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Isı ve Sıcaklık Ünitesinde Bir Akran Öğrenme Uygulaması

An Application of Peer Learning in the Heat and Temperature Unit

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Öz

Bu çalışmada akran öğrenme yaklaşımının 9. sınıf öğrencilerinin ısı ve sıcaklık ünitesindeki başarıları üzerine etkisi, öğrencilerin uygulama hakkındaki görüşleri ile birlikte araştırılmaktadır. Çalışma, iki deney (N=56) ve iki kontrol (N=53) grubu ile bir devlet okulunda gerçekleştirilmiştir. Veri toplama araçları "Isı ve Sıcaklık Başarı Testi" ve "Öz ve Grup Değerlendirme Anketi"dir. Çalışma yöntemi olarak yarı deneysel desen kullanılmıştır. Öğrenci başarısındaki değişim iki yönlü (faktörlü) varyans analizi (ANOVA) ile verilmiştir. Anket sonuçları ise nitel olarak ana temalar ve kodlar oluşturularak analiz edilmiştir. Çalışma sonuçlarına göre, akran öğrenme yaklaşımı uygulanan gruplar lehine öğrenci başarısı bakımından anlamlı bir fark ortaya çıkmıştır. Ek olarak, öğrenciler akran öğrenme uygulamasına yönelik olumlu görüşler sunmuşlardır.

Anahtar Kelimeler: akran öğrenme yaklaşımı, ısı ve sıcaklık ünitesi, öğrenci başarısı, öz ve grup değerlendirme

Abstract

In this study, the effect of peer learning approach on the 9th grade students' achievement in the heat and temperature unit is investigated together with students' opinions about the implementation. The study was conducted in a state school with two experimental (N=56) and two control groups (N=53). The data collection tools were the "Heat and Temperature Achievement Test", and the "Self and Group Assessment Questionnaire". Quasi-experimental design was utilized as the research method. The change in students' achievement was presented with the two-factor variance analysis (ANOVA). The questionnaire findings were analysed qualitatively by forming main themes and codes. According to the findings obtained in the research, a significant difference is observed in favour of the experimental groups taught with peer learning approach in terms of student achievement. In addition, the students expressed positive opinions about the peer learning implementation.

Keywords: peer learning approach, heat and temperature unit, student achievement, self and group assessment

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Extended Sumary

Introduction: As one of collaborative and active learning strategies, peer learning is a significant value in science teaching. During the peer learning process, learners interact with their peers and learn from each other. The benefit of collaborating and group learning strategies has been investigated extensively. Peer learning approach enables students more active. It increases students' understanding and skills. It also positively effects affective domains such as students' motivation and attitudes. Specially, students have difficulty with some physics concepts. Students have many misconceptions in heat and temperature. Traditional instruction does not provide conceptual learning. Therefore, active learning methods such as peer learning can be useful to understand the concept of heat and temperature.

Purpose : The aim of the research is to evaluate the use of peer learning approach with the following questions: (a) What is the effect of peer learning approach on 9th grade students' achievement on the heat and temperature unit? (b) What are the 9th grade students' perceptions about peer learning?

Method : Quasi-experimental design was preferred as the research method. The study was conducted in a state school during the second semester in the 2014-2015 academic year with two experimental (N=56) and two control groups (N=53). Students in experimental groups were received activities in which the peer learning approach was used throughout the unit. The data collection tools were the "Heat and Temperature Achievement Test", and the "Group and Self-Assessment Questionnaire". These instruments were originally developed by the researchers for the study. The achievement test was administered to the students both in the experimental and the control group as pre-post test twice, before and after teaching the unit, while the assessment questionnaire was administered only to the students in the experimental group at the end of the unit. The same teacher taught all groups in a period of 10 lessons. Students in the experimental group were divided into two groups and perform all activities. Pair discussions were made among the students in the experimental groups during the implementation. Both groups were received same teaching activities (e.g., cartoons, concept maps, open-ended questions, worksheets, experiments, story writing).

