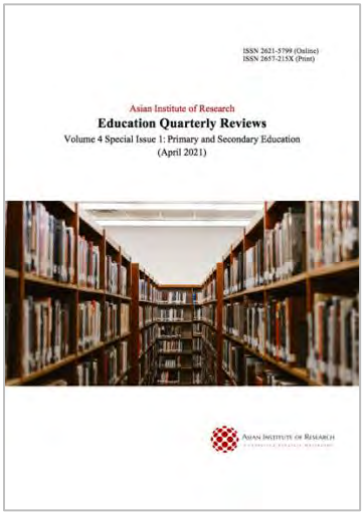

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The Development of Scientific Discussion-oriented Activities to Remove the Misconceptions: The Unit of 'Change of Matter'

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Abstract
This study, whose purpose is to examine the effect of scientific discussion-oriented activities on eliminating misconceptions in the 'Change of Matter' unit, has been designed in accordance with the action research method. Action research is a research approach that is carried out by practitioners alone or with a researcher to understand and resolve the problems that arise in practice, combines research and practice, and facilitates the transfer of research results into practice. In this context, the test developed, two tier diagnostic test, before the application started was applied to the students as a pre-test, then activities developed based on scientific discussion were applied in a total of 18 lesson hours, and reflective diaries were kept in the students during this process. After the application process, the same test was applied as a posttest. In addition, semi-structured interviews were conducted with the students at the end of the application. In these interviews, students were asked 5 questions to determine their misconceptions and 2 questions to determine their opinions about the application process. The sample of the study consists of 26 5th grade students. At the end of the study, it was determined that the science lesson which is taught with scientific discussion activities were effective in eliminating misconceptions, understanding the lesson better and enjoying group work.

Keywords: Misconception, Scientific Discussion Activities, Change of Matter

1. Introduction

1.1 Introduce the Problem

"In what period of life does an individual encounter the nature of science and science?" It is difficult to answer the question. Because science is a field, we will encounter in every period of our life. For example, weather events, the formation of the rainbow, cloning, recycling, fermentation, rancidity and degradation events, electric

shocks or salt spilling on the roads in snowy and icy weather are within the field of science. In our country, science education begins formally with the science lesson in the third grade of primary education and the science lesson in secondary education; it is divided into fields such as physics, chemistry and biology. In this respect, science lesson in primary education; it forms the basis of physics, chemistry and biology courses. In this context, providing individuals with an effective science education at an early age is important for their success in later science lessons. The purpose of the Science Curriculum is defined as "To train all students as science literate individuals" by MEB (2018). Expected from education processes; It is the training of individuals who can think logically, have problem solving skills, do not accept the situation as it is when faced with any situation, question it and think critically (Domaç, 2011).

In the Science Curriculum, a holistic perspective has been adopted in terms of learning-teaching theories and practices, and a learning strategy based on inquiry and knowledge transfer, which is generally responsible for the student's own learning, ensures active participation in the learning process, is taken as basis. In the learning-teaching process, while the teacher assumes the roles of encouraging and guiding, the student undertakes the role of an individual who researches, questions, explains, discusses and transforms the source of information into a product. '(MEB, 2018). Effective science education is provided by providing these gains to students. However, existing or potential misconceptions in students may prevent meaningful learning and effective science education. As students learn new information, they build on previous knowledge. In the process of learning the new concept, incorrect information may be in line with the student's logic and previous knowledge, and at the same time, the student may not know that his actions are not scientifically valid (Yağbasan & Gülçiçek, 2003). In this case, misconceptions develop in the student. Karakuyu et al. (2007) defines misconceptions as information that is against the scientific facts formed because of personal experiences and prevents the teaching and learning of concepts that have been proven by science.

Misconceptions are a distressing situation in science education for both the teacher and the learner (Aydoğan et al., 2003; Bayrakçı, 2007). According to Sarı Ay and Aydoğdu (2015), misconceptions affect student success negatively. It prevents the provision of a permanent science education and at the same time, individuals have difficulty in adapting the information they have learned in science lessons to their daily lives. In this context, trying to overcome misconceptions is a necessity. Many studies have been added to the literature on the detection and elimination of misconceptions students have in science education (Sarı Ay & Aydoğdu, 2015; Demircioğlu et al., 2004; Güneş et al., 2010; Tekkaya et al., 2000; Coştu et al., 2003; Pabuçcu & Geban, 2006). Studies aimed at eliminating misconceptions show that the traditional teaching method is inadequate in eliminating students' misconceptions (Yıldırım et al., 2007; Köse, 2007; Sarı Ay & Aydoğdu, 2015).

