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THE EFFECT OF REFLECTIVE SCIENCE DIARIES ON ACHIEVEMENT AND REMOVAL OF MISCONCEPTIONS OF GRADE 5th GRADE STUDENTS ABOUT THE MOON CONCEPT

Research article

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Abstract

The aim of this research is to determine the misconceptions of students about the subject of the moon and to examine the effects of science lesson with reflective science diaries on the achievements of students and eliminating their misconceptions. The research designed according to the pretest-posttest control group model among the experimental research methods was carried out with the participation of 50 students including 25 experiments and 25 control groups. Lessons were carried out through enabling students to keep reflective science diaries for 6 weeks in the experimental group. As a measurement tool, the achievement test, consisting of 4 open-ended questions, was applied to both groups as pretest and posttest. As a result of the research, a significant difference was observed in favor of the experimental group where reflective science diaries were applied. It was found that students have several misconceptions about the subject of the moon. It was concluded that the reflective science diaries were effective on the students' achievements and on elimination of misconceptions on the topic of the moon.

Keywords: Moon, misconception, reflective diaries, science education

1. Introduction

The history of research on space is as old as the birth of humanity. Space, universe, sky, celestial bodies and their movements have attracted the attention of people since ancient times. People tried to solve the mysterious events that occurred in space and reached some information with various observations. It is known that the Egyptians observed the sun and the moon, and the Greeks drew the star maps, and the Chinese were drawing what they observed in the sky on the parchment paper. Since ancient times, people have some misconceptions about the shape and movements of celestial bodies that do not match the scientific information. Similar misconceptions are frequently observed in students.

Current pre-knowledge of students has a major role in constructing the newly learned information. However, the pre-knowledge of the students may differ from the scientific facts in some cases (Palmer, 1999). The students' pre-knowledge acquired through the process of education, informal learning environment or personal experiences and the instinctual beliefs have caused them to misunderstand the topic. Scientists have named these concepts as misconceptions.

Misconception is defined as the student's understanding of the concept that is far from the scientifically accepted meaning (Stepans, 2003). Students are be able to comprehend the knowledge they learn by associating them with their previous knowledge and construct it in their minds (Osborne & Wittrock, 1983). According to Piaget, misconceptions showing a structure characteristic continue to be added onto each other (Yağbasan & Gülçiçek, 2003). An existing misconception of the student leads to a new one and the misconceptions continue to

increase sequentially. Misconceptions impede students 'meaningful learning and adversely affect students' academic achievement. For this reason, misconceptions should be identified and remediated in the early stages. Misconceptions can be determined through applying some tests and conducting one-on-one interviews. Various methods and techniques are used in remediating the misconceptions and one of the preferred ways is tasks based on reflective thinking.

Dewey, who leads the formation and development of the notion of reflective thinking, defines the concept of reflective thinking, as a type of an effective, continuous and careful thinking of any knowledge and an information structure supporting the achievement of the expected results. Reflective thinking is a logical and knowledge-based decision-making process that involves the assessment of outcomes in education-related issues (Taggart & Wilson, 1998).

Reflective teaching is a set of interrogative approaches and creative problem-solving activities that emphasize the importance of others' emotion and constructivism in teaching (Henderson, 1996). Activities that develop reflective thinking include mind maps, concept maps, questioning, learning articles, negotiated learning, self-assessment, reflective discussion, and writing reflective diaries (Keskinkılıç, 2010). The use of student diaries in the learning process increases reflective thinking skills **(**Andrusyszyn **&** Davie, 1997).

The main purpose of using reflective diaries in education is to raise awareness for students regarding what they do in the teaching process and to help them develop useful problem-solving strategies. Thus, students will become aware of the strengths and weaknesses in their knowledge and application field (Sparks-Langer et al., 1990). Students can express the problems they try to solve, observations that they conduct, results that they reach and their reflections through diaries (Ruiz-Primo, Li & Shavelson, 2002).

