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The Effect of Web-Based Instruction on Elementary Students' Academic Achievement *

Abdulkadir Karadeniz [1], Ercan Akpınar [2]

Abstract

The aim of this study is to investigate the effect of web-based instruction with web-based instructional material, which covers"Matter and Heat" unit on 6th grade Science and Technology Course Workbook, on students' academic achievement. Nonequivalent control group, which is a model of Quasi-experimental method, was used in the study. The research was conducted with 102 sixth grade students attending two different primary schools in Artvin in spring semester of the 2010-2011 school years. As data collection tools, "Matter and Heat" unit achievement test was administered in two schools as pre-tests and post-tests and open-ended questions were used after implementation. Between the experimental and the control group students' post- test scores, significant differences were found in favor of the experimental group in which web-based instruction was used.

Keywords

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Introduction

Students' problems of being not to be able to complete instructional activities or receiving inadequate feedback from teachers are among the unresolved issues that cannot be overcome within the sense of traditional education approach. It is thought that revising the topics with a sufficient number of questions by students is an important factor to provide permanent learning. Also, it is necessary to eliminate the causes of mislearning and insufficient learning. Günel, Kabataş Memiş and Büyükkasap (2010) found out that students' participation is low in the mainstream education process and lessons could be more exciting and more effective with different teaching techniques which ensure active participation. Similarly, Bülbül et al. (2006) stated that some extra out-of-school techniques should be included in order to enhance, revise and evaluate learning. The Internet is a good source for this (Alkan, 2011) and various enriched teaching materials could be obtained from the Internet for students to use in-school and out-of-school.

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[1] Anadolu University, Graduate School of Social Sciences, Turkey, abdulkadirkaradeniz@anadolu.edu.tr

[2] Dokuz Eylül University, Buca Education Faculty, Computer Education and Instructional Technologies Teacher Education, Turkey, ercan.akpinar@deu.edu.tr

A lot of different approaches have been used within the educational system, and web-based teaching is one of these approaches. Enriching the lessons at school with the Internet sources is called Internet-based or web-based teaching (WBT) (Kaya, 2002). Web-based teaching should not only have written materials but also audible and interactive materials as they increase learning efficiency. It can be said that the finding above popularized web-based teaching and materials. These changes and developments can fulfill individual needs and meet the needs of students with different expectations (Erdoğan, 2008; Odabaşı, Çoklar, Kıyıcı & Akdoğan, 2005). In web-based teaching (WBT), students are the focal point and the content is designed in a way students can learn it with interaction. Besides, time and place of learning are not the central considerations in web-based teaching; learning is not limited to traditional weekly course hours. It also provides flexibility for the teachers. Teachers can communicate with their students apart from the lessons and follow their students' progress and lessons (Bay & Tüzün, 2002; Doruk, 2005; Yalabık & Onay, 1998). Content enriched with multimedia technologies, effective lesson presentation, prompt feedback, and assessment possibilities demonstrate the importance of Internet-based applications. It is stated that sufficient and valid web-based educational content, which is developed with multimedia tools, appeals to more than than one sense and owing to its provision of active participation of students in the learning process, it maximizes the retention of learning as it provides learning by doing, hearing and reading (Azeta, 2008; Orhun, 2004).

