009), gauging the effect of self-regulation on resource control as a mediator could be meaningful. The Chicago School Readiness Project (CSRP) for low-income students investigated the mediating role of a self-regulating mechanism, and partial support was found for improvement in children's self-regulation as a hypothesized mediator for their gain in academic readiness (Raver et al., 2011). Barnard also focuses on the mediating role of self-regulation (Barnard et al, 2008). In addition, this study focuses on the mediating effect of self-regulation, in particular its impact on academic performance and learning motivation as internal cognitive processes within the learners themselves, (Raver et al., 2011; Barnard et al, 2008).

Method

Subject and Procedure

One hundred sophomores, all undertaking a regular curriculum in middle school, participated in this study in 2014. The school was highly interested in new technologies, and has adopted them into classes; thus, the teachers and students were used to using digital textbooks and devices. Of these 100 students, 40% were male and 60% female, all of whom (including their teachers) had experience using digital textbooks in the previous semester. At the first week of the study, orientation sessions were provided. Students were required to use mobile phones, iPads or tablet PCs with digital textbooks for eight weeks. The learning content included two lessons about traditional fairy tales and international foods, following the national curriculum with government-provided digital textbooks, including listening, speaking, reading and writing sessions. One teacher took charge during the entire period encompassed by the experiment.

Because of level differences, classes consisted of students of the same level, taught by a single English teacher. While in class, students were randomly assigned groups to perform class activities and tasks that consisted of teaching materials using a digital textbook. Questionnaires related to digital literacy and self-regulation were distributed to the students at the beginning, and learner motivation and academic achievement were measured at the end of the eight week period. After ten incomplete responses were eliminated, the remaining 90 responses were analyzed for this research.

Measurements

Digital Literacy

To measure digital literacy, questionnaire items developed by Jang (2014) were

revised in order to adapt the learning situation using a five point Likert scale. There were four subdivided sections: Information Utilization Ability (consisting of 7 items), Critical Understanding Ability (7 items), Communication Ability (7 items), and Norm Observance Ability (7 items). The Information Utilization Ability section was used to measure the skill of information utilization using digital media. The Critical Understanding Ability section was used to measure the critical interpretation ability. The Communication Ability section was used to measure the ability to express one's story and opinion as well as the ability to share with others. The Norm Observance section included social norms and etiquette involved in using the internet. The reliability of the 28 test items was .91.

Self-Regulation

Self-regulation is defined as the ability to recognize one's own learning and take control of the whole process of learning behavior. According to the definition, self-regulation was measured by a questionnaire developed by Pintrich and DeGroot (1990). It consisted of nine questions, with a five point Likert scale, including metacognitive strategies such as 'I ask myself questions to make sure I know the material I have been studying'. The reliability of the nine test items was .78 in this study.

Academic Achievement

To determine the students' performance, GPAs from their final exam were used at the end of the semester, since the exam reflects the content that they learned in that semester. The exam included multiple choice questions, open-ended descriptive questions, and performance test scores to reflect listening and speaking skills, ranging from 0 to 100.

Learning Motivation

Learning motivation was measured using an instrument described by Lee, Shim, Kim, and Lee (2010). It consisted of 12 questions, with a five-point Likert scale

based on Keller's ARCS theory. This section is divided into four segments, based on this theory: attention, relevance, confidence and satisfaction. The relevant questions are 'Do you think learning material is various and interesting?', 'Do you think you can learn well that you want to learn through this class?', 'Do you think the content of learning is useful?', and 'Are you satisfied with learning task after finishing it?'. The reliability of the 12 test items was .88 in this study.

Data analysis

Data from the survey responses was processed using the SPSS 20 for descriptive statistical analysis for the sake of this study. The reliability of the test scores were estimated using Cronbach's α . Then, regression analyses were used to investigate the effect of digital literacy and self-regulation on learning outcomes (IE: academic performance and learning motivation). In addition, to investigate the mediating effect of self-regulation between digital literacy and learning outcomes, Baron and Kenny's mediation analysis (Baron & Kenney, 1986) and Sobel test (Sobel, 1982) was used.