MEB (2018) has based on the research and inquiry-based learning approach in the science curriculum. According to this approach, the student is active in the planning and implementation of the lesson and the teacher is the guide. "Learning process; It covers exploring, questioning, argumentation and product design. In addition, it is expected that opportunities that enable students to develop their communication and creative thinking skills by expressing themselves in written, oral and visual forms are expected to be presented to students. In order for students to express their opinions comfortably, to support their opinions on different grounds, and to develop opposite arguments in order to refute the claims of their friends, environments where they can discuss the benefit-harm relationship for scientific facts should be provided. Teachers play a guiding role in discussions where students present their claims based on valid data for justified reasons" (MEB, 2018).

One of the methods to be used in science education in order to achieve the objectives stated above is the teaching method based on scientific discussion. In studies conducted in our country; It has been determined that the scientific discussion-oriented teaching method increases student achievement, participates actively in the learning process, is a cultivated method for students to defend their own ideas by discussing with their peers, and is beneficial for students' socialization (Tümay & Köseoğlu, 2010; Demirbağ, 2011; Mixan, 2011; Yeşildağ Hasançelebi & Günel, 2013; Öğreten & Uluçınar Sağır, 2014; Çetin et al., 2014; Demirbağ &Günel, 2014; Ulu & Bayram, 2015).

Scientific discussion-oriented teaching method is an effective method in which students will question their knowledge by making scientific discussions with their peers, develop students' critical thinking skills and increase their conceptual learning (Özkara, 2011; Ceylan, 2012).

It is especially important to use scientific discussions in teaching chemistry concepts, where abstract concepts are predominant and microscopic events that cannot be observed with the naked eye are common. Students can make sense of these abstract, complex and obscure concepts in their mind diagrams through scientific discussions. The subject of change of matter and matter is one of them. Atoms, particles, molecules, physical and chemical changes are all interrelated and basic topics of chemistry. However, studies have reported that understanding these issues is difficult for students of all ages (Bayrakçı, 2007; Buluş Kırıkkaya & Güllü, 2008; Taşdemir & Demirbaş, 2010; Turgut & Gürbüz, 2011; Çelik & Çakır, 2015; Gülay & Tekbıyık, 2015) . However, it is seen that there are not many chemistry activities focused on scientific debate in the literature. Developing and presenting activities focused on scientific discussion will enable teachers to access ready-made materials and save time. Of course, the most important contribution of this process will enable the learning of abstract chemistry concepts in a meaningful way.

In this context, the purpose of the research is to develop scientific discussion-oriented (SDO) activities that include the concepts in the unit of 'Change of Matter' and to examine the effects of these activities on eliminating the misconceptions of the students in the unit. Considering that science learning environments can be created in which students participate actively in the science learning process, by doing-living, by questioning their own and other learners' ideas and by establishing logic relationships with the "Scientific Discussion-Focused Teaching Method," it is indeed very resistant to change. It is thought to be important in the process of overcoming misconceptions. Misconceptions negatively affect subsequent learning and reduce academic achievement. In this context, this study aimed at eliminating misconceptions is thought to be important.

2. Method

This study, whose purpose is to examine the effect of scientific discussion-oriented activities on eliminating misconceptions in the 'Change of Matter' unit, has been designed in accordance with the action research method. Action research is a research appBuluşroach that is carried out by practitioners alone or with a researcher to understand and resolve the problems that arise in practice, combines research and practice, and facilitates the transfer of research results into practice (Yıldırım & Şimşek, 2013). In this context, it is thought that the action research method will be suitable for this study in order to ensure the active participation of the researcher in the process and to examine the research results in depth.

In this context, the test developed before the application started was applied to the students as a pre-test, then activities developed based on scientific discussion were applied in a total of 18 lesson hours, and reflective diaries were kept in the students during this process. After the application process, the same test was applied as a posttest. In addition, semi-structured interviews were conducted with the students at the end of the application. In these interviews, students were asked 5 questions to determine their misconceptions and 2 questions to determine their opinions about the application process.

2.1.Working group

In this study, an easily accessible situation sampling method was used for the researcher to better observe and manage the process, and the sample was chosen as 5th grade students of a public school in Çayeli district of Rize where the researcher worked. A student who only participated in the implementation process of the activities at certain intervals was not evaluated. In this context, the sample of the study consists of 26 5th grade students. The gender distribution of the sample is given in Table 1.

Table 1: Distribution of the selected sample by gender

Gender distribution of the sample	Female	Male
Number of students	12	14

2.2. Data Collection Tools

In the research, as data collection tools, the Misconception Test (MT), Semi-structured Interview and Reflective Diaries were used. Data collection tools used within the framework of the sub-problems of the research are given in Table 2.