Results and Conclusion : The change in students' achievement was presented with the two-factor variance analysis (ANOVA) that is a robust statistical analysis technique. The questionnaire findings measuring students' opinions about the implementation were analyzed qualitatively by creating main themes and codes. According to the findings, a significant difference was found in favour of the groups taught with peer learning approach in terms of student achievement. The students also expressed positive opinions about the peer learning implementation in the experimental groups. Based on the research findings, current study can be a good example for teachers in terms of its outcomes and encourage using the peer learning approach into the high school classroom teaching.

1. Introduction

Research on how students learn and benefit from each other has considerable gain and popularity in education. Working together influences socially as well as cognitively on learning. As a concept, peer learning is a practice in which learners interact with their peers to achieve educational goals. Peer learning is a type of collaborative and active learning strategies and it can take many forms such as; working on a project together, or tutoring among students, pair discussions, etc. (Slavin, 1990).

As a theoretical background, Piaget indicated peer experiences are as an important agent in child development. Peer interaction provides students to review their cognitively development (Piaget, 1932). According to Vygotsky (1978) collaboration is crucial for student performance as stated that "The child interacts with environment and peers in the zone of proximal development process in which less capable children improve with the help of more capable peers" (p. 90). From the point of social constructivist approach, learners develop their own knowledge by actively involving in a social learning environment instead of passively taking from the teacher. Interaction in social context makes learners more active and offers the transfer of knowledge and skills. Group members discuss with others, share their ideas, mediate learning, and suggest new way of learning and so on.

The benefit of collaborating and group learning has been documented by many researchers. They support the ideas that peer interaction and peer collaboration within small groups can facilitate better understanding (Ames & Murray, 1982; Androushchak, Poldin, & Yudkevich, 2013; Berndt, 1987; O' Donnell & King, 1999; Oktay, 2017), motivation and confidence (Burdett & Hastie, 2009; Hammond, Bithell, Jones, & Bidgood, 2010). A literature review research conducted by Reise, Samara and Lillejord (2012) have found that peer learning (1) positive effects on students' achievement, (2) reduces the teachers' workload, and (3) develops generic basic skills. Also peer interaction helps cognitively improve, eliminates misconceptions, and provides correct content understanding (Webb & Palincsar, 1996).

The benefits of different group learning strategies and social interaction with peers have been searched in terms of different outcomes and different level of learners. Gardner and Korth (1998) investigated graduate students' learning styles, and attitudes toward group work. Subjects were 178 students in a course on organization behavior. Two instruments; the Learning Style Inventory (LSI) (Kolb, 1984), and a survey on students' attitudes toward group work were implemented to the students. According to the findings, students' attitude to the group work is positive, neutral, and negative. Questions were analyzed by ANOVAs with a post-hoc Student-Newman-Keuls test. Statistically differences were found between assimilators and other types of learners. Based on Kolb's four learning styles, accommodators, divergers, and convergers were inclined to group learning while assimilators were focused on individual work.

Gabriele and Montecinos (2001) explored the effect of achievement goals and interactions between low and high achieving students on problem solving. Thirty-five pairs 4th and 5th grade students participated to the study. Interactions were videotaped and self reports were collected from low and high successful pairs. According to Iowa Test of Basic Skills (ITBS) mathematics achievement scores, students' scores were categorized as low and high status (below the 40th national percentile rank student scores are low, above the 80th national percentile rank students' scores are high. If students have between the 40th and 80th scores, they were excluded from the study). Individual post-test scores of mathematics performance were assessed to see the learning gain. The low achieving students improved their performance after the learning-goal instructions. There was no difference the level of low achievers' participation on the collaborative problem solving.

Fung (2014) used group work activities to see the difference in students' critical thinking ability in two Hong Kong primary schools. 205 students participated in control and experimental groups. According to pre-post scores of critical-thinking test, the analysis of students' graffiti works and interviews, experimental group students showed significantly improvement on critical thinking skills than control group students.

A meta-analysis study in chemistry related to the peer-led team learning (PLTL) reported that peer interaction improves learning and retention (Gosser, 2011). As a different group learning method, peer instruction (Crouch & Mazur, 2001) has been accepted to be useful method in physics education (Linton, Farmer, & Peterson, 2014).