Results

Descriptive Statistics

We calculated the mean and standard deviations of self-regulation, digital literacy, academic performance, and learning motivation to investigate the general tendency of the collected data. Except for academic the achievement results, each variable was measured with the five- point Likert response scale. The results are summarized in Table 1.

Table 1. Results of descriptive statistics (n=90)

Variable	<i>M</i>	<i>SD</i>	Minimum value	Maximum value
Self-regulation	3.23	1.05	1	5
Digital literacy	3.12	1.19	1	5
Academic performance	53.93	27.79	8	98
Learning motivation	3.52	1.12	1	5

Correlation Analysis

Correlations were also examined to check the strength of the relationships among the variables, and the results revealed significant correlations among all of the variables at the alpha level of .05. The results are summarized in Table 2, below. As shown in Table 2, there were positive correlations between academic performance and self-regulation ($r=.315$, $p<.01$), digital literacy and self-regulation ($r=.572$, $p<.01$), and academic performance and digital literacy ($r=.253$, $p<.01$).

Table 2. Correlations among variables (n=90)

Variable	Self-regulation	Digital literacy	Academic performance	Learning motivation
Self-regulation	1			
Digital literacy	.572**	1		
Academic performance	.315**	.253**	1	
Learning motivation	.460**	.462**	.143	1

** $p < .01$

Predictability of Self-regulation and Digital Literacy's on Academic Performance

We conducted a simple regression analysis, with self-regulation and digital literacy

Table 3. Results of regression analysis on academic performance (n=90)

Predictor variable	Dependent variable	B	SE	β	<i>t</i>	<i>p</i>	R ² (adj.R ²)
Self-regulation	Academic performance	1.424	.466	.315	3.058**	.003	.099 (.089)
Digital literacy		.375	.155	.253	2.412*	.018	.064 (.053)

***p* < .01, **p* < .05

to predict academic performance in a digital textbook setting in middle school English. Results are summarized in Table 3, below.

According to the results of regression analysis on academic performance, predictors such as self-regulation and digital literacy were significant (*p* < 0.1). Academic performance was explained by self-regulation, 10% (adj R² = .089), digital literacy, 6% (adj R² = .053) of value's total variation.

Predictability of Self-Regulation and Digital Literacy's on Learning Motivation

According to the regression results on learning motivation in Table 4, predictors like self-regulation and digital literacy were significant (*p* < 0.01). Learning motivation was explained by self-regulation, 21% (adj R² = .203), digital literacy, 21% (adj R² = .205) of value's total variation.

Table 4. Results of regression analysis on learning motivation (n=90)

Predictor variable	Dependent variable	B	SE	β	<i>t</i>	<i>p</i>	R ² (adj.R ²)
Self-regulation	Learning motivation	.737	.149	.460	4.938**	.000	.211 (.203)
Digital literacy		.246	.050	.462	4.969**	.000	.213 (.205)

***p* < .01

Mediation Analysis

The results confirmed that self-regulation and digital literacy were able to predict academic performance and learning motivation. Therefore, we additionally verified self-regulation as a mediator among digital literacy, academic performance, and learning motivation by using Baron & Kenny (1986)'s mediation analysis.

The mediating effect of self-regulation between digital literacy and academic performance

Our results revealed that digital literacy significantly predicted academic performance. We confirmed that it satisfied the first condition set forth by Baron & Kenny (1986). Then, we tested whether it satisfied the second condition set forth by Baron & Kenny (1986). The analysis results indicated that digital literacy was a significant predictor of academic performance ($\beta=.253, p < .05$, see Table 5). We also confirmed that digital literacy was a significant predictor of self-regulation ($\beta =.572, p < .01$).

After entering digital literacy and self-regulation into the regression model to test the final step, we confirmed that self-regulation was able to significantly predict academic performance ($\beta =.253, p < .05$), indicating that the model satisfied the third condition of Baron & Kenny (1986).