Table 2: Data collection tools for the sub-problems of the research

Sub-Problems of the Research	Data Collection Tools		
	MT	Semi-Structured Interview	Reflective Diaries
What is the effect of scientific discussion-oriented activities on students' overcoming misconceptions in the 'Change of Matter' unit?	X	X	X
What are the opinions of the students about the process of using scientific discussion-oriented teaching method?		X	X

Considering the misconceptions in the literature about the unit of substance change, a two-stage MT consisting of 13 questions was created. The distribution of the questions in the test according to the subjects is given in Table 3.

Table 3: Distribution of the questions in the MT by subjects

Question No	**Subject**
1, 2	Expansion-Shrinkage
3	Warm-Up-Cool-Down
4	Evaporation
5	Expansion
6	Evaporation-Condensation
7	Evaporation
8	Condensation
9, 10	Boiling
11, 12	Boiling-Evaporation

The questions in MT were examined by 3 faculty members who are experts in the field of chemistry education and 1 faculty member who is an expert about the SD0 teaching method and their opinions were taken in terms of the suitability of the questions prepared. The pilot study of the test was conducted with 50 students. As a result of the reliability analysis performed after the pilot study, the 7th question, which reduced the reliability of the test, was removed from the test and there are 12 questions in the final form of the test. In line with the data obtained from the pilot study, the reliability of KYBT was found to be $\alpha = 0.87$. The application time of the test was determined as 40 minutes.

In this study, semi-structured interview was used as another data collection tool because it is very powerful in revealing individuals' data, opinions, experiences, and emotions and is based on speech, the most common form of communication (Yıldırım & Şimşek, 2013). Expert opinion was received in order to ensure the validity of the interview questions. Whether the interview questions were suitable for the purpose of the study was evaluated in terms of content validity and it was determined that the interview questions were appropriate for the purpose of the study in line with the expert opinions. Semi-structured interviews consisting of 7 questions were conducted with 6 students at time intervals of approximately 15 minutes each, after the implementation process of the activities.

In the research; reflective diaries were used as a data collection tool in order to obtain information about the aspects that students liked and had difficulties in science lessons taught with scientific discussion-oriented activities, the contributions of the activities to the students and how they changed their interest in science. From the day the activities were implemented, they were asked to write at home their thoughts about the contributions

of the activities to the students, the aspects they liked and had difficulties, and whether their interest in science lesson changed at the end of each acquisition, and at the end of the application, the reflective diaries were collected from the students.

2.3. Creating Activities and Implementation Process

While creating the activities used in the study, the misconceptions in the literature regarding 5th grade science curriculum, SDO activities and the unit of 'Change of Matter' were examined (Bayrakçı, 2007; Buluş Kırıkkaya & Güllü, 2008; Taşdemir & Demirbaş, 2010; Turgut & Gürbüz, 2011 Çelik & Çakır, 2015; Gülay and Tekbıyık, 2015). In line with these examinations, 9 activities were developed in accordance with the SDO teaching method. Activities prepared in line with the misconceptions determined from the literature are shown in Table 4.

Table 4: Distribution of scientific discussion-based activities according to misconceptions

Misconceptions	**Activities**	**Explanations**
Cold substances do not have heat. The substance gets hot when it gets hot.	Racing Theories: The Story	The students were given a story about the effect of warming and cooling on matter. It is given on the worksheet, together with the explanation of the two claims for the story. Students are asked to explain which claim they support, along with reasons. After the students express their opinions, they make a joint decision by making a class discussion.
Expansion does not change with temperature. Seasonal change causes expansion-contraction. Expansion and contraction phenomena are mixed.	Racing Theories: Cartoon	Four theories about expansion and contraction were given to students. The students were asked which theory they participated in, and a group discussion was held by forming groups of students who supported the same theory.
Expansion does not change with temperature. Expansion and contraction phenomena have been mixed.	Creating arguments	The students were given visuals about the positive and negative effects of expansion, and they were asked whether they agreed with the theory given in line with the visuals, and they were asked to create arguments by forming groups with their reasons and discussing them.
They mixed condensation and evaporation phenomena.	Experiment report	A ready experiment report was given to the students. Based on this report, students are asked to discuss the claims about the experiment and explain the mistakes in the report along with their reasons.
They mixed condensation and evaporation phenomena. Water does not evaporate at all temperatures. The temperature of the environment does not affect evaporation. Temperature is required for evaporation.	Racing Theories: Cartoon	Students are given opinions about evaporation. Students are asked to divide into groups in line with the opinions they share and explain their claims along with their requirements.
Water does not evaporate at all temperatures. The temperature of the environment does not affect evaporation. Temperature is required for evaporation.	Racing Theories: The Story	Students are given a story about the relationship between temperature and evaporation. Based on this story, the students are asked to discuss as a class with the reasons for the opinion they defend.

