

Analysis on the Digital Textbook's Different Effectiveness by Characteristics of Learner

Jae Han Shin

han3645@hanmail.net

Abstract

In this study, learning satisfaction, learning ability, learning usefulness, and learning participation were used as effectiveness variables of using the digital textbook, and also, it's different effectiveness was considered by the student's school location, gender, grade, academic record, ICT literacy, and self-initiated learning competence. These learning characteristics were considered to measure the digital textbook's different effectiveness, and the purpose was to seek effective and efficient ways to utilize the digital textbook. The result of this study is as follows: First, the digital textbook should be designed and developed considering the learner's grade level. Second, the classroom management strategy should be developed considering the learner's academic record, ICT literacy, and self-initiated learning competency to use the digital textbook effectively. Third, in order to improve the learner's usage of the digital textbook, varied plans should be devised including providing immediate feedback, increasing the learner's motivation, and developing the learner's personalized learning environment.

Keywords: *Learner's Characteristic, Academic Record, ICT Literacy, Self-initiated Learning Competence, Digital Textbook*

1. Introduction

Today's society is a web 2.0 learning society that creates new knowledge through information. Learners immediately form an interaction with the Internet and should be able to process massive information through multitasking. The existing education environment and paper textbooks have a limited ability to search, process, and collaborate with information that this society requests (Ju, 2010). To overcome this limitation, the digital textbook was implemented. In other words, the research on the digital textbook started in 1997 and, in 2007, the digital textbook usage plan was announced. In 2008, digital textbook content was developed for an experiment in 6 subjects for 5th graders (Korean, Mathematics, Social Science, Science, English, Music), and in 2009, 4 subjects for 6th graders (Korean, Mathematics, Social Science, Science) were further developed.

The digital textbook is especially advantageous as it is an electric textbook system that could also use computer functions adjunctively and also it contains multimedia functions, connects with documents such as hyper-text, and can utilize a search engine that makes it possible to perform a variety of learning activities (Shepperd, Grace, & Koch, 2008). Additionally, the digital textbook is suitable for learners who are already well aware that a computer environment can have positive effects on learner's learning motivation (Byun etc, 2006), for learners to improve their self-initiated learning activity (Jo, 2008), and as an effective tool in improving the learner's school record (Ryu, 2009; Song etc, 2008).

The previous research on digital textbooks were mostly about its concept and characteristics, (Song, 2010; Hwang, 2010; Yu, 2008; Keris, 2004) and its effect (Park etc, 2008; Ryu, 2009; Song etc, 2008; Yeon, 2007; Byun etc, 2006). The previous research has

included limited dependent variables like learning attitude, learning achievement, problem solving strategies, and it lacks broader and diverse dependent variables. Further, even though the learner's characteristics of using digital textbook are important variables in research, the previous research has not been done considering the learner's characteristics to analyze the effectiveness of the digital textbook.

Thus, this study saw the necessity of using a variety of dependent variables that show the digital textbook's effectiveness and independent variables considering learner's characteristics to analyze the digital textbook's different effectiveness by characteristics of the learner.

This study not only used a variety of dependent variables like learning satisfaction, learning ability, learning usefulness, and learning participation to determine the digital textbook's effectiveness but also included different characteristics of learners such as student's school location, gender, grade, academic record, ICT literacy, and self-initiated learning competence to seek effective and efficient ways to utilize the digital textbook.

The specific research purposes are as follow:

First, what is the digital textbook's different effectiveness by the learner's school location?

Second, what is the digital textbook's different effectiveness by the learner's gender?

Third, what is the digital textbook's different effectiveness by the learner's grade?

Fourth, what is the digital textbook's different effectiveness by the learner's academic record?

Fifth, what is the digital textbook's different effectiveness by self-initiated learning competence?

2. Research Method

2.1. Research Participants

The research participants were 294 students from the 5th and 6th grade at G and D elementary schools that experimented with the digital textbook from March 2009 to February 2010. Except for 17 students who did not participate or showed error on the survey, a total of 277, 146 male and 131 female, students' survey answers were statistically analyzed for this research.

