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The effect of computer based instruction on middle school students' ideas about weather events and climate concept

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Abstract

The concepts of weather events and climate appear to be less studied than other concepts of physics in the literature. The aim of this research is to investigate the effects of computer-based instruction on the concepts of climate and weather events of middle school students. The sample of the research consisted of 19 8th grade students in the experimental group and 23 students in the control group. Computer-based instruction was carried out in the experimental group, and lessons were given in accordance with the middle school science program with the students in the control group. As a data collection tool, a concept test consisting of three open-ended questions was used to determine students' opinions about climate, weather events and the difference between climate and weather events. In the analysis of the data obtained from the answers of the students in the experimental and control groups to open-ended questions before and after the instruction, a rubric consisting of five categories was used. The categories in the rubric are correct answer, incorrect answer, non-coded and no answer categories. According to the findings, it was seen that the scientific responses of the students in both groups increased. Computer-based instruction was found to be more effective in eliminating the misconceptions faced by students about climate, weather events and differences between climate and weather events compared to the courses taught in the program. In the results of the study, it was determined that the students in the experimental and control groups confused the concepts of climate and weather events before instruction and there was a decrease in the misconceptions after instruction. The misconception that climate and weather events were the same was resolved in both groups after instruction. It is suggested that more studies using different instruction methods for teaching these concepts will be conducted.
Keywords: Climate, weather events, computer based instruction, middle school students;

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1. Introduction

It has been argued that one of the biggest problems in the world in recent years is climate change and global warming. Many campaigns have been carried out to raise the awareness in this topic. However, these campaigns are not effective in achieving enough progress. For this reason, it would be more appropriate to give students formal education on the issues regarding climate change and global warming. It would be more accurate to teach the concept of climate and weather events before determining students' ideas about climate change. In their study, Demirkaya and Kayacan (6) stated that 6th grade students have difficulties in understanding climate and weather events and have various misconceptions. Doğar and Başıbüyük (2005) mentioned that students cannot comprehend the climate and weather events sufficiently and different methods should be implemented in the teaching of these concepts. Akbaş, Koca, and Cin (2012) found that the teaching of climate and weather events concepts are more effective with the conceptual change approach than the traditional approach in 9th grade students. In the related literature, the ideas that students have about the concepts of climate and weather events have generally been researched. However, few studies on the teaching of these concepts have been conducted.

1.1. Computer based instruction

Studies have shown that computer assisted instruction has positive effects on students' learning (Kulik & Kulik, 1991). In studies analyzing computer based teaching, it is stated that this teaching method has an effect on students' achievements (Bangert-Drowns, Kulik, & Kulik, 1985; Tekbıyık & Akdeniz, 2010). Compared to traditional teaching methods, computer based teaching has been found to be more effective on students' achievements (Bayraktar, 2001; Tabassum & Farooq, 2011). Whether computer-based teaching is not only effective on students' achievements but also skills such as critical thinking and problem solving has been the subject of research. Renshaw and Taylor (2000) argued that computer-based instruction has an impact on students' cognitive skills such as critical thinking. Serin (2011) stated that computer-based instruction is effective on the success and problem-solving skills of 4th grade students in the sun, earth and moon concepts. Ulukök, Çelik and Sarı (2013) obtained the result that computer assisted instruction increases the experimental process skills of preservice primary school teachers.

1.2. The aim and significance of the study

This study aims to investigate the effects of computer-based instruction on the ideas of secondary school students about climate and weather events and differences among them. It has been revealed in many studies mentioned above that computer-based instruction has an impact on students' achievements. In science studies with secondary school students, while there are many studies in the literature on physics subjects such as electricity (Bostan Sarıoğlan & Abacı, 2017; Çepni & Keleş, 2006; Ezberci, Kurnaz & Bayri, 2015; Jabot & Henry, 2007), energy (Aktaş, 2017; Lee & Liu, 2010), force and motion (Dykstra & Sweet, 2009; Park & Han, 2002), optics (Aydın & Öztekin, 2018; Pompea, Johnson, Arthurs & Walker, 2005), astronomy (Bakas & Mikropoulos, 2003; Trumper, 2001; Trundle, Atwood, Christopher & Sackes, 2010), etc. there are few studies on weather events (Duit, 2009). Determining the cognitive structures of secondary school students related to climate and weather events and investigating the effects of computer-based instruction on these cognitive structures will constitute the significance of this study.

2. Method

This study used a quasi-experimental design with pretest-posttest control group (Singh, 2007).

2.1. Sample of the study

The sample of this study consisted of a total of 42 students studying in 2 different classes in the 8th grade of secondary school. There were 19 students in the experimental group and 23 students in the

control group. Experimental and control groups were determined by random assignment. The concepts subject to the research were taught with computer-based instruction to the students in the experimental group, whereas the concepts were taught with the textbook to the students in the control group. Instruction continued in both groups for 6 class hours.