As a discipline, physics is often thought as difficult and abstract concept. Students struggle to get success and have negative attitude to physics (Krogh & Thomsen, 2005; Reif, 1995). Students have difficulties to understand many aspects of heat and temperature (Aydoğan, Guneş, & Gulcicek, 2003; Lewis & Linn 1994; Meltzer, 2004; Rogan, 1988). It is still surprised that why a metal seems colder than the wooden or fabric objects in a room although the thermometer measures the same temperature for both. Students' ideas and beliefs are so strong and resistant to change (Driver,

1989; Osborne & Freyberg, 1985). Because students experience most of them in daily life and then they conflict to explain them by using scientific way of thinking. Therefore, everyday experiences affect students' content learning and they are a source of misunderstandings. Students must properly understand the concept of heat, temperature and energy. Traditional instruction is not enough to lead conceptual understanding for abstract physics concept such as heat and temperature (McDermott, 2001).

There has been some work in which different approaches and methods (e.g., problem-based learning, predict-observe-explain method) were used to increase understanding of heat temperature (Durmuş 2014; Kızılcık, 2012). Using different active learning approaches can be useful way to provide meaningful learning and eliminate misconceptions. Physics teaching with traditional instruction and just giving students textbook information are not effective strategies to deep learning (McDermott, 2001). According to some studies, strategies based on learning together have produced effective results in terms of overcoming misconceptions and promoting conceptual understanding in the concept of heat and temperature. As an example, Leinonen, Asikainen and Hirvoen (2013) used peer interaction in the instruction of introductory thermal physics course. They used a diagnostic test to assess students' conceptions. They recorded the peer discussions of students' pairs. Based on their results, students gained better conceptual learning and reduced the number of misconceptions after the intervention. Therefore, as one of the active learning approaches, we use peer learning in which students learn from each other and work in pairs two. There has been no study in the literature to investigate the effect of peer learning approach on the 9th grade level students' success about heat and temperature. The study aims at showing successful student learning as a finding of student interaction. The findings of the study are strengthened by taking students' opinions about themselves, their peers and the whole peer implementation process. Current study can be a good example for teachers in terms of its outcomes and point out using the peer learning into the high school classroom teaching. This study intends to be a useful example of peer learning application in the context of high school physics. The purpose of this study is to explore answers to these following questions:

- What is the effect of peer learning approach on 9th grade students' achievement on the heat and temperature unit?
- What are the 9th grade students' perceptions about peer learning?

2. Method

Research Design

The basic premise of the research methodology is quasi-experimental research. Quantitative part consisted of statistical analysis of pre/post-test data findings. On the other hand, survey data from students were depicted qualitatively for this research.

Researchers in this study expect to find out useful and applicable approach that works better for the classroom context. University researchers and a physics teacher collaborated with in this study to test a peer learning intervention. The reason is that classroom teacher was not satisfied with 9th grade students' performance on the heat and temperature unit based on her experiences in the previous years. She has a problem with some students that they were not willing to participate in activities during class teaching. Therefore, she has decided to collaborate with university researchers to use peer learning approach to improve their teaching.

Sampling

The study was conducted during the second semester in the 2014-2015 academic year with all 9th grade students in the school. Two (9-A and 9-I) of the four classes in which the study was performed were chosen randomly as the experimental group, and the two (9-E and 9-J) as the control group. Lessons in the experimental and the control group were given by the same teacher. The only difference between the experimental group and the control group was that peer learning approach was used in experimental group throughout the unit. Students' ages range between 15 and 17. The information about the students is summarized in Table 1.