Table 1. Background Information of Participants

Division	Information	Frequency (person)
School Location	Large City	137
	Small and Medium-sized City	140
Gender	Male	146
	Female	131
Grade	5 th Grade	136
	6 th Grade	143

2.2. Research Process

The research progressed from January 2009 to August 2010. The specific research process was as follows: First, after analyzing the references regarding the digital textbook from

January 2009 to February 2009, the participants and schools were selected. Second, the dependent variables related with the digital textbook's effectiveness (learning satisfaction, learning ability, learning usefulness, learning participation) and independent variables related with the learner's characteristics (school location, gender, grade, academic record, ICT literacy, self-initiated learning competence) were extracted and survey questions were developed. Two doctoral students in education, 4 teachers who used the digital textbook, and 6 elementary students reviewed the survey. After the survey questions were modified, 277 students participated in the survey on December 2010.

2.3. Measurement

Among the study measurement, ICT literacy measurement questionnaires were developed after reviewing the research on *The verification of standardizing elementary student's ICT literacy* (Han, 2003) and the research on the elementary student's ICT literacy analysis (Jeung, 2003). Additionally, the self-initiated learning competency measurement questionnaires were edited and modified from the self-initiated learning competency (self-efficacy, meta cognition, information search and problem solving ability, internal motivation and self-examination) questions that was used in a research on *The elementary computer and digital textbook development research to improve self-initiated learning competency* (Byun etc, 2008).

The questionnaires regarding learning satisfaction, learning ability, and learning usefulness that were used in Shin(2009)'s *A study of the Development and utilization of an open model for cyber home learning* were modified and used for the learning satisfaction, learning ability, and learning usefulness measurement. The questionnaire regarding learning participants that was used in Yoon(2006)'s *The factors that affect learning participant in cyber home study* were modified and used for the learning participation measurement. After, 3 specialists in Educational Technology reviewed the survey; unnecessary questions were deleted and other questions were edited and modified.

2.4. Data Analysis Method

The research data analysis is as follows: First, a T-test was used to analyze the digital textbook's different effectiveness (learning satisfaction, learning ability, learning usefulness, learning participation) by the learner's gender, school location, and grade. Second, an F-test was used to analyze the digital textbook's different effectiveness (learning satisfaction, learning ability, learning usefulness, learning participation) by the learner's academic record, ICT literacy, and self-initiated learning competence. The post analysis was analyzed by Scheffe's analysis method. SPSS 18.0 was used for the data analysis.

3. Research Results

3.1. The Digital Textbook's Different Effectiveness by the Learner's School Location

When the digital textbook's different effectiveness by the learner's school location was analyzed, no significant difference was found in learning satisfaction, learning ability, learning usefulness, and learning participation. According to this result, the digital textbook's effectiveness does not have a significant relationship with the learner's location, such as large city or small and medium-sized city.

Table 2. The Digital Textbook's Different Effectiveness by Learner's School Location

Variable	Location	Cases	Mean	Standard Deviation	t
Learning Satisfaction	Large City	137	3.35	0.91	-0.911
	Small and Medium-sized City	140	3.45	0.85	
Learning Ability	Large City	137	3.39	0.85	1.001
	Small and Medium-sized City	140	3.29	0.75	
Learning Usefulness	Large City	137	3.40	0.80	0.638
	Small and Medium-sized City	140	3.35	0.72	
Learning Participation	Large City	137	2.66	1.03	-0.221
	Small and Medium-sized City	140	2.68	0.94	

*P< .05

3.2. The Digital Textbook's Different Effectiveness by the Learner's Gender

When the digital textbook's different effectiveness by the learner's gender was analyzed, no significant difference was found in learning satisfaction, learning ability, learning usefulness, and learning participant. According to this result, the digital textbook's effectiveness does not have a significant relationship with the learner's gender, such as male or female.