The diaries written in the science classes can be defined as the writings as the records of the applications made during the course and the experiences of students in the classroom, as well as the texts used to improve their writing skills (Nesbit et al., 2004). Science diaries provide information about students' learning competencies, learning experiences and the difficulties they face regarding to science concepts, principles and problems and ensure continues monitoring of the development. In this way, the teaching process is formed by the student and the teacher (Korkmaz, 2004). The development of students' own science diaries makes it easier to understand the connections between the life and their imagination and their scientific experiences (Shepardson & Britisch, 2001). The use of diaries in the science classes not only encourages students (Baxter et al., 2001) but also motivates them when they observe the progress they have made in their writings. While students keep diaries, they collect data about their own learning styles, and they can repeat the lesson being implemented (Bölükbaş, 2004). In a study of Çavuş and Özden (2012) aiming to determine the students' opinions on diaries, students stated that they repeat the course and they became ready for the lesson. They also emphasized that they are more successful thanks to the science diaries they keep. McCrindle and Christensen (1995) showed that the diaries increased the students' performance and cognitive skills. Student diaries, which do not have to be written every day, can either cover the entire academic year or be applied in a specific unit, a project or homework (Korkmaz, 2004).

When the literature is examined, it is seen that students in various age groups have many misconceptions about astronomy. The movements of the moon (Bolat et al., 2014; Kaplan & Çifci-Tekinarslan, 2013), the reason why the same side of the moon appeared when viewed from the earth (Baloğlu-Uğurlu, 2005; Trumper, 2001; Ogan-Bekiroğlu, 2007) and the phases

of the moon (Baxter 1989; Kaplan & Çifci-Tekinarslan, 2013; Trumper, 2006; Trundle, Atwood & Christoper, 2007) are common misconceptions.

Although the shapes of the sky objects and their movements according to each other are started to be taught from the primary school, misconceptions about these subjects are frequently seen in the students. During the interviews with students, Kikas (2005) determined that students tried to explain the sky by using various information from their daily lives and that they experienced chaos in structuring and conceptualizing these concepts. It is very difficult to correct the misconceptions that may occur in personal experiences or in the first stages of education at very early ages and in the later stages of the education. Kavanagh, Agan and Sneider (2005) stated that not only students but adults also commonly had misconceptions about the phases of the moon. Bodner (1986) stated that the students' misconceptions about science lesson were extremely resistant to change. Ünsal, Güneş and Ergin (2001) revealed that students' misconception about the astronomy concepts could not be corrected in the following years. It is possible to replace these misconceptions with accepted concepts in the scientific field only by using appropriate teaching activities. In the literature, the effects of instruction that utilizes constructivist activities (Trumper, 2006), cooperative learning environment (Öztürk & Uçar, 2012), low cost models (Atwood & Atwood, 1997), estimation-observation-explanation and 3D computer programs (Küçüközer, 2008) on students' concept changes in astronomy is examined. The aim of this research is to determine the misconceptions of the 5th grade students about the moon, and to determine the effect of reflective science diaries used in science courses on students' achievement and eliminating misconceptions. For this purpose, the research seeks answers for the following questions;

1. Are the reflective science diaries used in the science course effect students' achievements and eliminating misconceptions regarding the moon?
2. What is the distribution of students' knowledge about the moon according to their achievement categories?
3. What are the students' misconceptions about the moon?

2. Method

In the research, pretest - posttest control group model, one of the experimental research methods was used. In this model, randomly selected test and control group measurement tools are applied to both groups as pretest and posttest. Unless there is significant difference between the groups in the pretest, the posttest scores of the groups are evaluated and interpreted (Karasar, 2014).

Sample selection was carried out using random sampling which is one of the probability-based sampling methods. Two 5th grade classes in a randomly selected secondary school located in a province of Black Sea Region of Turkey were selected. One the class was randomly assigned as experimental and the other was determined as control group. The research was conducted with a total of 50 students from the groups each having 25 students.

2.1. Data Collection Tool

In order to determine the effect of reflective science diaries on students' achievement regarding the subject of the moon, an achievement test consisting of 4 open-ended questions was used. The students were asked to draw the concepts and to explain them at the same time in 3 questions of the test. The test was prepared by examining the science curriculum in the 5th grade (Ministry of National Education, 2018) and the studies conducted in this field (Baxter, 1991; Bolat et al., 2014; Bostan, 2008; Frede, 2006; Harman, 2017; Trumper, 2003; Vosniadou & Brewer, 1990). The questions in the test are given below.

1. What movements does the moon do? Show the shape by drawing.
2. As a result of which event do the phases of the moon occur? Show the shape by drawing.
3. What are the phases of the moon? Show the shape by drawing.
4. Why is the same face of the moon always visible from the earth?