Web-based multimedia supported teaching materials are quite advantageous in that they provide teaching close to real-life experiences, retention and attractiveness as well as a flexible learning environment (Akkoyunlu and Yılmaz, 2005). Findings of the studies on multiple learning styles reveal that it is necessary to make multimedia supported teaching materials widespread (Bhowmick, Khasawneh, Bowling, Gramopadhye & Melloy, 2007; Huang, 2005; Veenema & Gardner, 1996). Sharing multimedia applications and evaluating students on the web affect learning positively (Fakas, Nguyen & Gillet, 2005; Kaifi, Mujtaba & Williams, 2009; Papastergio, 2011; Wright, 2008) and there are many experimental studies on this topic (Akpınar, Ergin, Tatar & Yıldız, 2010; Baki, Karakuş & Kösa, 2008; González, Jover, Cobo & Muñoz 2010; Wang, 2008; Yen, Tuan & Liao, 2010). Akpınar et al. (2010) presented a multimedia supported application to primary school students and found out that it had a positive impact on students' academic achievement and attitude. Similarly, Çetin and Günay (2010) used web-based teaching materials for the "States of Matter and Heat" unit in the 8th grade Science and Technology courses, and deduced that web-based teaching was more effective on students' academic achievement than traditional teaching. However; when the literature is investigated, it is observed that there are no studies on web-based applications for primary school students' workbooks. Also, it is stated that a lot of e-content has to be developed within the scope of FATIH Project (MEB, 2013). Similarly, Türel (2012) highlights a need for technology-enriched materials in his studies. Therefore, it is expected that the study on the web-based workbook would fulfill the gap in the field. This study is considered important because primary school students have many misconceptions on "Matter and Heat" topic (Clough & Driver, 1985; Kırıkkaya & Güllü, 2008; Nachimias, Stavy & Avrams, 1990; Sözbilir, 2003; Şenocak, Dilber, Sözbilir & Taşkesenligil, 2003; Tanahoung, Chitaree & Soankwan, 2010); most of the studies are in descriptive survey design and applied studies are suggested in these studies (Çetin and Günay, 2010); there is no study on web-based workbooks at primary school level; and there is a lack of web-based/ web-supported applications at primary school level (Bhowmick et al, 2007; Huang, 2005). Besides, when teachers use traditional student workbooks, they confront with some problems like they do not have enough time - the key element of contemporary curricula (Karacaoğlu and Acar, 2010) - to evaluate their students' assignments; they can not save students' assignments, and they can not make process assessment. It is expected that the web-based workbook developed within this purpose will help teachers and students overcome these problems.

Purpose of the Study

In this study, it is aimed to investigate the effect of multimedia supported web-based workbook, which is developed for "Matter and Heat" unit of the 6th grade Science and Technology Workbook, on students' academic achievement.

Research Question

The main research question of present study is "Does the multimedia supported web-based workbook affect students' academic achievement in "Matter and Heat" unit of Science and Technology course?" The following secondary questions are investigated within the scope of main research problems:

Q1: Is there a significant difference between the pre-test and post-test results of the 6th grade experimental and control group students in terms of academic achievement in "Matter and Heat Achievement Test"?

Q2: Is there a difference in the accuracy levels of open-ended post-test questions on "Matter and Heat" unit between the 6th grade experimental and control group students?

Limitations of the Study

The sampling group is limited to 102 (50 in the experimental group, 52 in the control group) 6th grade students.

- The study is limited to "Matter and Heat" unit of 6th grade Science and Technology course.
- The study is limited to two primary schools in Artvin.
- Open-ended questions, which are used to collect data, are used only after the implementation.

Method

Research Model

Experimental method was used in the study and the nonequivalent pre-test post-test control group design, which is one of the quasi-experimental research designs, was used. In experimental models, the data observed is manupilated by the researcher aiming to detect the cause and effect relationship (Karasar, 2009).

Research Group

During the study, group determination, purposeful sampling method, which is one of the improbable sampling methods, and criterion sampling, a purposeful sampling method, were used. In addition, the existence of computer labs at schools, the number of computers and Internet accessibility were taken into consideration. Necessary investigations were made, permissions were obtained and the 6th grade students in two primary schools in Artvin were determined as the research group. In each school, 51 6th grade students (26 in the experimental group, 25 in the control group) - totally 102 students - were included in the research.

Science and Technology coursebooks are published in a set (3 books). Two of these books are for students (coursebook and workbook) and the other one is for teachers (teacher's guide book). There is no difference between the experimental and control groups (learning approaches, homework assignments, teacher's guide book, evaluation, etc.) except the web-based workbook, which the experimental group students used.

Experimental Pattern

The experimental pattern used in the study is shown in Table 1.

Table 1. Experimental Pattern

School	Group	Pre-test	Application	Post-test
(School A)	EG	T_1	WBWb	T_1, T_2
	CG	T_1	SWb	T_1, T_2
(School B)	EG	T_1	WBWb	T_1, T_2
	CG	T_1	SWb	T_1, T_2

In Table 1, EG represents the experimental group students, who used the web-based workbook (WBWb), and CG represents the control group students, who used the printed workbook (SWb) of MEB. T1 represents the achievement test on "Matter and Heat" module, and T2 represents the open-ended questions, which are used at the end of the application.