Table 4. The Digital Textbook's Different Effectiveness by Learner's Gender

Variable	Sex	Cases	Mean	Standard Deviation	t
Learning Satisfaction	Male	146	3.40	0.94	0.036
	Female	131	3.40	0.81	
Learning Ability	Male	146	3.35	0.82	0.238
	Female	131	3.33	0.78	
Learning Usefulness	Male	146	3.34	0.77	-0.839
	Female	131	3.41	0.75	
Learning Participation	Male	146	2.71	1.06	0.782
	Female	131	2.62	0.89	

*P< .05

3.3. The Digital Textbook's Different Effectiveness by the Learner's Grade

When the digital textbook's different effectiveness by learner's grade was analyzed, a significant difference was found in all variables - learning satisfaction, learning ability, learning usefulness, and learning participation ($P < 0.01$). The 5th graders showed higher results compared to the 6th graders in learning satisfaction, learning ability, learning usefulness, and learning participation. Because it was the 5th graders' first time using the digital textbook, they were more interested than the 6th graders and used the digital textbook as a result of their internal motivation. However, since the 6th graders had already used the digital textbook in the previous year, they were less interested and more bored with the digital textbook than the 5th graders; therefore, the result was lower in learning satisfaction, learning ability, learning usefulness, and learning participation for the 6th graders.

Table 5. The Digital Textbook's Different Effectiveness by Learner's Grade

Variable	Grade	Cases	Mean	Standard Deviation	t
Learning Satisfaction	5 th	136	3.51	0.90	3.023**
	6 th	143	3.18	0.80	
Learning Ability	5 th	136	3.44	0.82	2.880**
	6 th	143	3.15	0.73	
Learning Usefulness	5 th	136	3.51	0.80	4.205**
	6 th	143	3.11	0.59	
Learning Participation	5 th	136	2.80	1.01	3.102**
	6 th	143	2.41	0.88	

** $P < .01$

3.4. The Digital Textbook's Different Effectiveness by the Learner's Academic Record

When the digital textbook's different effectiveness by learner's academic record was analyzed, a significant difference was found in all variables - learning satisfaction, learning ability, learning usefulness, and learning participation ($P < 0.01$). In particular, the students with 'good' academic records showed higher results in learning satisfaction and learning usefulness than the students with 'fair' and 'poor' academic records. The students with 'fair' academic records showed higher results in learning satisfaction and learning usefulness than the students with 'poor' academic records. The result showed that learning satisfaction and learning usefulness were higher among students with higher academic records.

In addition, the students with 'good' and 'fair' academic records showed higher results in learning participation and learning ability than students with 'poor' academic records. The students with higher academic records used the digital textbook frequently, and they believed using the digital textbook for learning was effective.

Table 6. The Digital Textbook's Different Effectiveness by Learner's Academic Record

Variables	Classification	Sum of Squares	Degree of Freedom	Mean Square	Record	Mean	F	Post - Analysis
Learning Satisfaction	Between Group	18.619	2	9.309	poor	3.01	12.958*	poor<good fair<good poor<fair
	Within Group	196.855	274	0.718	fair	3.37		
	Total	215.474	276		good	3.71		
Learning Ability	Between Group	14.680	2	7.340	poor	2.94	12.182*	poor<good poor<fair
	Within Group	165.089	274	0.603	fair	3.39		
	Total	179.769	276		good	3.56		
Learning Usefulness	Between Group	20.775	2	10.388	poor	2.99	20.157*	poor<good fair<good poor<fair
	Within Group	141.201	274	0.515	fair	3.32		
	Total	161.976	276		good	3.72		
Learning Participation	Between Group	46.665	2	23.333	poor	1.95	28.529*	poor<good poor<fair
	Within Group	224.093	274	0.818	fair	3.00		
	Total	270.758	276		good	2.72		

*P< .05, **P< .01

3.5. The Digital Textbook's Different Effectiveness by the Learner's ICT Literacy

When the digital textbook's different effectiveness by learner's ICT literacy was analyzed, a significant difference was found in learning satisfaction, learning ability, and learning usefulness ($P<0.01$); however, no significant difference was found in learning participation. In other words, the learning participation variable on the digital textbook has no relationship with ICT literacy.

The students with 'good' and 'fair' levels of ICT literacy showed greater learning satisfaction, learning ability, and learning usefulness than students with 'poor' levels of ICT literacy when using the digital textbook.