2.2. Data Analysis

The answers to the questions in the achievement test were evaluated by using the Abraham, Williamson and Westbrook (1994)'s categories, scoring criteria and the score correspond to each category, as given in Table 1.

Table 1. *Table of test evaluation*

Score	Categories of Understanding	Criteria of Scoring
0	No understanding	Empty, meaningless, question repetition, irrelevant or uncertain answers
1	Specific misconception	Scientifically incorrect answers
2	Partial understanding with a specific misconception	Answers that show an understanding of the concept but include a misconception
3	Partial understanding	Answers that include a part of scientifically accepted concepts
4	Sound understanding	Answers including all scientifically accepted concepts

When evaluating the answers given in the test, the answer of the student who has done any of the drawings or explanations correctly is considered as correct and the highest category answers of the students are taken into consideration.

After calculating the total scores obtained from the pretest and posttest by the students, they were analyzed in SPSS program. Pretest scores of the experimental and control groups were compared and the suitability of using these two groups in the research was determined. In addition, the success of the experimental and control groups was compared before and after the application separately. Then, the success of the experimental and control groups in the posttest was compared to determine whether the reflective science diaries were effective in students' achievements regarding the moon. In addition, pretest and posttest answers of the groups were given according to categories presented as percentage (%). Besides, the pretest and posttest were examined by comparing the changes in students' misconceptions in the categories of "specific misconception" and "partial understanding with a specific misconception".

In determining the appropriate test to be used in the analysis of the tests, the normality of the variables was taken into consideration. For this purpose, descriptive values of variables such as arithmetic mean, median, standard deviation, kurtosis and skewness are examined. It is suggested that instead of determining normality by using descriptive methods, results should be evaluated together with descriptive methods as well as other methods (Abbott, 2011). Therefore, descriptive values as well as normality tests were used in the research. The normality of the variables was determined by using Shapiro-Wilk test since Shapiro-Wilk test yields the most accurate and precise results with in small samples (Ahad et al., 2011) and this test is used when the sample size is between 3 to 50 (Shapiro & Wilk, 1965). For normal distribution of the groups, p values should be greater than 0.05 in normality tests (Mertler & Vannatta, 2005).

In this research, since Shapiro-Wilk of the variables was greater than 0.05, it was interpreted that these variables were normally distributed. Therefore, the findings of the achievement test were analyzed using parametric tests.

2.3. Validity and Reliability of Data Collection Tool

Two experts of the field and two science teachers reviewed the test and indicated that the test is appropriate to the student level and the purpose of the research.

In order to determine the reliability of the questions in the categorical evaluation, the agreement between the scores of two raters was calculated by the Kappa coefficient. 4 out of a total of 16 answer papers were randomly determined from the pretest and posttest papers of the experimental and control groups, were scored according to categories by two researchers. Kappa coefficients of the achievement test ranged between 0.682-1.000. The Kappa coefficients' mean of the questions in the test were calculated as 0.840 and it was determined that the agreement between the raters was level of almost perfect (Landis & Koch, 1977).

2.4. Research Implementation

The lessons in the experimental and control groups were carried out by the same science teacher and were completed in 6 weeks, including 24 class hours. In the control group, the teacher did not make any changes in the course process. In this group, the teacher carried out the lessons by keeping the course method for this subject similar to previous years. In the experimental group, she carried out lessons with enabling students to keep diary. Before the implementation, science teachers and researchers came together to inform the teacher regarding what to do during the implementation to the experimental group, what s/he should pay attention to and how to implement the application.

Achievement test was applied to both groups as pretest before starting to implementation. The teacher informed the students regarding the duration of the research and expressed that they should keep a diary on the topic. She asked them to write their diaries in a notebook in order to be more arranged. On the day of science lesson, they were asked to write about the topics they had learned, topics that they did not understand and the topics they had difficulty with understanding when they went home. They were asked to make self-criticism about the causes of the topics they could not understand and to comment on what happened in the teaching process. They were also asked to explain the topics attracted their attention and why they were interested in these topics. They were asked to write down the topics they would like to examine related to the subjects they learned if they were given unlimited opportunities. They were asked to evaluate themselves in their diaries and to write freely what they wanted to say and feel about the implementation of the course. In addition, the students were asked to observe the moon for 29 days at the same hour in the evenings and to draw the shape they saw and to state the phase of the moon in their diaries.

At the beginning of each lesson, the teacher read the diaries without any intervention and shaped the next lessons according to the student diaries. After completion of the implementation, the achievement test was applied as a posttest to both groups.