Continuation Table 4: Distribution of scientific discussion-based activities according to misconceptions

Misconceptions	Activities	Explanations
Temperature is required for evaporation. The higher the evaporation rate, the higher the temperature. The higher the temperature, the higher the evaporation rate.	Experiment Design	In order to ensure the reliability of the data, the students are given the order of how often they will measure, indicating which variables are wanted to be measured. The students are guided in this direction and discuss their claims by dividing them into groups together with their reasons.
Bubbles from boiling water; oxygen and air bubbles. There is no evaporation without boiling. Boiling takes place on the surface of the liquid. Evaporation is at every point in the liquid. Temperature is required for a liquid to boil.	POE	The experiment designed for boiling was given to the students as a worksheet. First, students are asked to make predictions about the event before starting the experiment. Afterwards, an experiment is done and students are asked to make observations. If a different situation arises between their predictions and their observations, students are asked to reconsider and explain their first arguments.
They mixed condensation and evaporation phenomena. Boiling takes place on the surface of the liquid. Evaporation is at every point in the liquid. There is no evaporation without boiling.	Statement of Expressions	Students were given a worksheet consisting of 7 statements about the item and the exchange unit. Students are asked to divide into groups and discuss with the group members whether each statement is true or false, along with the reasons. Afterwards, the group representatives expressed the opinions of the groups for each statement and a class discussion was held.

After the activities were developed, they were checked by 2 lecturers who are experts in the field of chemistry education, 1 lecturer and 1 science teacher specialized in the field of SDO teaching method, some activities were corrected in line with the feedback received, and some activities were removed from the application.

Before the actual sampling, the activities were applied to 27 5th grade students studying at the same school and a pilot study was conducted, and the places that students had difficulty understanding and the deficiencies in the activities were determined. As a result of the pilot study, necessary corrections were made and activities were finalized.

2.4. The implementation process of the activities

The Toulmin discussion model was used in the discussions during the course of the lessons. In this context, four and five activity groups were formed for the students in the teaching of the unit "Change of Matter" and lessons were conducted. In this context, a total of 7 groups were formed. In addition, for each acquisition, students were exchanged for their group mates so that they could interact and discuss with different friends.

In the activities, students were asked to find data that support or refute the claims they made and discuss them. In addition, they were asked to discuss which claim they support or why they do not support them, along with their reasons. Using this method of discussion, students were first asked to reach a consensus within themselves, and then by their chosen group representative, they were asked to explain the group's ideas and decisions to other groups along with their reasons and to reach a consensus using discussion items with other group representatives.

The researcher is in the role of conducting the discussion in the application process. In cases where students had difficulty during the implementation process, students were guided in line with the scientific discussion-based teaching method.

The argumentation worksheet developed by Ceylan (2012) for students to better understand Toulmin's discussion model and its elements before starting to practice with scientific discussion-oriented teaching method activities, and the researcher developed "What Should Doctor Cenk Do?" activity has been done.

2.5. Data Analysis

Students' responses to the two-stage misconception test (MT) in the pre and post tests were examined by two researchers and divided into categories as shown in Table 5. By evaluating the categories made by the two researchers, common categories were created for each student's answers. Afterwards, the frequency values of the student responses in each category were found and converted into a table.

Table 5: Categories used in the analysis of MT and their explanations

Abbreviation	Explanation
DS-DN	Right Option - Right Reason
DS-KDN	Right Option - Partially Right Reason
KYS-DN	The Misconceptional Option - Correct Reason
DS-KYN	Correct Option-The Misconceptional Reason
DS-B	Correct Option-Blank
KYS-KDN	The Misconceptional Option - Partially Correct Reason
KYS-KYN	The Misconceptional Option - The Misconceptional Reason
KYS-B	The Misconceptional Option -Blank
B	Blank

While analyzing the semi-structured interviews, descriptive analysis method was used in the analysis of 5 questions regarding the scientific discussion-oriented teaching method and the implementation process. Students' answers were categorized as full comprehension (TA), partial understanding (KA), misconceptional answer (KYC), wrong answer (YC) and empty (B). Then, frequency and percentage values are tabulated according to the categories. In addition, some remarkable student expressions were presented with direct quotation method. The analysis of two questions about the teaching of the science course with scientific discussion-oriented teaching method was done by direct quotation method.