The implementation of the research was totally online. Experimental group students participated in the web-based application on "Matter and Heat" module out of school. Control group students continued to use the printed workbook. Both students and teachers were informed about how to use the web-based workbook (WBWb) with a sample application at school laboratories. Apart from this, there was no group application at schools. Only the students without a computer or Internet access were able to use the computers in the laboratory.

The reason why two schools were chosen for the application is the "teacher" factor. In both schools, the same science and technology teacher instructed to both experimental and control groups.

Material: Multimedia Supported Web-Based Workbook (WBWb)

Multimedia supported web-based workbook (WBWb) is able to assess multiple choice, fill in the gap and true-false questions on its own and give necessary feedback. Thereby, it might be thought that teachers assess only the open-ended questions. Students connect to the system via the Internet and study the topics. Students' answers are stored in the system and might be used when needed. If the students re-study the topic, they are allowed to change their answers and their answers are checked synchroniously or asynchroniously. Teachers can reach the grouped results and follow students' progress via the Internet. When necessary, teachers can get in touch with all or specific students through the system. Under these circumstances, it is expected that WBWb will save teachers' time.

During the development process of the web-based teaching material, opinions of academicians who have academic studies on computers and instructional technologies, and science teaching as well as opinions of experts and teachers were gathered in order for the software to be genuine and to match with learning-teaching principles, design models, and the constructivist theory. The multimedia supported web-based workbook for "Matter and Heat" module of 6th grade Science and Technology course was designed by using programs like Flash CS4, Photoshop CS4, Dreamweaver CS4 and AppServ; and was programmed by using programming approaches like ActionScript 3.0, AmfPHP, PHP, MySql and AJAX.

Figure 1. Pictures of the Application

Data Collection Tools

Achievement Test

It is appliedre to the experimental and control group students before and after the study. It was developed to compare students' scores before and after the implementation. For the achievement test, the table of specifications was prepared for the 17 learning outcomes of the 6th grade Science and Technology course "Matter and Heat" module, and 3 questions at different levels were prepared for each outcome. After the experts' opinions were collected, the number of questions was decreased to 47. In order to make item analysis, the achievement test was applied to 152 students who studied this module before. The students in the research group were excluded. The achievement test, which contains 47 questions, was analyzed by Finesse program, and the KR-20 reliability coefficient was found 0.75. In accordance with the values stated by Tekin (2004), the discrimination power indices of the items were investigated. The items with a 0.30 discrimination power indice or less were removed from the test as the number of questions in the achievement test is quite high. However, only two items, discrimination power indices of which are between 0.00 and 0.20, were redesigned as there were no questions left for the learning outcomes within the scope of the table of specifications. Discrimination power indices of 14 items were between 0.30 and 0.40; and of 12 items were higher than 0.40, so these items were not redesigned. The KR value of the remaining 28 items was found 0.80 after the second analysis.

Open Ended Questions

Open-ended questions were developed by the researcher by taking some experts' opinions. Questions for the 6th grade Science and Technology course "Matter and Heat" module were prepared by taking topic titles into account and it was aimed to assess different comprehension levels. According to the expert opinion, 7 open-ended questions were used. The questions were designed to make students explain and question their knowledge. Also, it was aimed to reveal students' prior knowledge and daily life events were included in the questions. These open-ended questions are presented in the "Findings" part and the findings for each question are presented separately.

Data Analysis

The p value was higher than 0.05 according to Kolmogorov Smirnov Test, which is used to determine the suitability of the scales, which were applied to the sampling group before and after the application, to normal distribution, and the p value was higher than 0.05 according to One-Way ANOVA Test, which is used to check the homogeneity of the scales, which were applied to the sampling group before and after the application; so the t-test, a parametric test, was used in the research. When comparing experimental group and control group, independent samples t-test was used; and when comparing the groups separately, dependent samples t-test was used.