Table 5. Results of mediation analysis between digital literacy and academic performance (n=90)

Model	Predictor Variable	Dependent variable	B	SE	β	t	p	R ² (adj. R ²)
1step (predictor→ dependent variable)	Digital literacy	Academic performance	.375	.155	.253	2.412*	.018	.064 (.053)
2step(predictor→ mediator)	Digital literacy	Self-regulation	.190	.029	.572	6.652**	.000	.327 (.320)
3step(predictor, mediator→ dependent variable)	Digital literacy	Academic performance	.192	.574	.150	1.307	.195	.121 (.100)
	Self-regulation		1.142	.567	.253	2.014*	.047	

** $p < .01$, * $p < .05$

Finally, digital literacy was shown to have an effect on academic performance. However, when we factored in the effect of self-regulation on digital literacy, we saw that it had a higher effect on academic performance with full mediation.

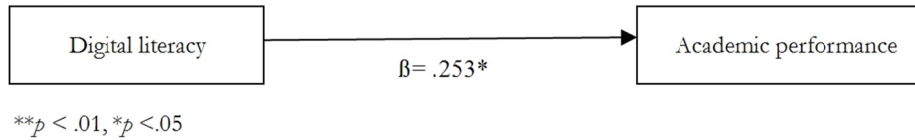


Figure 1. Regression on Academic Performance.

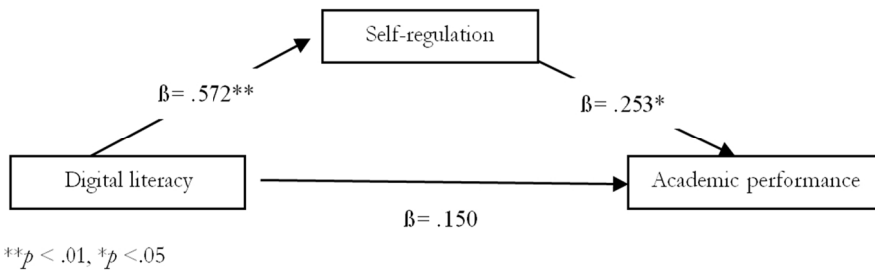


Figure 2. Results of mediation analysis between digital literacy and academic performance

As seen in Figure 1, ($R^2=.064, p < .05$), the influence of self-regulation was increased 5.6% compared to when digital literacy was used as a predictor with self-regulation, as shown in Figure 2, ($R^2=.121, p < .05$). Using the Sobel test equation, self-regulation was found to be statistically significant between digital literacy and academic performance ($z=2.769, p < .05$). Eventually, the mediating effect of self-regulation satisfied Baron & Kenny's Sobel test (Baron & Kenny, 1986; Sobel, 1982) at a significance level of .05. It demonstrated that self-regulation had a full mediation effect between digital literacy and academic performance.

The mediating effect of self-regulation between digital literacy and learning motivation

The results of the regression analysis on learning motivation, between digital

literacy and learning motivation are represented in Table 6. Digital literacy had a significant effect on learning motivation ($\beta=.462, p < .01$), satisfying the first condition set forth by Baron & Kenny (1986). Digital literacy also had significant effect on self-regulation ($\beta=.572, p < .01$), satisfying their second condition. Finally, after digital literacy and self-regulation was entered into the regression equation to analyze their influence on learning motivation, it was discovered that there were significant effects ($\beta=.290, p < .05$). Therefore, self-regulation could mediate between digital literacy and learning motivation.

Table 6. Results of Mediation Analysis of Self-Regulation Between Digital Literacy and Learning Motivation (n=90)

Model	Predictor Variable	Dependent variable	B	SE	β	t	p	R ² (adj. R ²)
1step (predictor→ dependent variable)	Digital literacy	Learning motivation	.246	.050	.462	4.969**	.000	.213 (.205)
2step (predictor→ mediator)	Digital literacy	Self- Regulation	.190	.029	.572**	6.65**	.000	.327 (.320)
3step (predictor, mediator→ dependent variable)	Digital literacy	Learning motivation	.158	.058	.296**	2.69**	.008	.270 (.254)
	Self- regulation		.466	.176	.290	2.65*	.010	

** $p < .01$, * $p < .05$

In addition, when the mediator (self-regulation) was entered into the regression model, learning motivation's influence ($R^2=.270, p < .05$) was increased about 6% compared to the result obtained when digital literacy was used as a predictor for self-regulation, using Figure 3 ($R^2=.213, p < .05$). The final model is represented in Figure 4. Using the Sobel test equation, self-regulation was found to be statistically significant between digital literacy and learning motivation ($z=3.947, p < .05$). Eventually, self-regulation's mediation effect satisfied the conditions set forth by Baron & Kenny as well as the Sobel test at significance level of .05, indicating that

self-regulation had a partial mediating effect between digital literacy and learning motivation (Sobel, 1982).