Content analysis method was used in the analysis of reflective diaries. In this section, the students were given codes such as ST1, ST2, ST3, ……., ST25, ST27 and abbreviated. Then, the codes were determined by examining the expressions of the students about each department and themes were created based on the codes. Afterward, similar expressions were coded in the reflective diaries and tabulated with frequency values.

3. Findings

3.1. Findings Obtained From the Analysis of MT

In this section, the distribution of the explanations given by the students to the MT in the pre and post test is tabulated (Table 7). In Table 7, the categorized form of the responses given by the students to MT and the number of students responding to each category are presented.

Table 6: Pre-post test frequency distribution of MT by categories

Kategoriler		DS-DN	DS-KDN	KYS-DN	DS-KYN	DS-B	KYS-KDN	KYS-KYN	KYS-B	No answer
1	Pre test	1	6	0	3	2	0	13	1	0
	Post test	11	2	3	1	1	1	7	0	0
2	Pre test	7	4	2	2	1	0	6	4	0
	Post test	6	1	1	0	3	2	13	0	0
3	Pre test	5	3	1	2	2	1	8	4	0
	Post test	12	0	1	3	4	1	5	0	0
4	Pre test	4	13	0	3	1	0	3	2	0
	Post test	6	9	1	1	3	1	5	0	0
5	Pre test	7	3	0	2	1	2	9	2	0
	Post test	15	2	3	0	1	0	3	2	0
6	Pre test	12	5	0	3	1	2	3	0	0
	Post test	10	1	2	1	1	3	7	1	0
7	Pre test	3	0	0	4	1	0	12	6	0
	Post test	18	0	0	0	0	0	7	1	0
8	Pre test	9	1	0	3	5	0	5	1	2
	Post test	11	0	0	2	1	0	7	5	0
9	Pre test	9	2	0	0	1	5	5	3	1
	Post test	15	2	1	1	1	1	3	2	0
10	Pre test	10	1	0	0	2	1	8	4	0
	Post test	16	0	0	1	4	0	4	1	0
11	Pre test	2	0	0	0	2	3	16	3	0
	Post test	10	0	0	2	3	0	10	0	1
12	Pre test	7	8	0	0	0	3	4	4	0
	Post test	15	4	0	0	1	4	2	0	0

When Table 6 is examined, it is seen that the number of students who responded in the DS-DN category in the post-test generally increased. However, it is seen that there are student answers in KYS-KYN and KYS-B categories even after the activities are applied in the posttest.

3.2. Findings from Structured Interviews

In this section, the findings obtained from the interviews with 6 students after the application in order to deepen the research results are included.

In the first question, "What is evaporation? Please explain. "The question was asked. The answers given by the students are presented in Table 7.

Table 7: Answers given by the students to the first question

Categories	Frequency (f)	Student Codes
TA	4	S1, S14, S25, S26
KA	2	S2, S4
KYC		
YC		
B		

When Table 7 was examined, it was determined that 4 students answered the first question in the TA category and 2 students in the KA category. Examples of students' responses in the TA category are "Evaporation is the transformation of a liquid substance into a gas state by taking heat." (ST26), "Liquids take heat and turn into gas." (ST1, ST14, ST25). Examples of student responses in the KA category are "The transformation of a liquid substance by taking heat is evaporation." (ST2), "A liquid evaporates by absorbing heat. It is like this; If we put a liquid under the sun, it will evaporate over time. " (ST4).

In the second question, "What is a condensation event? Please explain." The question has been asked. The answers given by the students are presented in Table 8.

Table 8: Students' responses to question two

Categories	Frequency (f)	Student Codes
TA	2	ST1, ST25
KA	1	ST4
KYC	3	ST2, ST14, ST26
YC		
B		

When Table 8 was examined, it was determined that 2 students answered the question in TA category, 1 student in the KA category and 3 students in the KYC category. Examples of students' responses in the TA category are "The transformation of gaseous substances into liquid by heat." (ST1, ST25). An example answer to the KA category is "Moving from gas to liquid is condensation. Gaseous substances take heat and condense. For example, precipitation event is… " (ST4). Examples of student responses in the KYC category "Condensation is the solid state of gaseous substances. For example, it may be cloud but not solid… " (ST14), "It is the transformation of solid materials into gas without transforming into liquid state by taking heat. Naphthalene is an example of condensation. When we put the naphthalene somewhere, it turns into a gas without turning into a liquid. "(ST26). The students were asked to show the condensation phenomenon with a drawing, but the students could not show the condensation phenomenon with a drawing.