At the end of the experimental phase, the answer key for the open-ended questions, which were directed to the sampling group, was prepared. Students were evaluated according to the answer key and with the help of the concept evaluation chart, which was developed by Akpınar et al. (2010).This chart is presented in Table 2. The questions were analyzed by a Science and Technology teacher and the researchers separately; the results were compared; inconsistencies have been removed; and final grades were given. Accuracy levels of the answers for the open-ended questions were compared with chi-square test.

Table 2. Concept Evaluation Chart

Percentage of Learning the Concepts	**Evaluation Criteria**
0- No Answer	No Concept (Almost no answers or no correct answers)
1- Partly Incorrect	Misconceptualization - Concept Error (Inconsistent info, mostly incorrect)
2- Slightly Correct	Part Learning (Some correct info, but still incorrect info exists)
3- Partly Correct	Part Learning (Mostly correct info, but still insufficient)
4- Correct	Conceptualization (Correct and complete info)

Findings

Findings for the First Sub-Problem

Findings for the first sub-problem can be seen in Table 3 and Table 4.

Table 3. Comparison of the Pre-test - Post-test Achievement Grades of Experimental Group and Control Group (School A)

Groups	Test	N	$\bar{x}$	SS	Sd	t	P
Control	Pre-test	26	9.61	4.70	49	-.63	.531
Experimental		25	10.28	2.42			
Control	Post-test	26	16.46	7.14	49	-2.21	.032
Experimental		25	20.20	4.61			

When Table 3 is examined, it can be observed that there is no significant difference between the pre-test grades average ($\bar{X}$=10.28) of the experimental group and the pre-test grades average ($\bar{X}$=9.61) of the control group at School A (p>.05). When the post-test grades were compared with t-test after the implementation, it can be observed that there is a meaningful difference on behalf of the experimental group (p<.05). Also, pre-test – post-test comparison of the experimental group and the control group at School A was made separately; and a meaningful difference was found between the pre-test – post-test results of each group (t_experimental (48)=-9.52,p=.000 (p<.001), (t_control (50)=-4.08,p=.000 (p<.001).

Tablo 4. Comparison of the Pre-test-Post-test Achievement Grades of Experimental Group and Control Group (School B)

Groups	Test	N	$\bar{x}$	SS	Sd	t	P
Control	Pre-test	26	11.34	3.44	49	-.50	.622
Experimental		25	11.80	3.06			
Control	Post-test	26	16.11	5.87	49	-2.48	.017
Experimental		25	19.80	4.64			

When Table 4 is examined, it can be observed that there is no significant difference between the pre-test grades average ($\bar{X}$=11.80) of the experimental group and the pre-test grades average ($\bar{X}$=11.34) of the control group at School B (p>.05). When the post-test grades were compared with t-test after the application, it can be observed that there is a meaningful difference on behalf of the experimental group (p<.05). Also, pre-test - post-test comparison of the experimental group and the control group at School A was made separately; and a meaningful difference was found between the pre-test - post-test results of each group (t_experimental (48)=-7.19,p=.000 (p<.001), (t_control (50)=-3.57,p=.001 (p<.05).

According to the findings shown in Table 3 and Table 4, it can be concluded that the implementation affected students'learning positively in both schools. The traditional instruction also contributed to students' achievement positively in both schools, but less than the web-based application.

Findings for the Second Sub-Problem

Table 5. The Percentage and Frequency of the Accuracy Levels of the Control and Experimental Group Students' Answers for Post-Application Open-Ended Questions in School A and School B