Table 1. Number of experimental and control group students (N=109)

	Experimental group		Control group	
Classes	9A	9I	9E	9J
Female	6	8	6	6
Male	24	18	19	22
Class size	30	26	25	28
Total (N=109)	56		53	

Data Collection Tools

Heat and Temperature Achievement Test

The heat and temperature achievement test was developed by the researchers in accordance with the outcomes defined in the 9th grade physics curriculum. In this test, there were multiple-choice questions about the heat and temperature. Necessary changes in the achievement test were made with the help of views from four experts (three academicians and one teacher). The test was administered to 150 students who studied the heat and temperature unit in order to perform the item analyses and measure the reliability of the achievement test. The item difficulty index of the questions ranges from 0.38 to 0.73. The average of the item difficulty index for the whole test is 0.54. On the other hand, the discrimination index varies between 0.61 to 0.32 and the average of the item discrimination index is 0.44. The reliability of the test, 0.75 according to Cronbach alpha, was found as acceptable (Pallant, 2007). The achievement test, whose content validity and face validity were ensured with the help of expert views, consists of 39 questions in its final form. The achievement test was administered to the experimental group and the control group as "pre-test" before the peer learning implementation. After finishing the unit, it was administered to both of the groups as "post-test". While measuring students' achievement, correct answers were taken into consideration and scored as 1 point and incorrect answers were scored as 0 point. The test findings were expressed with the mixed Analysis of Variance (ANOVA) statistical analysis.

Self and Group Assessment Questionnaire

After finishing the implementation, a questionnaire consisting of 10 likert-type and 11 open-ended questions was given to the experimental group students to enable them to assess their group-mates' and their own performances. The questionnaire was developed by the researchers. The validity of the questionnaire was presented to the five-expert view, and the readability of the questions was checked. The total agreement of percentage was found 80% for all items among the experts. Data obtained from the likert-type scale were evaluated on the basis of their frequencies, and the responses to the open-ended questions were evaluated by classification.

Implementation

Composition of Groups

In the formation of the groups, the mean of the experimental group students' two physics exam scores in the first semester was taken as the basis. Students in the experimental group were divided into two groups in accordance with the means; students with high means and those with lower means. In Galton and Williamson's (1992) view, the effect of the number and size of groups are important for the efficiency of a peer learning implementation. If the number of students in group activities is too big, it may find in the disappearance of some students during the activities. In this study, the students were divided into groups of two so that they had the opportunity to work in side-by-side sitting design. The experimental group students were told that the heat and temperature unit would be studied in groups of two. After that, students with higher means and lower means were announced as two groups. Then, the students were asked to form groups of two with one student from each of those two groups. In other words, grouping was based on willingness in a sense. As a finding, the peer learning implementation was performed in 28 groups.

Instructions Given in the Experimental and Control Groups

The heat and temperature unit was taught in the experimental and control groups in a period of 10 lessons. The implementation was carried out by the same teacher who routinely taught in these classes all the year round. That is why it was not necessary to explain to the students the fact that this research was a scientific study. That is to say, the study was conducted in a natural environment. The only difference between the two groups was that, in the experimental groups, the unit was taught using the peer learning approach within group work. Pair discussions as a form of

peer learning were made among the students in the experimental groups. Both groups were received same teaching activities (e.g., cartoons, concept maps, open-ended questions, worksheets, experiments, story writing) utilized by the teacher in order to teach the subject, and necessary information about the subjects in the unit was provided. The process of teaching the unit was observed by one of the researchers who conducted the study in order to perform the verification of the experiment as being carried out as planned in both the experimental and the control group. Certain amount of time was allocated for each teaching activity, and all the groups were told to finish their activities in time. In the control group, teaching activities were carried out by the teacher in the lesson and with the students. All students in both groups were evaluated by using performance homework. Some groups prepared boards, and some of them made presentations about their performance homework in the classes. It was ensured that the whole unit was completed by the classes in both groups in the same period of time. Then, "self and group assessment questionnaire" was carried out only in the experimental group.

3. Findings

The findings are presented in two parts. The first section gives the findings of students' achievement test based on peer learning approach. Students' opinions about the peer learning were given under the second section.

Section 1. Heat and Temperature Achievement Test Findings

In this section, it is investigated whether using the peer learning approach in class had any significant effect on students' achievement in the learning of heat and temperature unit. A test which consisted of 39 questions and which was measured out of 39 points in total was utilized. First, the data obtained from the achievement test were organized using IBM SPSS Statistics 22 and then controlled by taking into consideration whether the necessary assumptions were provided. The descriptive statistics findings of the groups in the achievement test in total are given in Table 2.