In the third question, students said, "What do you think about the temperature at which evaporation takes place? The question has been asked. The answers given by the students are presented in Table 9.

Table 9: Students' responses to question three

Categories	Frequency (f)	Student Codes
TA	4	ST1, ST4, ST25, ST26
KA		
KYC	2	ST2, ST14
YC		
B		

When Table 9 was examined, it was determined that 4 students answered the first question in the TA category and 2 students in the KYC category. Examples of students' responses in the TA category are "Evaporation occurs at any temperature." (ST1, ST4, ST25), “Evaporation takes place at any temperature. In other words, according to the ratio of temperature, evaporation will be more at the phase temperature, less evaporation at low temperature. “(ST26). Examples of student responses in the KYC category are "No evaporation without boiling." (ST14), "Evaporation happens when it gets heat." (Ö2).

In the fourth question, "Explain the boiling event." The question has been asked. The answers given by the students are presented in Table 10.

Table 10: Students' responses to question four

Categories	Frequency (f)	Student Codes
TA	1	ST4
KA	4	ST2, ST14, ST25, ST26
KYC	1	ST1
YC		
B		

When Table 10 was examined, it was determined that 1 student answered the 4th question in the TA category, 4 students in the KA category and 1 student in the KYC category. Examples of student responses in the partial understanding category "Water boils when heated, bubbles appear in boiling." (Ö14), "A liquid substance boils when it gets heat." (ST2). Sample answer to the full comprehension category;

- “For example, let's put a liquid substance in a pot… For example, we put a liquid substance in a pot, whatever, let's say water. Liquids boil when heated. " (ST4)
- “Is temperature required for boiling? ”(Researcher)
-" Must." (ST4)
- “Is the boiling temperature the same for each substance? ”(Researcher)
- "It's not the same." (ST4).

In the 5th question to students, “Is there a difference between boiling and evaporation events? Please explain. " The question was asked. The answers given by the students are presented in Table 12.

Table 11: Students' responses to question five

Categories	Frequency (f)	Student Codes
TA	1	ST4
KA	3	ST14, ST25, ST26
KYC	1	ST1
YC		
B	1	ST2

When Table 11 was examined, it was determined that 1 student answered in TA category, 3 students in KA category, 1 student in KYC and 1 student in category B. Examples of answers given in TA category; “There is a difference between boiling and evaporation. While evaporation happens at any temperature, boiling does not occur at all temperatures. " (ST4), examples from the answers given in the KA category; "In the boiling event, the conversion of the liquid into gas is faster, and it is slower in evaporation. (Ö26), examples from the answers given in the KYC category; “There is a difference between boiling and evaporation. When it boils, the water gets hot. It does not evaporate when it boils, but when it evaporates, it becomes gas, and water decreases… ”(ST1).

As the seventh question, the students asked, “What are your thoughts about the teaching of your science course with scientific discussion-oriented activities?” The students answered this question that the lesson was generally enjoyable and that the information learned with this method was more memorable. Some of the student answers are presented below.

- "For example, I did not know that there is evaporation at every temperature, we learned these by discussing with our friends." (ST1),
- “Our lessons were very good. It was better than our other science classes. " (ST2),
- “I think our lesson was very good. We learned many things. I was learning before, but I didn't remember much. Now I think I remember more. " (ST4),
- “Our lesson was fun, we always discussed very well. We learned better. I could not learn last semester, now I understand better. “(ST25).

“What do you think about the previous science lesson and the science lesson taught according to scientific discussion-oriented activities? Students stated that the lessons taught with the scientific discussion model were generally better and they enjoyed group discussions. Some of the student answers are presented below.
- "I liked arguing with our friends." (ST2),
- “We argued with our friends, we defended ourselves. We argued with our friends in unknown places and corrected our mistakes. In our previous lessons, information remained in our minds for a short time. In these lessons, we corrected our mistakes and stayed more in our minds with our friends. “(ST4),
- "The lesson we taught according to the scientific discussion model was very nice and more fun." (ST25),
- "I think we learn better by discussing with groups." (ST14),

Findings from the Analysis of Reflective Diaries

The data obtained from the students' reflective diaries were analyzed with content analysis and the direct opinions of the students were given in the rest of the table.