		School A					School A				
		Control		Experimental			Control		Experimental		
Question	Level	Frequency	%	Frequency	%		Frequency	%	Frequency	%	
Question 1	0	3	12.5	2	8.69	X^2= 22.98 P=.000 Sd=4	3	12	2	8	X^2= 36.18 P=.000 Sd=4
	1	4	16.67	2	8.69		6	24	1	4	
	2	6	25	4	17.39		8	32	4	16	
	3	8	33.33	5	21.73		5	20	10	40	
	4	3	12.5	10	43.48		3	12	8	32	
Question 2	0	7	29.16	5	21.74	X^2= 8.23 P=.083 Sd=4	6	24	3	12	X^2= 21.71 P=.000 Sd=4
	1	5	20.83	3	13.04		4	16	3	12	
	2	5	20.83	4	17.39		8	32	4	16	
	3	4	16.66	5	21.74		2	8	5	20	
	4	3	12.5	6	26.08		5	20	10	40	
Question 3	0	6	25	2	8.69	X^2= 27.71 P=.000 Sd=4	4	16	2	8	X^2= 39.30 P=.000 Sd=4
	1	5	20.83	2	8.69		6	24	5	20	
	2	7	29.17	5	21.74		11	44	5	20	
	3	3	12.5	6	26.09		4	16	7	28	
	4	3	12.5	8	34.78		0	0	6	24	
Question 4	0	6	25	1	4.34	X^2= 30.89 P=.000 Sd=4	4	16	3	12	X^2= 20.84 P=.000 Sd=4
	1	4	16.67	4	17.39		3	12	3	12	
	2	4	16.67	5	21.74		9	36	3	12	
	3	6	25	3	13.04		4	16	6	24	
	4	4	16.67	10	43.48		5	20	10	40	
Question 5	0	6	25	3	13.04	X^2= 26.61 P=.000 Sd=4	3	12	1	4	X^2= 17.62 P=.000 Sd=4
	1	4	16.67	1	4.35		5	20	2	8	
	2	4	16.67	2	8.70		5	20	3	12	
	3	2	8.33	6	26.07		4	16	7	28	
	4	8	33.33	11	47.82		8	32	12	48	
Question 6	0	5	20.83	0	0	X^2= 46.11 P=.000 Sd=4	6	24	3	12	X^2= 25.98 P=.000 Sd=4
	1	6	25	3	13.04		8	32	3	12	
	2	5	20.83	4	17.39		4	16	5	20	
	3	6	25	7	30.43		5	20	7	28	
	4	2	8.33	9	39.13		2	8	7	28	
Question 7	0	6	25	2	8.69	X^2= 46.26 P=.000 Sd=4	12	48	6	24	X^2= 28.32 P=.000 Sd=4
	1	5	20.83	1	4.35		5	20	4	16	
	2	7	29.17	4	17.39		2	8	5	20	
	3	4	16.67	7	30.43		5	20	4	16	
	4	2	8.33	9	39.13		1	4	6	24	

Seven open-ended questions were applied to the experimental and control group students in School A and School B after the implementation. Accuracy levels of students' answers for these questions are presented in Table 5 above in terms of percentage and frequency. Findings for each question are as following: examined:

Question 1: Why do people prefer dark clothes in winter and light clothes in summer? Explain the reason for your answer. When the answers of the first question were analyzed; it was found out that 65% of the experimental group students and 46% of the control group students in School A and 72% of the experimental group students and 32% of the control group students in School B completely or partly gave correct answers. In both schools, the rate of the experimental group students with correct answers was high; however, in both experimental groups, there were some students with incorrect answers. The observed difference was found meaningful between the accuracy levels of the experimental group and control group students at School A ($X^2 = 22.98, P < .001$). Similarly, the observed difference was meaningful between the accuracy levels of the experimental group and control group students at School B ($X^2 = 36.18, P < .001$).

Question 2: There are different states of matter. What can you write about the particle structure of the matters and the movement of these particles? When the answers for the second question were analyzed; there was a difference for the correct and partly correct answers of the students in School A and School B in support of the control groups while a considerable part of the control and experimental groups in both schools (School A (51% control, 34% experimental), School B (40% control, 24% experimental)) couldn't answer or partly answered the questions. When the control groups in School A and School B are compared with the experimental groups in each school, it can be concluded that experimental group students have better answers than the control groups and explain the physical states of matter and particle structure better. However, the difference is not meaningful at School A ($X^2 = 8.23, P < .001$) but it is meaningful at School B ($X^2 = 21.71, P < .001$).

Question 3: How do exothermic and endothermic matters change? Explain according to the physical states of matter. For the third question, the percentage of the correct or partly correct answers at School A is 25% for the control group and 61% for the experimental group, and 16% for the control group (students have no complete answers) and 52% for the experimental group at School B. There is a difference between the correct or partly correct answers of both groups in support of the experimental group. The mentioned difference is meaningful between the accuracy levels of control group and experimental group students' answers at School A ($X^2 = 27.71, P < .001$). Similarly, there is a meaningful difference between the accuracy levels of control group and experimental group students' answers at School B ($X^2 = 39.30, P < .001$).