Table 2. Descriptive Statistics

	Pre Test			Post Test		
Groups	N	$\bar{X}$	Sd	N	$\bar{X}$	Sd
Experimental group (peer learning)	56	11.05	4.6	56	19.46	6.8
Control group	53	9.79	4.4	53	15.70	5.2

Independent t-test was used to investigate whether there was a difference between pre-test scores of the experimental and control groups. According to this finding, no significant difference was observed between the average pre-test score of the experimental groups ($\bar{X}$=11.05, Sd=4.6) and the average pre-test score of the control groups ($\bar{X}$=9.79, Sd=4.4) [t(107)=1.46, p=0.148]. After that, the effect of the peer learning approach was presented with the Two-Factor Anova Test for Mixed Measures. The test findings are given in detail in the following tables.

Table 3. Tests of Within- Subjects Effects

	Source	Type III Sum of Squares	df	Mean Squares	F	Sig.
Factor 1	Sphericity Asumed	2790.445	1	2790.445	186.840	.000
	Greenhouse-Greiser	2790.445	1.000	2790.445	186.840	.000
	Huynh-Feldt	2790.445	1.000	2790.445	186.840	.000
	Lower-bound	2790.445	1.000	2790.445	186.840	.000
Factor 1*	Sphericity Asumed	85.436	1	85.436	5.721	.019
	Greenhouse-Greiser	85.436	1.000	85.436	5.721	.019
	Huynh-Feldt	85.436	1.000	85.436	5.721	.019
	Lower-bound	85.436	1.000	85.436	5.721	.019

According to Table 3, a significant difference was observed between students' scores before and after the heat and temperature unit regardless of their groups [F(1-107)=186.84, p<0.05]. The effect of the implementation on the experimental group was found significant [F(1-107)= 5.72, p<0.05].

Table 4. Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig
Intercept	42708.478	1	42708.478	1003.777	.000
Group	344.093	1	344.093	8.087	.005
Error	4552.614	107	42.548		

According to the significance test finding in Table 4, there is a significant difference between the sum of pre-post test scores of the experimental group and the sum of pre-post test scores of the control group [F(1-107)= 8.08, p<0.05]

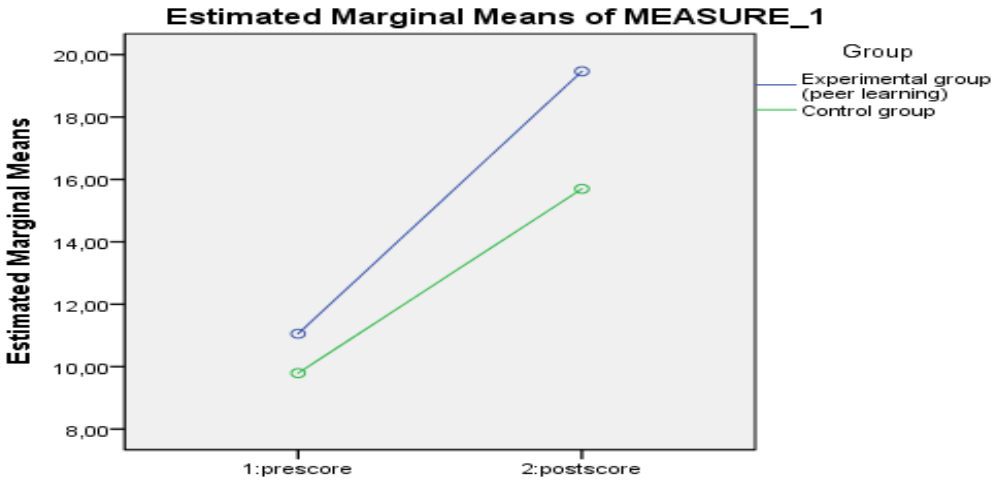

Figure 1. Experimental and control group means at pre-test and post-test

As seen in Figure 1, the experimental and control group means in the pre-test findings change in favour of the experimental group in the post-test findings. Achievement in the experimental group who were taught using the peer learning approach increases in comparison with the control group.