3. Results

In the achievement test, the scores obtained from the pretest of the experimental and control group were analyzed by the independent t-test and the results were given in Table 2.

Table 2. *Independent t-test results for pretest scores of groups*

Group	N	$\overline{X}$	S	df	t	p
Experimental	25	4.00	2.61	48	-1.181	0.857
Control	25	4.12	2.03			

It was found that there was no statistically significant difference between the pretest achievement test scores of the experimental and control group [t(48)= -1.181, p>0.05]. Before the implementation, it was determined that the achievement levels of the experimental and control group were close to each other about the subject on the moon, and it was found appropriate to compare the achievements of these two groups in the research.

In the achievement test, the scores obtained from the pretest and posttest of the experimental and control group were analyzed by the dependent t-test and the results were given in Table 3.

Table 3. *Dependent t-test results for pretest and posttest scores of groups*

Group	Test	N	$\bar{X}$	S	df	t	p
Experimental	Pretest	25	4.00	2.61	24	-9.549	0.000*
	Posttest	25	11.16	4.12			
Control	Pretest	25	4.12	2.03	24	-5.312	0.000*
	Posttest	25	7.76	3.22			

**: p<0.05*

A statistically significant difference was found between the pretest and posttest scores of achievement test of the experimental group [t(24)= -9.549, p<0.05] and control group [t(24)= -5.312, p<0.05]. The arithmetic mean of the experimental group in the posttest was higher than the arithmetic mean in the pretest, indicating that the significant difference was in favor of the posttest. Similarly, the arithmetic mean of the control group in the posttest was higher than the arithmetic mean in the pretest, indicating that the significant difference was in favor of the posttest.

In the achievement test, the scores obtained from the posttest of the experimental and control group were analyzed by the independent t-test and the results were given in Table 4.

Table 4. *Independent t-test results for posttest scores of groups*

Group	N	$\bar{X}$	S	df	t	p
Experimental	25	11.16	4.12	48	3.252	0.002*
Control	25	7.76	3.22			

**: p<0.05*

A statistically significant difference was found between the posttest scores for the achievement test of the experimental and control group [t(48)= 3.252, p<0.05]. The arithmetic mean of the experimental group students was higher than arithmetic mean of the control group students, indicating that the significant difference was in favor of the experimental group.

The percentage distribution of the answers of the students according to categories in the groups to the questions in the test is given in Table 5.

Table 5. *Percentage distribution of answers of the questions in terms of categories*

Tests		Pretest		Posttest	
Groups		EG	CG	EG	CG
Question Number	Category	%			
1	NU	40	52	-	8
	SM	-	8	-	-
	PU/SM	-	-	-	-
	PU	60	40	28	68
	SU	-	-	72	24
2	NU	68	68	40	64

	SM	32	16	16	8
	PU/SM	-	-	-	-
	PU	-	16	-	4
	SU	-	-	44	24
3	NU	40	56	16	12
	SM	12	-	-	-
	PU/SM	-	4	-	60
	PU	48	40	16	-
	SU	-	-	68	28
4	NU	72	76	28	40
	SM	28	24	16	40
	PU/SM	-	-	-	-
	PU	-	-	8	-
	SU	-	-	48	20

NU: No understanding, SM: Specific misconception, PU/SM: Partial understanding with a specific misconception, PU: Partial understanding, SU: Sound understanding, EG: Experimental group, CG: Control group.

Regarding the 1st question asked about the movements of the moon, it was found that 60% of the answers of the experimental group and 40% of the answers of the control group were coded under partial understanding category in the pretest. In the posttest, 72% of the answers of the experimental group were coded under sound understanding category and 68% of the answers of the control group were coded under partial understanding category.

Regarding the 2nd question asked about how the phases of the moon were formed, it was found that 68% of the answers of the experimental and control groups were coded under no understanding category in the pretest. In the posttest, 44% of the answers of the experimental group were coded under sound understanding category and 64% of the answers of the control group were coded under no understanding category.

Regarding the 3rd question asked about what the phases of the moon are, it was found that 40% of the answers of the experimental group and 56% of the answers of the control group coded under no understanding category in the pretest. In the posttest, it was found that 68% of the answers of the experimental group reached sound understanding category whereas none of the answers of the control group reached the sound understanding category. However, 60% of the answers were coded under a partial understanding with a specific misconception category.