Question 4: Is there any means of convection? If yes, what are they? Explain your answer with examples. When the analysis results of the fourth question are investigated, it can be seen that there is a significant difference between the correct or partly correct answers of both groups in support of the experimental group at School A. The rate of control group students who couldn't answer the fourth question is greater than the rate of experimental group students. The rate of control group students is almost the same in all categories. The greatest rate of experimental group students is in the 4th category. As a result, it can be said that experimental group students at School A can explain the means of convection and give better examples than the control group students. 64% of the experimental group and 36% of the control group students gave correct or partly correct answers at School B. The greatest rate of experimental group students is in the 4th category whereas control group students are in the 2nd category. There are no students who gave wrong answers or couldn't answer the question in both groups. There is a meaningful difference between the accuracy levels of control group and experimental group students' answers at School A and School B ($X^2 = 30.89, P < .001$ for School A, $X^2 = 20.84, P < .001$ for School B).

Question 5: What is conductivity and resistivity? It is possible to say similar things about heat? What do "heat conductor" and "heat insulator" mean? Give 4 examples for each. When the answers of the fifth question were analysed, it was found that 74% of the experimental group and 42% of the control group students gave correct or partly correct answers at School A. The rate of control group students who couldn't answer the fifth question is much greater than the rate of experimental group students. Despite this, the greatest rate of experimental group students is in the 4th category. Similarly, control group students are in the 4th category. 76% of the experimental group and 48% of the control group students gave correct or partly correct answers at School B. The rate of control group students who couldn't answer the fifth question is greater than the rate of experimental group students. Apart from the 4th category, in which the control group students are in the greatest rate, they are in similar categories. Almost half of the experimental group students are in the 4th category. There is a meaningful difference between the accuracy levels of control group and experimental group students' answers at School A and School B ($X^2 = 26.61, P < .001$ for School A, $X^2 = 17.62, P < .001$ for School B).

Question 6: Is it necessary to make heat insulation? If yes, what should be considered while making? When the answers of the sixth question were analyzed, 70% of the experimental group and 34% of the control group students at School A and 56% of the experimental group and 28% of the control group students at School B gave correct or partly correct answers. The rate of students who couldn't answer this question or had misconceptions was greater in the control groups. There is a meaningful difference between the accuracy levels of control group and experimental group students' answers at School A and School B ($X^2 = 46.11, P < .001$ for School A, $X^2 = 25.98, P < .001$ for School B).

Question 7: How does water heated on a cooker get warmer? What are your observations about it? When the answers of the seventh question were analyzed, a significant difference was found between the correct or partly correct answers of the students at School A in support of the experimental group. The rate of students who couldn't answer the seventh question was much greater in the control groups than in the experimental groups. The greatest rate of experimental group students was in the 4th category whereas control group students were in the 2nd category. 40% of the experimental group and 24% of the control group students at School B gave correct or partly correct answers. The greatest rate of experimental group students was in the category 0 and 4 whereas control group students were in the category 0. The number of students who gave wrong answers or couldn't answer this question was high in both groups but the rate was greater in the control group. There is a meaningful difference between the accuracy levels of control group and experimental group students' answers at School A and School B ($X^2 = 46.26, P < .001$ for School A, $X^2 = 28.32, P < .001$ for School B).

Results, Discussion and Recommendations

The aim of this study is to investigate the effect of web-based multimedia supported workbook, which is prepared for "Matter and Heat" unit on the 6th grade Science and Technology Course Workbook, on students' academic success. The achievement test and open-ended questions are used as the data collection tools.