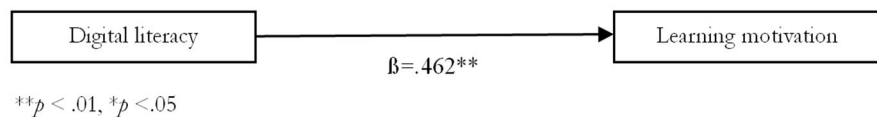


Figure 3. Regression on learning motivation

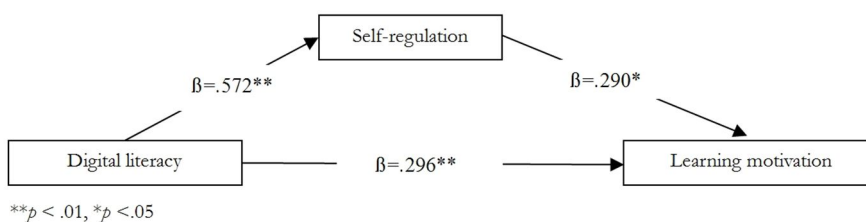


Figure 4. Results of mediation analysis between digital literacy and learning motivation.

Conclusion

The purpose of this study was to investigate whether digital literacy could predict academic performance and learning motivation. In addition, the mediating effect of self-regulation among digital literacy, academic performance, and learning motivation is examined in digital textbooks for middle school English. Our results are summarized as follows:

First, though our results are inconsistent with the results of previous research studies (Kang, Lee, Kim, Yun, 2011; Kang, Song, Lee, Ku, 2010), we found that digital literacy ($\beta = .25, p < .05$) was able to significantly predict academic performance. This means that if the learner has higher digital literacy, the learner will have higher academic performance. Therefore, having higher digital literacy ability will enhance learning in the digital textbook circumstance.

Second, digital literacy ($\beta=.46, p < .01$) was able to significantly predict learning motivation. This is in agreement with a previous research study (Kim & Nam, 2008), suggesting that digital literacy has an important role in the digital textbook learning process; having a higher literacy ability can make it easier to participate in the learning process, giving learners a more positive feeling about their educational experience. It will make learners feel positive about the learning process. This kind of positive reinforcement lends itself to boosting the student's learning motivation.

Third, self-regulation ($\beta=.31, p < .01$) was able to predict academic performance. In addition, self-regulation ($\beta=.46, p < .01$) was able to predict learning motivation. Our results are in agreement with previous research results (Sim, 2013), indicating that having higher self-regulation can positively affect academic performance and learning motivation.

Fourth, self-regulation was fully mediated between digital literacy and academic performance. In addition, self-regulation was partially mediated between digital literacy and learning motivation. Previous research results support our current research results (Jeong, 1999; Pintrich & De Groot, 1990). If learners possess higher digital literacy skills, their self-regulation will increase. Self-regulation can further academic performance and learning motivation in the case of digital textbooks.

The findings provided the following implications. These results imply that high level of digital literacy and self-regulation tends to result in better academic performance and learning motivation as claimed in prior research. Therefore, teacher allows a certain amount of time to get used to the tools and develop one's digital literacy for preparation stage. Strategic learning is also a key to develop self-regulation. Teacher's guide, tips and explanation during learning activities enables to raise learner autonomy – the one of the most important goals of language education and successful learning.

Moreover, self-regulation was fully or partially mediated digital literacy and learning outcomes. Given that digital literacy generally reflects inequality of

educational opportunity, textbook design to increase self-regulation, such as allowance for success, positive feedback, and learner control, would be beneficial in this regard. For digital textbooks class, designing a strategy in the utilization of textbooks by teachers is needed to help their students develop their own self-regulation ability. Some researchers have suggested that rewards or strategies, such as shortening learning content using the summary method, and having structured review time, are effective (Sim, 2013).