2.2. Data collection tool

As a data collection tool, a conceptual understanding test including three open-ended questions was used to determine students' opinions about climate and weather events and the differences among them. Factual-based open-ended questions were prepared by the researcher. For the content validity of the questions in the conceptual understanding test, opinions of physics education and two science education experts were consulted. According to the feedbacks, the questions in the conceptual understanding test were completed. The test was applied to the students before and after instruction. In the first question of the conceptual understanding test, the students were asked about the concept of climate, in the second question, they were asked about the weather and in the third question, the differences between the climate and weather were asked.

2.3. Data analysis

The descriptive analysis method was used in the analysis of the responses given by students in the experimental and control groups to open-ended questions before and after instruction. The answers given by students to open-ended questions before and after the instruction were analyzed under 4 categories as scientific answer, incorrect answer, non-coded and no answer. If the students give correct answers and the answer do not contain the incorrect ideas, it is included in the scientific answer category. If the students' answers contradict with the scientific truth, that is, it contains misconceptions, this answer is included in the incorrect answer category. If the students' answers are not related to the concept, it is in the non-coded category. If the students do not comment on the concept, it is included in the category of no answer. The frequency and percentages of the answers given by the students before and after the instruction were calculated.

3. Findings

In this section, the findings obtained from the analysis of the answers given by the students in the experimental group before and after the computer based instruction, and the answers given by the students in the control group before and after the instruction with textbook are presented.7

The findings obtained from the analysis of the answers given by the students to the question of what the climate means are given in Table 1 below.

Regarding what the climate means, no correct answers were given by students in the experimental group before instruction, while 52.6% of the students gave correct answers after the instruction. In the control group, 8.7% of students gave scientific answers before the instruction, while this rate as 56.6% after the instruction. While all the students in the experimental group gave incorrect answers before the instruction, 42.1% of the students gave incorrect answers after the instruction. While 78.3% of students in the control group gave non-scientific answers before the instruction, this rate was 43.5% after the instruction. The most common misconception among students in this question was that climate is the weather events that occur in different regions. While the rate of this misconception before the instruction was 63.1% in the experimental group, the rate of this misconception after the instruction decreased to 21.1%. In the control group, while this misconception was encountered in 4.3% before the instruction, the rate increased by 13% after the instruction. Another misconception was that the climate is weather events

such as raining, hailing, etc. While it was encountered in 21% of the students in the experimental group before the instruction, the frequency after the instruction decreased to 10.5%. In the control group, 47.9% of students experienced the misconception before instruction, whereas the frequency after instruction decreased to 8.7%. While the misconception that climate is a seasonal change was found in 5.3% of students in the experimental group before the instruction, this misconception was not encountered in the experimental group after the instruction. The misconception was encountered in 8.7% of students in the control group before the instruction, the frequency after the instruction decreased to 4.3%.

Table 1. Findings from the analysis of the answers given by students about climate

Response Types	**Experimental Group**				**Control Group**			
	Pre test		Post test		Pre test		Post test	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Correct answer	0	0	10	52.6	2	8.7	13	56.6
Incorrect answer	19	100	8	42.1	18	78.3	10	43.5
Non-coded	0	0	0	0	3	13	0	0
No answer	0	0	1	5.3	0	0	0	0
Total	**19**	**100**	**19**	**100**	**23**	**100**	**23**	**100**

Non-coded answers were not encountered in the experimental group before and after the instruction. While 13% of the students in the control group gave non-coded answers before the instruction, the answers in this category were not encountered after the instruction. In the experimental group, 5.3% of the students did not give answers to the questions after the instruction.

Table 2. Findings obtained from the analysis of the answers given by the students about the weather events

Response Types	**Experimental Group**				**Control Group**			
	Pre test		Post test		Pre test		Post test	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Correct answer	0	0	3	15.8	5	21.8	6	26.2
Incorrect answer	19	100	16	84.2	16	69.5	15	65.1
Non-coded	0	0	0	0	2	8.7	2	8.7
No answer	0	0	0	0	0	0	0	0
Total	**19**	**100**	**19**	**100**	**23**	**100**	**23**	**100**

In Table 2 above, the findings obtained from the analysis of the answers given by the students in the experimental and control groups before and after the instruction about the weather events.

In the question asking what the weather events mean, the students in the experimental group did not answer correctly before the instruction, while 15.8% of the students gave the correct answer after the instruction. While in the control group, 21.8% of students answered correctly before the instruction, 26.2% of students gave correct answer after the instruction. While all students in the experimental group before

the instruction gave incorrect answers, 84.2% of the students gave incorrect answers after the instruction. While the incorrect answers were encountered in 69.5% of students in the control group before the instruction, alternative concepts were encountered in 65.1% of students after the instruction. The most common misconception in both groups is that weather events are temperature and flooding. While this misconception was encountered in 47.4% of students in the experimental group before the instruction, it was encountered in 52.6% after the instruction. While it was 39.2% in the control group before the instruction, it was 43.5% after the instruction. In both groups, the frequency of encountering this misconception increased after the instruction. The misconception of whether the weather is cold or warm was encountered in 31.5% of students in the experimental group before the instruction whereas 5.3% after the instruction. While this misconception was found in 8.7% of students in the control group before the instruction, it was not encountered after the instruction. While the misconception that weather events are climate change was encountered in 5.3% of the students in the experimental group before the instruction, it was encountered in 10.5% of students after the instruction. While this misconception was not encountered before the instruction in the control group, this misconception was found in 4.3% of students after the instruction.