When the achievement test results are investigated, it is possible to see that there is not a meaningful difference between the pre-test results of the control and experimental groups in both schools, but the difference is meaningful according to the post-test results in favour of the experimental groups. When the groups are compared in themselves, it was found out that the application in both schools influenced students' achievement positively. However, according to the post-test grades, the mean of experimental group students is greater than the mean of control group students. Nevertheless, some students in both experimental group and control group still have misconceptions after the implementation. After the application, it can be claimed that experimental group students in both schools could explain why people wear dark clothes in winter and light clothes in summer, different physical states of matter, particle structures, changes in exhothermic and endothermic matters according to different physical states of matter, means of convection, heat conductivity and heat resistivity better than the control group students. For example, it can be observed that there is a significant difference between the experimental and control group students' correct or partly correct answers for the question about the means of convection in support of the experimental groups. There are also students who couldn't answer the question in both groups.

In conclusion, when the achievement test results and the answers of the open-ended questions are considered, it can be said that the application affected students' academic achievement positively. The consistency of the achievement test results and answers for open-ended questions supported the reliability and validity of the study.

There are no studies on web-based workbooks; therefore, the literature review focused on web-based studies, and there are some studies which have similar results as this study. For instance, in a study of Taş, Çetinkaya, Karakaya and Apaydın (2013), a web-based assessment and evaluation material for "Matter and Heat" unit was developed, and it was emphasized that the web-based material worked out better than traditional education. Karadeniz Bayrak and Bayram (2012) used a web-based material in a study and found out that post-test achievement of experimental group students was meaningfully greater than the control group students' achievement. Similarly, Cüez (2006) investigated the affect of web-based teaching on 8th grade students' academic achievement in Science and Technology course, and came up with the result that web-based Science teaching increased students' achievement more than the traditional teaching. In a study of Çetin and Günay (2010) the web-based teaching, during which web-based teaching materials for "States of Matter and Heat" unit in 8th grade Science and Technology course were used, was found to be more effective on students' academic achievement than the traditional teaching. According to the results of many similar studies in literature, web-based teaching influences students' academic achievement positively (Baki, Karakuş & Kösa, 2008; Baturay, Yıldırım & Daloğlu, 2009; Berigel, 2007; Can, 2008; González, Jover, Cobo & Muñoz 2010; Karakuş, Karakuş & Kösa, 2008; Khalifa & Lam, 2002; Özkan, 2010; Serin, 2012; Taş & Çepni, 2011; Wang, 2008; Yen, Tuan & Liao, 2010). On the other hand, in some of the studies it was found that web-based education didn't influence students' academic achievement positively (Katz & Yablon, 2003; Linn, Bell & Hsi, 1998; Ünlü, 2007).

According to the results of this study, some students in both groups have some misconceptions (Liquid with great distance between the molecules gets warm quickly; The thicker the concrete is, the better the heat insulation is; Water is one of the best heat conductors, etc.) but these misconceptions are more in the control group students. It shows that misconceptions have been corrected to some extent but haven't been removed totally. Studies on misconceptions reveal that correcting misconceptions is challenging (Aydoğan, Güneş & Gülçiçek, 2003; Başer & Geban, 2007). During the literature review of this study, it was observed that conceptual change method helps students to learn the terms "matter, heat and temperature", to correct misconceptions and to replace misconceptions with alternative concepts (Başer & Çataloğlu, 2005: Şenel Çoruhlu & Er Nas, 2009).

The lack of studies on web-based workbooks in literature is a significant limitation. The number of studies on student workbooks and on web-based/ web-supported applications need to be increased. Within this perspective, this study on multimedia supported web-based workbooks sets a good example for further studies.

In the future studies, web-based multimedia supported workbook can be used with conceptual change method and their effect on students' academic achievement can be investigated. Also, all Science and Technology teachers need to be aware of the difficulty of teaching the differences between heat and temperature while teaching these concepts (Niaz, 2006), use daily life concepts in teaching and take students' prior knowledge into account. The web-based multimedia supported workbook (WBWb) in this study is for "Matter and Heat" unit in 6th grade Science and Technology course. It is suggested that this kind of software should be developed for different courses and subjects. The web-based teaching material has a dynamic structure. The substructure of the software can be used to develop similar software for different courses. The study is limited to two primary schools in Artvin. The web-based material of the study can be applied in different cities and schools, and its effectiveness can be investigated with a broader sampling. Also, different ways to collect data can be found and data collection tools such as interview and observation can be used.

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