Digital literacy and self-regulation are a critical determinant of academic performance and learning motivation as claimed in prior research. The figure for academic performance was significant but doesn't seem to have high explanation power (self-regulation, 10% (adj $R^2=.089$), digital literacy, 6%, (adj $R^2=.053$)). Given that the participants are in their beginning level of digital textbook, assuming the limitation of language sources and utilization of self-regulation ability, the generalization of this findings were limited. Therefore, future research should examine the effects of integrating other learning process variables such as learning presence, learning flow, etc.

This study also includes several limitations, the most important of which is the small size and scope of the sample. A follow-up study, consisting of a larger group of samples, could provide a better understanding. In addition, elaboration of the definition, scope, and research context could be pointed out. If the study divides the sub-categories of self-regulation, the result would show high correlation between factors. Moreover, as it is second language class in public school, the time was short and the whole percentage of self-regulated activities by student themselves were limited. Moreover, the influence of background knowledge was significant. A lack of control in variables, such as the individual's socio-economic background, may influence to the results. The relatively short period of observation could be also pointed to as a weakness in this study. Further research addressing the limitations of this study is required to elaborate all these suggestions using a larger sample size, controlled variables and longer research periods.

References

- American Association of Colleges & Universities. (2010). *Information literacy value rubric*. Retrieved from <http://www.aacu.org/value/rubrics/pdf/InformationLiteracy.pdf>
- Auld, D. C., Blumberg, F. C., & Clayton, K. (2010). Linkages between motivation, self-efficacy, self-regulated learning and preferences for traditional learning environments or those with an online component. *Digital Culture & Education*, 2(2), 128-143.
- Bandura, A. (1991). Social cognitive theory of self-regulation. *Organizational behavior and human decision processes*, 50(2), 248-287.
- Barnard, L., Paton, V., & Lan, W. (2008). Online Self-Regulatory Learning Behaviors as a Mediator in the Relationship between Online Course Perceptions with Achievement. *The International Review of Research in Open and Distributed Learning*, 9(2), 1-11.
- Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of personality and social psychology*, 51(6), 1173-1182.
- Becker, M., McElvany, N., & Kortenbruck, M. (2010). Intrinsic and extrinsic reading motivation as predictors of reading literacy: A longitudinal study. *Journal of Educational Psychology*, 102(4), 773.
- Bell, B. S. & Kozlowski, S. W. J. (2008) Active Learning: Effect of core training design elements on self-regulatory processes, learning and adaptability, *Journal of Applied Psychology*, 93(2), 296-316.
- Boekaerts, M., & Niemivirta, M. (2000). Self-regulated learning: Finding a balance between learning goals and ego-protective goals. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 445-457). San Diego, CA: Academic Press.
- Boyd, M. J., & Dobrow, J. (2011). Media literacy and positive youth development. *Advances in Child Development and Behavior*, 41, 251-271.