Table 12: Data obtained from analysis of reflective diaries

Categories	Codes	Theme			
		Benefits from the activities Frequency (f)	Positive views towards the lesson Frequency (f)	Difficult sections in the course Frequency (f)	Interest in science class Frequency (f)
Academic success	Learning concept	21	6		4
Learning skills	New techniques	18	7		
	Learning new concepts Clearing misconceptions	22	23		6
	Scientific process skills	10	3		
	The ability to think		13		
Affective skills	Fun	16			13
	Be happy	5			5
Social skills	Team work	8	16		2
	To express yourself	7	14	16	6
Arouse interest	Increased interest in the lesson	7	6		15

When the data obtained from the students' reflective diaries were analyzed, the expressions of the students in the diaries were gathered under five themes: 'Acquisitions from activities, Positive opinions about the lesson, difficult parts of the lesson, interest in science lesson.' These themes are categorized under five categories: "Academic achievement, Learning skills, Affective skills, Social skills, and arousing interest." When Table 12 is examined, it was determined that during the implementation of the activities, students stated that the activities increased their academic achievement, enabled them to learn new concepts meaningfully, enabled them to gain scientific process skills, the process was fun, enabled them to gain positive opinions about the lesson, and that they enjoyed group work. In addition to these, the students also stated that they had difficulties in expressing themselves, persuading the other group and understanding the statements of the other group during the application process. Examples of students' views are presented below:

“I understood better the temperature, heat, expansion and contraction. I learned how to defend my claim. “(ST1)

"I liked to say my own opinion." (ST14)

“I learned to have scientific discussions and now I like science lesson more. Because our lesson is fun. ” (ST15)

"I like it when we think with our bandmates and defend our thoughts." (ST2),

“I understand the subject better by arguing. It is very nice to think and express our opinions with our group friends… ” (ST10)

“It was great to experiment. I understood the subject better. “(ST25)

“I had a hard time understanding the rival team's statements. Sometimes I had trouble making my own statements. “(ST1)

"I had difficulty defending my claim." (ST14)

“I had trouble understanding my friends' examples. Sometimes I couldn't make a sentence myself. "(ST22)

4. Discussion

In this section, firstly, the data obtained for the effect of scientific discussion-oriented activities on eliminating the misconceptions in the 'Change of Matter' unit, and then the data obtained to determine the students' opinions about the process were evaluated and discussed.

When the findings obtained from the pre-test and post-test taken by the students from MT in general, it is seen that the number of students who gave correct answers to the questions in the post-test (Table 6) increased. Based on this result, it can be said that activities focused on scientific discussion-oriented (SDO) activities have a positive effect on eliminating misconceptions. In this context, in order to examine this situation in more depth, the findings obtained from MT were evaluated and presented in the dimension of questions.

In the pre-test, one of the students answered in the DS-DN category to the FIRST question about expansion and contraction, while 11 students answered in this category in the post-test. Again in the same question, 13 students answered in the KYS-KYN category in the pre-test, while 7 students answered in this category in the post-test (Table 6). The increase in the DS-DN category and the decrease in the KYS-KYN category show that activities based on scientific discussion are effective in eliminating misconceptions. A similar situation occurred in other questions in general. However, in the post-test, the increase in the number of correct answers and the decrease in student answers in the KYS-KYN category are the 3rd, 5th, 7th and 11th questions. It can be said that activities have an effect on eliminating students' misconceptions. Because, while preparing the activities, they were developed by taking into account the misconceptions determined in previous studies on this subject in the literature. And during the activities, the students from time to time participated in individual discussion processes and sometimes in group discussion processes. This process enabled them to constantly examine themselves and their knowledge and concepts. At the end of the process, there was a decrease in the number of misconcepted answers in general. When Table 12, which includes the findings from the reflective diaries, is examined, similarly, it is seen that the students think that the scientific discussion-based teaching method eliminates their misconceptions (f = 22). S4's opinion on this issue; “It made me understand the science lesson better. I learn the truth of what I know wrong. Once I realized that evaporation is at every temperature. It made us remember some things. " in the form.

In this case, it coincides with the studies in the literature, with the result that scientific discussion-oriented teaching method increases academic achievement in students, improves conceptual understanding and conceptual change. Özkara (2011) concluded in his study that scientific discussion activities applied to the experimental group enabled the students to construct their knowledge about pressure in their minds. Boyraz et al. (2016) stated in their study that argumentation was effective in removing confusion in students. Acar et al. (2016), in their study to examine the effect of argumentation teaching activities on the conceptual understanding of 6th grade students, scientific thinking skills and understanding of the nature of science, the conceptual understanding of the experimental and control group students developed from pre-test to post-test, but the conceptual understanding between the two groups was pre-tested. They concluded that there was no significant difference between the post-test scores. Demirel (2015) concluded that the teaching of science lessons with scientific discussion activities on the subject of solid pressure eliminates students' misconceptions. There are many similar studies in the literature (Güler, 2016; Doğru, 2016; Cin, 2013; Türkoğuz & Cin, 2013; Üstünkaya & Savran Gencer, 2012; Şahin & Hacıoğlu, 2010; Tüay & Köseoğlu, 2011; Ulu & Bayram, 2015; Altun, 2010; Öğreten & Uluçınar Sağır, 2014; Uluay, 2012; Yeşildağ Hasançelebi & Günel, 2013; Yeşiloğlu, 2007; Deveci, 2009; Okumuş, 2012; Arlı, 2014; Kabataş Memiş, 2011; Öztürk, 2013).