Table 7. The Digital Textbook's Different Effectiveness by Learner's ICT Literacy

Variables	Classification	Sum of Squares	Degree of Freedom	Mean Square	ICT Literacy	Mean	F	Post - Analysis
Learning Satisfaction	Between Group	10.495	2	5.247	poor	3.11	7.014**	poor<good poor<fair
	Within Group	204.979	274	0.748	fair	3.51		
	Total	215.474	276		good	3.58		
Learning Ability	Between Group	11.800	2	5.900	poor	3.06	9.624**	poor<good poor<fair
	Within Group	167.969	274	0.613	fair	3.41		
	Total	179.769	276		good	3.62		
Learning Usefulness	Between Group	9.246	2	4.623	poor	3.10	9.293**	poor<good poor<fair
	Within Group	152.731	274	0.557	fair	3.48		
	Total	161.976	276		good	3.54		
Learning Participation	Between Group	2.138	2	1.069	poor	2.56	1.090	
	Within Group	268.621	274	0.980	fair	2.68		
	Total	270.758	276		good	2.82		

*P< .05, **P< .01

3.6. The Digital Textbook's Different Effectiveness by the Learner's Self-initiated Learning Competency

When the digital textbook's different effectiveness by learner's self-initiated learning competency was analyzed, the significant difference was found in learning satisfaction, learning ability, and learning usefulness ($P < 0.01$); however, the significant difference was not found in learning participation. In other words, the learning participation of digital textbook has no relationship with learning self-initiated learning competency.

Especially, the students with 'good' and 'fair' level of self-initiated learning competency showed the greater learning satisfaction than students with 'poor' level of self-initiated learning competency of using the digital textbook.

In addition, the students with 'good' level of learning self-initiated learning competency showed the greater learning ability and learning usefulness than students with 'fair' level of learning self-initiated learning competency of using the digital textbook. Further, the students with 'fair' level of self-initiated learning competency showed greater result in these areas than the students with 'poor' level of self-initiated learning competency. The result showed the students with higher self-initiated learning competency have greater learning ability and learning usefulness of using the digital textbook.

Table 8. The Digital Textbook's Different Effectiveness by Learner's self-initiated Learning Competency

Variables	Classification	Sum of Squares	Degree of Freedom	Mean Square	Self-initiated learning competency	Mean	F	Post - Analysis
Learning Satisfaction	Between Group	17.207	2	8.603	poor	3.05	11.890**	poor<good poor<fair
	Within Group	198.267	274	0.724	fair	3.44		
	Total	215.474	276		good	3.72		
Learning Ability	Between Group	15.911	2	7.956	poor	3.03	13.303**	poor<good fair<good poor<fair
	Within Group	163.858	274	0.598	fair	3.35		
	Total	179.769	276		good	3.67		
Learning Usefulness	Between Group	22.646	2	11.323	poor	2.97	22.267**	poor<good fair<good poor<fair
	Within Group	139.331	274	0.509	fair	3.42		
	Total	161.976	276		good	3.73		
Learning Participation	Between Group	3.106	2	1.553	poor	2.51	1.590	
	Within Group	267.652	274	0.977	fair	2.71		
	Total	270.758	276		good	2.78		

*P< .05, **P< .01

3.6.1. The Digital Textbook's Different Effectiveness by Learner's Self-efficacy: When the digital textbook's different effectiveness by learner's self-efficacy was analyzed, a significant difference was found in learning satisfaction, learning ability, and learning usefulness ($P<0.01$); however, no significant difference was found in learning participation. In other words, the learning participation of the digital textbook has no relationship with the learner's self-efficacy.

The students with 'good' levels of self-efficacy showed greater learning satisfaction than students with 'poor' levels of self-efficacy with the digital textbook.

In addition, the students with 'good' levels of self-efficacy showed greater learning ability and learning usefulness than students with 'fair' levels of self-efficacy when using the digital textbook. Further, the students with 'fair' levels of self-efficacy showed greater results in these areas than the students with 'poor' levels of self-efficacy. The results showed that the students with higher self-efficacy have greater learning abilities and learning usefulness with the digital textbook.