- Byeon, H., Kim, J. C., Song, Y. H., & Lee, W. H. (2010). Effectiveness of digital textbook. Seoul: Korea education and research information service. Retrieved from <http://lib.keris.or.kr/search/detail/CATLAG000000010234>
- Byeon, H., Yu, K., Yu, J., Choi, J., & Park, S. (2005). A study for developing a standard of e-textbooks in 2005. Seoul: Korea education and research information service. Retrieved from <http://www.keris.or.kr/upload/board01/915844095.pdf>
- Byun, H., Choi, J., & Song, J. (2006). Research on the development of Electronic textbook prototype. *Journal of Korean Educational Technology*, 22(4), 1-24.
- California Media and Library Educators Association. (1994). *From library skills to information literacy: A handbook for the 21st century*. Castle Rock, CO: HiWillow.
- Connor, C., Ponitz, C., Philips, B., Travis, Q., Glasney, S., & Morrison, F. (2010). First graders' literacy and self-regulation gains: The effect of individualizing student instruction. *Journal of School Psychology*, 48(5), 433-455.
- Corno, L., & Mandinach, E. B. (1983). The role of cognitive engagement in classroom learning and motivation, *Educational Psychologist*, 18(2), 88-108.
- Crook, G., & Schmidt, R. W. (1991). Motivation: Reopening the Research Agenda. *Language Learning*, 41(4), 469-512.
- Delfino, M., Dettori, G. & Persico, D. (2008) Self-Regulated Learning in Communities. *Technology, Pedagogy and Education*, 17(3), 195-205.
- Gilster, P., & Glistler, P. (1997). *Digital literacy*. Retrieved from <http://www.ncsu.edu/meridian/jul99/downloads/diglit.pdf>
- Han, J. I. (2014). The effects of learning models of English digital textbooks on Korean middle school students' English learning and attitudes toward English. *Multimedia-Assisted Language Learning*, 17(1), 132-158.
- Hong, H., Baek, H., & Lim, H. (2013). Meaning of 'comprehensive' textbook, 'not requiring supplementary materials' and its implementation strategy. *Korean Association for Learner-Centered Curriculum Instruction*, 13(2), 255-283.
- Jang, E. W. (2014). *The effects of Internet Access, Utilization and Cognitive factors on Digital*

- Literacy*. Unpublished master dissertation. Seoul National University.
- Jeong, M. K. (1999). A study on the difference of self-regulated learning by grade and ability group. *Korean educational psychology association, 13*(4), 305-332.
- Kahne, J., Lee, N. J., & Feezell, J. T. (2012). Digital Media literacy education and online civic and political participation. *International Journal of Communication, 6*, 1-24.
- Kang, M. H., Lee, J. E., Kim, M. J., Yun, N. R. (2011). Identifying the predictors of learning outcomes in using mathematics digital textbooks. *The Journal of Educational Methodology studies, 23*(1), 127-150.
- Kang, M. H., Song, Y. H., Lee, J. E., Ku, J. A. (2010). Outcomes in using English digital textbook. *The Journal of Educational Information and Media, 16*(2), 197-221.
- Keller, J. M. (1987). Strategies for stimulating the motivation to learn. *Performance and Instruction, 26*(8), 1-7.
- Keller, J. M. (2010). *Motivational design for learning and performance: The ARCS model approach*. Boston, MA: Springer.
- Kim M., & An, M. (2003). Development of digital literacy checklist. *Korean Association for Educational Information and Media, 9*(1), 159-192.
- Kim, J., & Jung, H. (2010). South Korean digital textbook project, *Computers in the Schools, 27*(3), 247-265
- Kim, S. T., & Nam, Y. H. (2008). A study on competence for digital literacy of an elementary school pupils. *Journal of the Korean Association of Information Education, 12*(2), 151-161.
- Lee, J. S., Sim, H. A., Kim, K. Y., & Lee, K. S. (2010). Effects of reality based science learning program on learning motivation and achievement: development and implementation of elementary school level's science learning program applied the Keller's ARCS. *Theories and Practice of Education, 15*(1). 99-121.
- Lee, M. J. (2011). The problems and challenges for self-regulation studies. *The Journal of Research in Education, 3*(39), 161-193.

- Lim, D., Morris, M., & Yoon, S. (2006). Combined effect of instructional and learner variables on course outcomes within an online learning environment. *Journal of Interactive Online Learning*, 5(3), 255-269.
- Mischel, W., Shoda, Y, & Peake, E K. (1988). The nature of adolescent competencies predicted by preschool delay of gratification. *Journal of Personality and Social Psychology*, 54(4), 687 -696.
- Mohammadyari, S., & Singh, H. (2015). Understanding the effect of e-learning on individual performance: The role of digital literacy. *Computers & Education*, 82(1), 11-25.
- Pintrich, P. (1995). Understanding self-regulated learning. In P. Pintrich (Ed.), *Understanding Self-Regulated Learning*. San Francisco, CA: Jossey-Bass.
- Pintrich, P. R., & DeGroot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance, *Journal of Educational Psychology*, 82(1), 33-40.
- Prensky, M. (2006). *Don't Bother Me, Mom, I'm Learning!: How Computer and Video Games are Preparing Your Kids for 21st Century Success and how You Can Help!*. New York: Paragon House.
- Raver, C. C., Jones, S. M., Li-Grining, C., Zhai, F, Bub, K., & Pressler, E. (2011). CSRP's impact on low-income preschoolers' preacademic skills: self-regulation as a mediating mechanism. *Child development*, 82(1), 362-378.
- Rickman, J. T., Holzen, R., Klute, P. G., & Tobin, T. (2009). A campus-wide E-textbook initiative. *Educause Quarterly Magazine*, 32(2). Retrieved January 10, 2014 from <http://www.editlib.org/p/103795>.
- Schunk, D. H., & Ertmer, P. A. (1999). Self-regulatory processes during computer skill acquisition: Goal and self-evaluative influences. *Journal of Educational Psychology*, 91(2), 251.
- Sim, S. K. (2013). Influence of learning instrument and self-regulated learning strategy on learning achievement in online learning. *The Journal of Korea Contents Association*, 13(3), 456-467.