Section 2. Self and Group Assessment Findings

In this section, the findings of the questionnaire in which experimental group students evaluated themselves, their groups, their group mates, and the peer learning approach in general are summarized.

The section in which the students assessed themselves consists of likert-type questions with five items. In this section, students were asked to scale the following items from “always” to “never”; participation in the group work, coming to the group work prepared, establishing efficient communication with the group mates, task sharing, and being open to self development and change as a finding of the group mates’ opinions. According to the responses to the questionnaire, 40 of the students stated that they “always” and 13 of them stated they “usually” participated in the group work. Two students responded to this question with “sometimes”. Twenty-nine of the students stated that they “usually”, 16 students stated they “always”, and 11 students stated they “sometimes” came to group work prepared. As regards to the efficient communication with the group mate, 36 students stated they “always”, and 17 students stated they “usually” established it. Thirty-one students “always”, 19 students “usually” and 3 students “sometimes” took responsibilities in task sharing and decisions while performing the activities. Finally, in the self assessment questionnaire, the students were asked whether they were open and eager to change themselves as a finding of their group mates’ opinions. Thirty students replied this question with “usually”, 17 students with “always” and 5 students with “sometimes”. According to these answers, it is possible to say that students thought that they performed their duties in the group work. The students were also asked to write the most important thing they did to make the groups work more efficient. Students’ answers are given in Table 5.

Table 5. Findings of the self assessment in which students stated what they did to make the group work more efficient

Things done to make group work more efficient	**I. Preparation before class (4 students)**
	II. Things done during class (53 students)
	Performing duties in the group (20 students)
	Exchanging ideas/Effective communication (20 students)
	Being respectful (6 students)
	Being helpful (5 students)
	Using time effectively (2 students)

As seen in Table 5, "Performing duties in the group" (20 students) and "Exchanging ideas/Effective communication" (20 students) are the students' answers with the highest frequency, while the one with the lowest frequency is "Using time effectively" (2 students). Students were asked what should be done to make groups work more efficient, and their answers are summarized in Table 6.

Table 6. Findings of the self assessment in which students stated what should be done to make group work more efficient

Things that should be done to make group work more efficient	**I. Preparation before class (32 students)**
	II. Things to be done during class (14 students)
	Performing duties in the group (11 students)
	Exchanging ideas/Effective communication (3 students)

As seen in Table 6, the students mostly stated "Preparation before class" as the thing they should do to make the peer learning approach more efficient (32 students). The second most frequent answers were "Performing duties in the group" (11 students) and "Exchanging ideas/Effective communication" (3 students).

In the second part of the questionnaire, the students were asked to assess their group mates. With regards to their group mates' full participation in the activities, 32 students responded with "always", 14 students replied to "usually", and 8 students responded with "sometimes". To the question whether their group mates came to class prepared, 24 students answered with "usually". Fifteen students stated "always", and 13 students stated "sometimes" for this question. As for their group mates' effective communication with them, 33 students replied with "always", 13 students stated "usually", and 8 students stated "sometimes". Twenty-two students stated that their group mates "always" took responsibility, 21 students stated "usually", and 9 students stated "sometimes" for this question. To the question whether their group mates were open to change and development, 24 students replied to "always", 17 students replied to "usually", and 10 students responded with "sometimes". The students were also asked to write the most important thing their group mate did for the groups to work more efficiently. Students' answers are summarized in Table 7.

Table 7. Findings of the peer assessment in which the students stated what their group mates did to make group work efficient

Things done by the group mate to make group work efficient	**I. Preparation before class (none)**
	II. Things done during class (50 students)
	Performing duties in the group (20 students)
	Exchanging ideas/Effective communication (13 students)
	Being respectful (8 students)
	Being helpful (7 students)
	Being willing (2 students)

As seen in Table 7, the most frequent answer given to the question "what is the most important thing your group mate did to make group work more efficient?" is "Performing duties in the group" (20 students), and the next most frequent is "Exchanging ideas/Effective communication" (13 students). The least frequent answer is "being willing" (2 students). The answers to the question "What should group mates do to make groups work more efficiently?" were summarized in Table 8.