Regarding the 4th question asked about why the same face of the moon always visible from the earth, it was found that 72% of the experimental group's answers and 76% of control group' answers coded under no understanding category in the pretest. In the posttest, it was found that 48% of the experimental group's answers had reached the sound understanding category and 40% of the control group's answers were coded under no understanding category and 40% of them were coded under a partial understanding with a specific misconception category.

Table 6 shows the misconceptions identified in the responses to the questions of the test of students in experimental and control groups under the categories of "specific misconception" and "partial understanding with a specific misconception" and their changes in pre and posttests.

Table 6. *Misconceptions detected in the test*

Answers	Pretest	Posttest

Question Number		EG	CG	EG	CG
1	The moon stays as it is	-	1	-	-
	New-moon half turns	-	1	-	-
2	Because it is a satellite	1	1	-	-
	Because of the formation of day and night	4	1	-	-
	With the earth revolves around the moon	1	2	-	1
	Earth and the moon revolve around their own axis at equal time	-	-	1	-
	The earth does not always stay in the same place	2	-	-	-
	Moon rotates its own axis	-	-	2	-
	When the moon is between the earth and the sun	-	-	-	1
	With 365 days expiration	-	-	1	
3	To be large-small	2	-	-	-
	To be a satellite	1	-	-	-
	Half Moon	-	1	-	-
	Through drawing the crescent, naming it as half moon	-	-		1
	Drawing new moon as first quarter	-	-	-	8
	Confusing the New Moon with the Full Moon	-	-	-	2
	Confusing the first quarter with last quarter	-	-	-	3
	Draw all phases like a full moon	-	-	-	1
4	Because the Earth revolves around the sun	1	-	1	-
	Because Earth rotates	-	-	-	2
	Because the moon is far away	4	5	2	3
	The moon is out at night	1	-	-	-
	Because the shape of the moon is always the same	-	-	-	1
	Because the moon always stayed on the same spot	1	1	1	-
	Because the other side of the moon is dark	-	-	-	1
	Because we always look at the moon from the same place.	-	-	-	2
	The Earth and the Moon are turning on the same axis	-	-	-	1

EG: Experimental group, CG: Control group.

In the pretest, it was determined that two students in the control group have misconceptions about the moon movements. These misconceptions were; the moon stays as it is and new-moon half turns. In the posttest, it was found that there was no student with misconceptions about the movements of the moon in the groups.

In the pretest, it was determined that eight students in the experimental group and four students in the control group had misconceptions about how the phases of the moon were formed. The students attributed these misconceptions to the moon being the satellite, the formation of the day and night, the earth revolving around the moon and the earth not staying stable. In the posttest, four students in the experimental group and two students in the control group were found to have the misconceptions. In the posttest, the students stated that the phases of the moon are formed after the expiration of 365 days, formed when the moon is between the earth and the sun, formed as a result of the moon turning around its own axis and the earth revolves around the moon. In addition, one student had the misconception of the phases of moon are formed since the moon and earth revolve around their own axis at equal time.

It was determined that three students in the experimental group and one student in the control group had misconceptions about what the phases of the moon are. These misconceptions were toward the existence of the phases of the moon such as large-small, satellite, half-moon. In the posttest, fifteen students in the control group were found to have misconceptions regarding to the phases of the moon while there were no students with these misconceptions in the experimental group. In these misconceptions it was determined that eight students drew new moon as first quarter, three students drew the first quarter and the last quarter in the place of each other, two students confused the names of the new moon and the full moon, one student drew all the phases as a full moon and one student drew a crescent and called it a half-moon.

In the pretest, it was determined that seven students in the experimental group and six students in the control group had misconceptions about why the same face of the moon is always seen when viewed from earth. These misconceptions are the expressions of students regarding to the same face of the moon is always seen when viewed from earth since the moon is far away, the moon is out at night, the moon always stays stable, and earth revolves around the sun. In the posttest, it was determined that four students in the experimental group and ten students in the control group had the misconceptions. It was determined that the students attributed these misconceptions regarding the same face of the moon is always seen when viewed from earth to the reasons of the earth rotates, the moon is far away, the other side of the moon is dark and the earth and the moon are turning on the same axis.