- Sobel, M. E. (1982). Asymptotic confidence intervals for indirect effects in structural equation models. In S. Leinhardt (Ed.), *Sociological Methodology 1982* (pp. 290-312). Washington DC: American Sociological Association.
- Song, Y. H., & Kang, M. H. (2011). Comparison of learning effect between digital textbook and paper textbook on elementary social studies, *Journal of Educational Technology*, 27(1), 177-211.
- Spitzer, K. I., Eisenberg, M. B., & Lowe, C. A. (1998). *Information Literacy: Essential skills for the information age*. NY: Syracuse University.
- Steffens, K. (2008). Technology Enhanced Learning Environments for self-regulated learning: a framework for research. *Technology, pedagogy and education*, 17(3), 221-232.
- Verhoeven, L., & Snow, C. E. (Eds.). (2001). *Literacy and motivation: Reading engagement in individuals and groups*. Routledge.
- Vohs, K. D., Baumeister, R. F., & Ciarocco, N. J. (2005). Self-regulation and self-presentation: regulatory resource depletion impairs impression management and effortful self-presentation depletes regulatory resources. *Journal of personality and social psychology*, 88(4), 632.
- Vrana, R. (2014). *Digital Literacy as a Prerequisite for Achieving Good Academic Performance*. In *Information Literacy. Lifelong Learning and Digital Citizenship in the 21st Century* (pp. 160-169). Springer International Publishing.
- Westhuizen, D. & Jones, G. (2010). The Role of Digital Literacy in the Academic Performance of First-Year Students in an Information Technology Course. *World Conference on Educational Multimedia, Hypermedia and Telecommunications*, 1(1), 873-878.
- Winters, F. I., Greene, J. A., & Costich, C. M. (2008). Self-regulation of learning within computer-based learning environments: A critical analysis. *Educational Psychology Review*, 20(4), 429-444.
- Wolf, S. (2007). Information Literacy and Self-Regulation: A Convergence of Disciplines. *School Library Media Research*, 10, 1-1.

Zillien, N., & Hargittai, E. (2009). Digital distinction: Status-specific types of internet usage. *Social Science Quarterly*, 90(2), 274-291.

Zimmerman, B. J., & Martinez-Pons, M. (1986). Development of a structured interview for assessing student use of self-regulated learning strategies. *American Educational Research Journal*, 23(4), 614-628.



Jeongmin LEE

Assistant Professor, Dept. of Educational Technology, College of Education, Ewha Womans University.

Interests: Technology-based Learning Design, Learning Motivation, Complex Problem Solving

E-mail: jeongmin@ewha.ac.kr



Jiyeon MOON

Graduate Student, Dept. of Educational Technology, College of Education, Ewha Womans University.

Interests: Educational Technology, Instructional Design, ESL, Instructional Communications, Social Learning

E-mail: gracemoon626@gmail.com



Boram CHO

PHD candidate, Dept. of Educational Technology, College of Education, Ewha Womans University.

Interests: Instructional Design, Mobile Learning, STEAM

E-mail: esprit1003@ewha.ac.kr

Received: April 23, 2015 / Peer review completed: April 27, 2015 / Accepted: April 30, 2015