Table 8. Findings of the peer assessment in which the students stated what should be done by their group mates to make group work efficient

Things that should be done by the group mate to make group work more efficient	I. Preparation before class (9 students)
	II. Things that should be done during class (25 students)
	Performing duties in the group (20 students)
	Exchanging ideas/Effective communication (5 students)

It is observed that the most frequent answer to the question "What should be done by the group mate to make group work more efficient?" was "Performing duties in the group" (20 students). This answer was followed by "Things done before class" (9 students) and Exchanging ideas/Effective communication (5 students). The statement made by a more successful student in the group clarifies the subject; "My group mate should produce more ideas and help me more".

In the questionnaire, students were also asked to assess their groups. In response, 28 students wrote "We worked well together", 18 students wrote "It was excellent", 4 students wrote "It was not bad" and 1 student wrote "It was problematic" and 1 student wrote "It was very bad". One of the students who described the group as "excellent" explained the reason as "Because we joined the activities together, we performed together and prepared together". The answers to the question in which the students were asked to explain the reason why they chose their group mates are summarized in Table 9.

Table 9. Students' reasons for choosing their group mates

Students' reasons for choosing their group mates	Familiarity/Getting on well (27 students)
	Achievement (16 students)
	Being responsible (9 students)
	No reason (5 students)

According to Table 9, the students mostly chose their group mates considering the degree of familiarity (27 students) and then achievement (16 students). In addition, another reason for choosing the group mate was "Being responsible" (9 students). On the other hand, it was observed that 5 students gave no reasons for choosing their group mates. The following statement made by a student shows that he chose his group mate to give help instead of getting help; "I chose him because I thought he could not understand the lesson, he did not listen and he was not productive. I wanted him to be my group mate in order to make him more productive and help him understand the lesson". This statement is a good example that shows it is possible to increase cooperation among students using this approach. In the questionnaire, the students were asked the positive aspects of the peer learning approach and their answers were elaborately summarized in Table 10.

Table 10. Positive aspects of the peer learning approach

Positive aspects	**Cognitive Contribution (39 students)**
	Contribution to learning the subject better (31 students)
	Making problem solving easier (4 students)
	Contribution to skill development (3 students)
	Contribution to the course scores (1 student)
	Affective Contribution (17 students)
	Improving communication (10 students)
	Increasing positive attitude towards the lesson (7 students)

Students' answers to this question were divided into two parts; cognitive contribution and affective contribution. In terms of cognitive contribution, most of the students (31) stated that it contributed to their learning the subject. In addition, among other answers were the facts that it made problem solving easier (4 students) and it contributed to skill development (3 students) and course scores (1 student). In terms of positive affective aspects of the approach, 10 students mentioned that it increased communication, while 7 students wrote it increased positive attitude towards the lesson. Students' answers with regards to the negative aspects of the approach are given in Table 11.

Table 11. Negative aspects of the peer learning approach

Negative aspects	Disagreement (8 students)
	Increase in workload (8 students)
	Inadequacy of preparation before class (3 students)
	Inefficient use of time (2 students)
	Group mate's irresponsibility (2 students)

According to Table 11, students mentioned the negative aspects of the peer learning approach as follows; disagreement (8 students), increase in workload (8 students), inadequacy of preparation before class (3 students), inefficient use of time (2 students) and group mate's irresponsibility (2 students). In the questionnaire, students were asked "Which concept of the heat and temperature unit was the peer learning approach helpful in?" Students mentioned all the concepts they were supposed to learn in accordance with the objectives of the heat and temperature unit. In this regard, it is possible to claim that group work had a positive effect on the learning the concepts in the heat and temperature unit. In response to the question about which activity/activities were more effective while working with the group mates, 21 students mentioned worksheets, 17 students stated performance homework, 17 students said cartoons, and 12 students mentioned all of them. According to the answers, it can be said that the students thought worksheets were the most useful. Students were also asked which additions should be made or which parts should be changed in order to make peer learning approach more effective. Seventeen students said there was no need for change, six students said performance homework should be increased. Four students stated that experiments should be carried out, and another four students stated that visuals and cartoons should be increased. Three students suggested that cartoons and questions should be increased, and another three students suggested that peer learning implementation should be made more enjoyable.