Table 9. The Digital Textbook’s Different Effectiveness by Learner’s Self-efficacy

Variables	Classification	Sum of Squares	Degree of Freedom	Mean Square	Self-efficacy	Mean	F	Post - Analysis
Learning Satisfaction	Between Group	8.585	2	4.293	poor	3.15	5.685**	poor<good
	Within Group	206.888	274	0.755	fair	3.40		
	Total	215.474	276		good	3.69		
Learning Ability	Between Group	8.585	2	4.292	poor	3.05	6.870**	poor<good poor<fair
	Within Group	171.185	274	0.625	fair	3.37		
	Total	179.769	276		good	3.58		
Learning Usefulness	Between Group	11.541	2	5.770	poor	3.02	10.510**	poor<good poor<fair
	Within Group	150.436	274	0.549	fair	3.42		
	Total	161.976	276		good	3.62		
Learning Participation	Between Group	1.197	2	0.598	poor	2.56	0.608	
	Within Group	269.561	274	0.984	fair	2.68		
	Total	270.758	276		good	2.76		

*P< .05

3.6.2. The Digital Textbook’s Different Effectiveness by Learner’s Meta Cognition:

When the digital textbook’s different effectiveness by learner’s meta recognition was analyzed, a significant difference was found in learning ability and learning usefulness (P<0.01); however, no significant difference was found in learning satisfaction and learning participation. In other words, the learning satisfaction and learning participation of the digital textbook has no relationship with the learner’s meta recognition.

The students with ‘good’ levels of meta recognition showed greater learning ability than students with ‘poor’ levels of meta recognition when using the digital textbook.

In addition, students with ‘good’ levels of learner’s meta recognition showed greater learning abilities than students with ‘fair’ levels of learner’s meta recognition when using the digital textbook. Further, the students with ‘fair’ levels of meta recognition showed greater results in learning ability than the students with ‘poor’ levels of meta recognition. The results showed that the students with higher meta recognition have greater learning abilities when using the digital textbook.

Table 10. The Digital Textbook's Different Effectiveness by learner's Meta Cognition

Variables	Classification	Sum of Squares	Degree of Freedom	Mean Square	Meta cognition	Mean	F	Post - Analysis
Learning Satisfaction	Between Group	4.690	2	2.345	poor	3.23	3.048	
	Within Group	210.784	274	0.769	fair	3.43		
	Total	215.474	276		good	3.60		
Learning Ability	Between Group	6.124	2	3.062	poor	3.15	4.832**	poor<good
	Within Group	173.645	274	0.634	fair	3.37		
	Total	179.769	276		good	3.58		
Learning Usefulness	Between Group	11.222	2	5.611	poor	3.11	10.198*	poor<good poor<fair
	Within Group	150.755	274	0.550	fair	3.42		
	Total	161.976	276		good	3.67		
Learning Participation	Between Group	1.814	2	0.907	poor	2.56	0.924	
	Within Group	268.944	274	0.982	fair	2.69		
	Total	270.758	276		good	2.79		

**P< .01

3.6.3. The Digital Textbook's Different Effectiveness by Learner's Information Search and Problem Solving Ability: When the digital textbook's different effectiveness by the learner's information search and problem solving ability was analyzed, a significant difference was found in learning satisfaction, learning ability, and learning usefulness ($P<0.01$); however, no significant difference was found in learning participation. In other words, the learning participation of the digital textbook has no relationship with the learner's information search and problem solving ability.

The students with 'good' levels of information search and problem solving ability showed greater learning satisfaction than students with 'poor' levels of information search and problem solving ability when using the digital textbook.

In addition, the students with 'good' levels of learner's information search and problem solving ability showed greater learning ability and learning usefulness than students with 'fair' levels of learner's information search and problem solving ability when using the digital textbook. Further, the students with 'fair' levels of information search and problem solving ability showed greater results in learning ability and learning usefulness than the students with 'poor' levels of information search and problem solving ability. The result showed that the students with higher information search and problem solving abilities have greater learning abilities and learning usefulness when using the digital textbook.

Table 11. The Digital Textbook's Different Effectiveness by Learner's Information Search and Problem-solving Ability

Variables	Classification	Sum of Squares	Degree of Freedom	Mean Square	Information Search & Problem solving ability	Mean	F	Post - Analysis
Learning Satisfaction	Between Group	18.866	2	9.433	poor	3.04	13.146**	poor<good poor<fair
	Within Group	196.608	274	0.718	fair	3.47		
	Total	215.474	276		good	3.77		
Learning Ability	Between Group	18.631	2	9.315	poor	3.01	15.840**	poor<good fair<good poor<fair
	Within Group	161.138	274	0.588	fair	3.37		
	Total	179.769	276		good	3.76		
Learning Usefulness	Between Group	21.474	2	10.737	poor	2.98	20.938**	poor<good fair<good poor<fair
	Within Group	140.503	274	0.513	fair	3.45		
	Total	161.976	276		good	3.76		
Learning Participation	Between Group	1.460	2	0.730	poor	2.56	0.742	
	Within Group	269.299	274	0.983	fair	2.71		
	Total	270.758	276		good	2.74		