The misconception of weather events occurring in different seasons was not encountered in the experimental group before the instruction, whereas it was encountered in 10.5% after the instruction. This misconception was not found in students in the control group before the instruction, while it was encountered in 8.7% of students after the instruction. While this misconception was not encountered before the instruction in both groups. However, it was found for the first time after the instruction. Non-coded responses were not observed in students in the experimental group before and after the instruction, whereas the rate of non-coded responses was 8.7% in the control group before and after the instruction. There were no students who did not answer this question before and after the instruction in the experimental and control groups.

In Table 3 below, the findings obtained from the analysis of the answers of the students in the experimental and control groups to the question interrogating the difference between the climate and weather events before and after the instruction are given.

Table 3. Findings obtained from the analysis of students' answers regarding the difference between climate and weather events

Response Types	**Experimental Group**				**Control Group**			
	Pre test		Post test		Pre test		Post test	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Correct answer	4	21.0	14	73.7	2	8.7	11	47.8
Incorrect answer	14	73.7	5	26.3	18	78.3	8	34.6
Non-coded	1	5.3	0	0	2	8.7	2	8.7
No answer	0	0	0	0	1	4.3	2	8.7
Total	**19**	**100**	**19**	**100**	**23**	**100**	**23**	**100**

For this question, 21% of students in the experimental group answered correctly before the instruction, while 73.7% of students gave correct answers after the instruction. In the control group, 8.7% of students answered correctly before the instruction, whereas 47.8% gave correct answers after the instruction. While 73.7% of students in the experimental group gave incorrect answers, the rate was 26.3% after the

instruction. While 78.3% of the students gave incorrect answers in the control group before the instruction, 34.6% of the students gave incorrect answers after the instruction. The alternative concept that there is no difference between climate and weather events was encountered in 5.3% of the students in the experimental group and 21.9% in the control group. This misconception was not encountered in both groups after the instruction. The misconception that the climate remains the same and the weather event varies was observed in 21% of the students in the experimental group before the instruction, while this rate decreased to 10.5% after the instruction. In the control group, the rate did not change before and after the instruction and this misconception was 4.3%. The misconception regarding climate, vegetation and weather was not encountered in the students in the experimental group before the instruction, while it was observed in 10.5% of the students after the instruction. While 4.3% of the students in the control group had this misconception before the instruction, no misconception was encountered after the instruction. The change of weather events is called climate. The climate difference is based on the difference in weather events. The misconception regarding these was not observed in the experimental group before and after the instruction, whereas it was seen in students in the control group after the instruction. Weather events occur in different climates, climate causes weather events and the climate is predicted. The misconception that the weather events are unpredictable was not observed in the experimental group whereas it was found in control group before the instruction but it was not observed after the instruction. While 5.3% of students in the experimental group gave non-coded answers before the instruction, no answers were encountered in this category after the instruction. 8.7% of students in the control group gave non-coded answers before and after the instruction. While there were no students who did not answer this question in the experimental group, 4.3% of students in the control group did not answer this question before the instruction and 8.7% after the instruction.

4. Discussion and conclusion

The results obtained from this study demonstrated that the students in both groups have a very low rate of correct response regarding climate and weather events before the instruction. It was found that there was an increase in correct answers in both the experimental group that took computer assisted instruction and the control group that was instructed with the activities in the textbook. It was determined that the rate of increase in correct answers was higher in students in the experimental group. Based on this result, it can be said that computer-based instruction is a more effective method to give correct answers regarding the concepts of climate and weather events. Bayraktar (2001), Tabassum and Farooq (2011) Tekbıyık and Akdeniz (2010) obtained similar results claiming that computer-based instruction was more effective in increasing students' success compared to traditional teaching methods. At the same time, the rate of misconceptions among students before the instruction decreased in both experimental and control groups. It was seen that the rate of misconceptions after the instruction decreased more in the experimental group students than in the control group. Based on this result, we can say that computer-based instruction is effective in reducing the rate of misconceptions about climate and weather events. Similarly, Çepni, Taş and Köse (2016) concluded that computer-based instruction is effective in reducing students' misconceptions. In short, computer-based instruction increased in the scientific answers of secondary school students related to the concepts of climate and weather events, and it was also effective in reducing the misconceptions.

Based on these results, the following suggestions were made:

Students are often confused and may not correctly understand the concepts regarding climate and weather events. Research using various instructional methods can be conducted in the teaching of these concepts. In those studies, the concepts can be taught with different methods and techniques for longer periods. More studies should be conducted on the change of ideas about misconceptions related to the

concepts of climate and weather events. In addition, more studies should be carried out on teaching these concepts not only in the social sciences but in the sciences.

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