4. Conclusion and Discussion

Conclusion 1: Peer learning approach brought about a positive effect on increasing student achievement in heat and temperature unit.

As one of the factors that influence peer learning is the size and number of groups in a classroom context. Too large groups often can reduce the effectiveness of group activities (Galton & Williamson, 1992). Our findings show that studying in groups of two increase students' achievement. It was observed during students' activities that more successful students helped less successful ones during the pair discussions. Students' understanding the concept more easily and the increase in their achievement are the finding of the fact that less successful students could ask the questions they could not ask to the teacher easily to their group mates and, during their effort to learn a concept, they used their own perspectives, which were different from their teachers. Increased attainment in the concept of heat and temperature unit was seen during the use of peer learning approach. This result is consistent with using peer learning as a strategy in school setting to provide incerased attainment (Hallam, Ireson, & Davis, 2004; Slavin, 1987).

Conclusion 2: Students opinions about the implementation of peer learning approach and the effect of this implementation on their learning and their group mates are quite positive.

According to the findings of the questionnaire, in which students who studied in peer learning approach assessed themselves, their group mates, their groups and the implementation, students think they did their part of the task in the peer learning approach. Even though they said their group mates also did their part, they expect their friends to take more responsibilities in the group, establish effective communication, come to class prepared and exchange ideas more. Students stated that they chose their group mates mostly according to the level of familiarity, agreement and achievement. In addition, they also mentioned the importance of being responsible which is an indicator of showing the success of cooperative learning (Slavin, 1990). Students who assessed their groups expressed positive opinions about their groups to a large extent. According to the answers they gave to the questions about the peer learning approach and general assessment, they think that this study approach contributed to their learning the heat and temperature unit. In addition, they expressed that it brought about positive attitudes towards the lesson. This finding is compatible with previous studies related to learning with peers in physics education (Ergin, Atasoy, & Şen, 2013; Zhang, Ding, & Mazur, 2017).

As for the negative aspects, they mentioned disagreement with their friends during the activities, increase in the workload, irresponsibility of their friends and inadequacy of preparation before class for performing the activities. Similar problems have been observed in group work studies (Erdamar & Demirel, 2010; Gatfield, 1999; Payne & Monk-Turner, 2006; Walker, 2001). Worksheets and performance homework are the activities which students found most effective during the group work. In addition, cartoons were also effective in students' opinion. When students' opinions were asked on how to improve the effectiveness of the peer learning approach, they stated there was no need for a change and lessons could be taught in this way. It was also suggested that worksheets, performance homework, cartoons, experiments and visual materials should be increased. Students expressed positive opinions about not only the peer learning approach but also the various methods used during group works.

5. Implications and Recommendations

When the findings of the study are taken as the basis, it is possible to state that keeping the minimum number of students in group works produced quite positive findings. That is why, groups of two students are recommended while using the peer learning approach at high school level in order to ensure active participation of all the class and use of the control mechanism by teachers easily. Involvement of teachers and students together in the process of forming groups may help reduce the number of problems that may occur during the implementation. It was quite useful to carry out assessment in various forms (self, peer and group) after the implementation of peer learning approach in terms of teachers' getting feedback. In this way, teachers can see the deficiencies in practice and the working parts of the implementation and take necessary precautions. An interesting point is that students mentioned the importance coming to class with preliminary preparation in terms of the subject to be studied in the lesson for the peer learning approach to be effective during the lesson. From this viewpoint, teachers should use mechanisms such as pre-reading, quizzes etc. that enable students to make preparation for the subject to be studied in the lesson before the implementation. By doing so, pair discussions during the lesson may become more useful.

6. References

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