A striking point in the data obtained from the test is that in the second question, 6 of the students answered in the KYS-KYN category, while 7 of them answered in the DS-DN category (Table 6). When the posttest findings were examined, 13 of the students answered in the KYS-KYN category, while only 6 of them answered in the DS-DN category. In this case, the conclusion that activities based on scientific discussion are effective in eliminating misconceptions in the 1st question does not match the result obtained in the 2nd question. However, when the answers given by the students about the expansion and contraction to the question asked in the interview are examined in detail, it is seen that the students who gave the wrong answer in the test gave the

correct answer to the question asked in the interview. This contradictory situation is similar to the result of the study conducted by Coştu (2002) with high school 1st, 2nd and 3rd grade students in order to determine the level of understanding by students of evaporation, condensation and boiling concepts and to compare between levels. In the study, it was concluded that the students gave a misconceptual answer to the question in the test related to the condensation event, but gave correct answers to the question asked about the subject in the interview. This situation can be considered as an indication of the advantage that the interviews provided in revealing students' learning in more detail.

In the other questions in the test, the answers of the students in the correct DS-DN category in the pre-test to the post-test generally increased, while their answers in the KYS-KYN category decreased. However, it has been determined that it is not a question in which the frequency of misconceptions is zero. This is an indication that misconceptions are highly resistant to change. A similar situation can be seen from the answers given by the students to the interviews. Among the answers to all five questions asked to students, there are answers in the Misconceptional answer (KYC) category (Tables 7, 8, 9, 10, and 11).

The opinions of the students about the activities carried out with scientific discussion-oriented instruction were revealed both in the interviews and with the findings obtained from the reflective diaries they wrote throughout the process. In this context, in both data sources, the students emphasized that the lesson was fun, the information learned with this method was more memorable, it provided meaningful learning, and that they learned new techniques. There are many studies in the literature that support this result (Demirel, 2015; Uluay, 2012; Ceylan, 2010; Arlı, 2014; Kabataş Memiş, 2011). Similarly, Küçük (2012) investigated the effect of using classroom activities supported by scientific discussion on students' conceptual understanding, perceptions of inquiry learning skills and attitudes towards science. During the implementation phase, while the lesson was taught with the experimental group with in-class activities supported by scientific discussion, the lesson was taught with the control group with the traditional method. The result of the study showed a significant difference in favor of the experimental group between the students' conceptual understanding levels and their attitudes towards science lesson.

When Table 12 is examined about the sections in the reflective diaries that were difficult in the lesson, the students stated that they had difficulties in expressing themselves (f = 7), persuading the other group (f = 6) and understanding the explanations of the other group (f = 3), while 10 students stated that they had no difficulty in the lesson. They stated. It is thought that the reason for students' difficulties is that students are not familiar with such activities, although two case studies were conducted to introduce scientific discussion-oriented activities before the application began. It is believed that after a few activities they will not have any problems. Similarly, Aslan (2014), in his study with high school students in order to examine the ability to construct a written argument and to evaluate the argument presented, concluded that his students were successful in establishing an argument, but mostly failed to construct an acceptable justification to support their claims and that students could not support their claims in all aspects.

5. Suggestions

In this section, some suggestions are given in line with the results obtained from the study.

1. It has been determined that the students find the science lesson, which is taught with scientific discussion activities, entertaining, understand the lesson better, and enjoy group work. In this context, it is thought that giving more scientific discussion activities in science lessons will increase the science achievement of students.
2. In the literature reached about the second item change unit, studies to determine misconceptions are frequently encountered, but there are few studies to eliminate them. Some gains have been studied in this study on the unit of change of 5th grade item. In other acquisitions related to the unit of change of matter, the effect of scientific discussion-oriented activities on overcoming misconceptions can be investigated.
3. The sample of this study consists of 5th grade students. The effect of scientific discussion-oriented activities in eliminating misconceptions can be applied to students at the next level.
4. Studies can be conducted to compare the effect of scientific discussion-oriented activities on overcoming misconceptions with the effects of different methods on overcoming misconceptions.

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