**P< .01

3.6.4. The Digital Textbook's Different Effectiveness by Learner's Internal Motivation and Self-examination: When the digital textbook's different effectiveness by the learner's internal motivation and self-examination was analyzed, a significant difference was found in learning satisfaction, learning ability, and learning usefulness ($P<0.01$); however, no significant difference was found in learning participation. In other words, the learning participation in using digital textbook has no relationship with the learner's internal motivation and self-examination.

The students with 'good' levels of internal motivation and self-examination showed greater learning satisfaction than students with 'poor' levels of internal motivation and self-examination when using the digital textbook.

In addition, the students with 'good' levels of learner's internal motivation and self-examination showed greater learning abilities and learning usefulness than students with 'fair' levels of learner's internal motivation and self-examination when using the digital textbook. Further, the students with 'fair' levels of internal motivation and self-examination showed greater results in learning ability and learning usefulness than the students with 'poor' levels of internal motivation and self-examination. The results showed that the students with higher internal motivation and self-examination have greater learning abilities and learning usefulness when using the digital textbook.

Table 11. The Digital Textbook’s Different Effectiveness by Learner’s Internal Motivation and Self-examination

Variables	Classification	Sum of Squares	Degree of Freedom	Mean Square	Internal Motivation & Self-examination	Mean	F	Post - Analysis
Learning Satisfaction	Between Group	18.866	2	9.433	poor	3.04	13.146**	poor<good poor<fair
	Within Group	196.608	274	0.718	fair	3.47		
	Total	215.474	276		good	3.77		
Learning Ability	Between Group	18.631	2	9.315	poor	3.01	15.840**	poor<good fair<good poor<fair
	Within Group	161.138	274	0.588	fair	3.37		
	Total	179.769	276		good	3.76		
Learning Usefulness	Between Group	21.474	2	10.737	poor	2.98	20.938**	poor<good fair<good poor<fair
	Within Group	140.503	274	0.513	fair	3.45		
	Total	161.976	276		good	3.76		
Learning Participation	Between Group	1.460	2	0.730	poor	2.56	0.742	
	Within Group	269.299	274	0.983	fair	2.71		
	Total	270.758	276		good	2.74		

**P< .01

4. Conclusion and Discussion

In this study, learning satisfaction, learning ability, learning usefulness, and learning participation were used as effectiveness variables, and the digital textbook’s different effectiveness was considered by the student’s school location, gender, grade, academic record, ICT literacy, and self-initiated learning competence. These characteristics of learners were considered to measure the digital textbook’s different effectiveness, and this study’s purpose was to seek effective and efficient ways to utilize the digital textbook. The research participants were 294 students from the 5th and 6th grades at G and D elementary schools who were experimenting with the digital textbook from March 2009 to February 2010. The results of this study are as follows:

When the digital textbook’s different effectiveness by the learner’s gender and school location were analyzed, no significant difference was found in learning satisfaction, learning ability, learning usefulness, and learning participation. According to this result, the digital textbook’s effectiveness does not have a significant relationship with the learner’s school location and gender. The study results conflict with the previous research which mentioned that the digital textbook has greater effects in rural areas than urban areas; however, it showed similar results that gender does not have a significant effect on the digital textbook’s effectiveness (변 외, 2008).

However, when the digital textbook’s different effectiveness by learner’s grade was

analyzed, a significant difference was found in learning satisfaction, learning ability, learning usefulness, and learning participation. In other words, the 5th graders showed greater results than the 6th graders in learning satisfaction, learning ability, learning usefulness, and learning participation.

Second, when the digital textbook's different effectiveness by the learner's academic record was analyzed, a significant difference was found in learning satisfaction, learning ability, learning usefulness, and learning participation. In other words, the students with 'good' academic records showed greater learning satisfaction and learning usefulness than students with 'fair' academic records when using the digital textbook. Further, the students with 'fair' academic records showed greater results in these areas than the students with 'poor' academic records. This result conflicts with the previous research that found that the digital textbook is more effective for students with 'poor' academic records (변 외, 2006).

Students with 'good' and 'fair' academic records showed higher learning participation and learning ability than students with 'poor' academic records, which means that students with higher academic records tend to actively participate in using the digital textbook and recognize that learning with the digital textbook is useful.

Third, when the digital textbook's different effectiveness by the learner's ICT literacy was analyzed, a significant difference was found in learning satisfaction, learning ability, and learning usefulness; however, no significant difference was found in learning participation. Students with 'good' and 'fair' levels of ICT literacy showed greater learning satisfaction, learning ability, and learning usefulness than students with 'poor' levels of ICT literacy when using the digital textbook. The results showed that students with higher ICT literacy have greater learning satisfaction, learning ability, and learning usefulness when using the digital textbook.

Fourth, when the digital textbook's different effectiveness by the learner's self-initiated learning competency was analyzed, a significant difference was found in learning satisfaction, learning ability, and learning usefulness; however, no significant difference was found in learning participation. Students with 'good' and 'fair' levels of self-initiated learning competency showed greater learning satisfaction than students with 'poor' levels of self-initiated learning competency when using the digital textbook. In addition, students with 'good' levels of learner's self-initiated learning competency showed greater learning abilities and learning usefulness than students with 'fair' levels of learner's self-initiated learning competency when using the digital textbook. Further, the students with 'fair' levels of self-initiated learning competency showed greater results in these areas than the students with 'poor' levels of self-initiated learning competency. The results showed that the students with higher self-initiated learning competency have greater learning abilities and learning usefulness when using the digital textbook. This result corresponds with the result of the research (Lim, 2009), which reveals that "the figure class" using a digital textbook is effective to the 6th grade students' basic understandings of 'figure'.

Especially when the digital textbook's different effectiveness was broken down by the sub-categories of self-initiated learning competency, self-efficacy, information search and problem solving ability, and internal motivation and self-examination, there was a significant difference in learning satisfaction, learning ability, and learning usefulness; however, no significant difference was found in learning participation. However, when the digital textbook's different effectiveness by learner's meta recognition was analyzed, a significant difference was found in learning ability and learning usefulness; however, no significant difference was found in learning satisfaction and learning participation.

Students with 'good' levels of information search and problem solving ability and internal motivation and self-examination showed greater learner's learning satisfaction than students

with 'poor' levels of information search and problem solving ability and internal motivation and self-examination when using the digital textbook. Also, students with higher levels of learner's information search and problem solving ability and internal motivation and self-examination had greater learning abilities and learning usefulness when using the digital textbook. Additionally, the students with 'good' levels of self-efficacy showed greater learning satisfaction than students with 'poor' levels of self-efficacy when using the digital textbook. Further, the students with 'good' levels of learner's self-efficacy showed greater learning ability and learning usefulness than students with 'fair' levels of learner's self-efficacy when using the digital textbook. Students with 'fair' levels of self-efficacy showed greater results in these areas than the students with 'poor' levels of self-efficacy. The results showed the students with higher self-efficacy have greater learning abilities and learning usefulness when using the digital textbook. Students with 'good' levels of meta recognition showed greater learning abilities than students with 'poor' levels of meta recognition when using the digital textbook and students with higher meta recognition had greater learning abilities when using the digital textbook.

The results of this study are as follows: First, the digital textbook's effectiveness varies depending on the learner's grade; therefore, the digital textbook should be designed and developed considering the learner's grade. Second, the learner's academic record, ICT literacy, and self-initiated learning competency showed significant differences in learning satisfaction, learning ability, and learning usefulness in using the digital textbook so the classroom management strategy should be developed to use the digital textbook effectively. Third, because the learner's ICT literacy and self-initiated learning competency do not have a significant relationship with learning participation in using the digital textbook, in order to increase the digital textbook's participation, a variety of plans should be devised such as providing immediate feedback, increasing the learner's motivation, and developing the learner's personalized learning environment.

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Authors



Shin, Jae Han

Researcher in Korean Educational Development Institute

Educational Researcher in Ministry of Education, Science and Technology

Interests

Teaching-Learning Theory, Instructional Design, Instructional Model Development, e-Learning, Cyber-Home Learning etc