4. Discussion

As a result of experimental implementation, there was a significant difference between the experimental and control group scores of the posttest scores of the achievement test in favor of the experimental group. This result shows that the reflective science diaries applied to the experimental group in relation to the moon are more effective in increasing the students' success compared to the method applied to control group. The reflective science diaries used in this research are thought to be effective on the achievement of the experimental group students in terms of ensuring that reflective journals enable students to reflect on when collecting data on events taking place in a learning environment (Richards, 1995) and they enable them to repeat the lesson they have taught (Bölükbaş, 2004). Similarly, it was determined that the student diaries used in science lesson increased the students' achievement (Aymen-Peker et al., 2014). In addition, Ruiz-Primo et al. (2002) concluded that the science diaries were effective in students’ achievement in terms of being a learning source.

The answers of more than half of the experimental group and a few of control group regarding the movements of the moon were coded under sound understanding category. The result also indicated that the reflective diaries were effective on the success of the experimental group students. In the posttest, the control group students mostly answered in the partial understanding category, indicating that these students could not fully understand the movements of the moon. In addition, some misconceptions in both groups in the pretest regarding the movements of the moon were found to be vanished in the posttest.

It was found that there were more students in the experimental group who responded in sound understanding category according to the control group in relation to how the phases of moon are formed. In addition, more than half of the control group students still respond in the no understanding category, reflecting that the reflective science diaries applied to the experimental group were effective in the students' learning of the causes of the phases of the moon. In the posttest, a small number of students had misconceptions and these misconceptions regarding to the moon phases are formed as a result of the ideas such as earth revolves around the moon, the moon rotates its own axis, and the moon is between the sun and the earth. There

are misconceptions about the formation of the phases of the moon since the moon rotates its own axis (Bostan, 2008) in the literature and those are different from the misconceptions examined in this research. These misconceptions are; the formation of the phases of the moon is related to the clouds covering a part of the moon, the wind moves towards the moon and the shadow of the planets and the earth fall upon the moon (Bolat et al., 2014; Dunlop, 2000; Sharp, 1996; Trumper, 2003).

While in the responses of pretest of both groups regarding what the moon phases were predominantly in no understanding category, it was determined that more than half of the experimental group students reached the sound understanding category in the posttest. However, there was no student in the control group reaching the sound understanding category. In the posttest, it was found that more than half of the students in the control group responded in partial understanding with a specific misconception category. There were few students who were found to have misconceptions in the pretest because they responded in no understanding category in both groups regarding the phases of the moon. It was found that none of the students had the misconception in the experimental group whereas more than half of the students in the control group had the misconception in the posttest. These misconceptions were generally about confusing the phases of the moon in drawing process and the stages in the naming process. Kaplan and Cifci-Tekinarslan (2013) indicated that the 5th grade students did not know all the phases of the moon and they have difficulties in understanding the movement of the moon because of inadequate observation and incorrect pre-knowledge. This result shows that the reflective science diaries applied to the experimental group have an impact on the knowledge of the students about the phases of the moon. In addition, it is believed that this success in the experimental group is effective especially as a result of observing the moon for 29 days and drawing their observation as well as naming the phases.

While more than half of the students from both experimental and control group responded under no understanding category for the question why the same face of the moon is always seen when viewed from earth, it was determined that almost half of the students in the experimental group reached the sound understanding category in the posttest. However, few students were detected in the control group reaching the sound understanding category. In the posttest, almost half of the students in the control group still responded in the category of no understanding, while the other half responded under with a specific misconception category. In the pretest, both groups had a similar number of misconceptions whereas there were fewer students with misconceptions in the experimental group in the posttest. These misconceptions were as follows; because the earth rotates, the other side of the moon is dark, the earth and the moon are turning on the same axis, the same face of the moon is always seen when viewed from earth. These results indicate that the reflective science diaries applied to the experimental group were effective on the students' achievements, and that the control group students could not fully understand the reason for why the same face of the moon is seen when viewed from the earth. Trumper (2001) also stated that few secondary school students understand the reason for seeing the same side of the moon from the earth.

5. Conclusion

As a result of the implementation in the research, a significant difference was found between posttest scores of the achievements test of the experimental and control group in favor of the experimental group. In addition, it was concluded that the number of students reaching the sound understanding category in the experimental group was higher than the control group in the posttest regarding the movements of the moon, the reasons why the same face of the moon is seen all the time.

As a result of the research, there were a high number of students in the experimental group having sound understanding of the topics on the phases of the moon in the posttest. But it was concluded that there was a high number of the control group students having partial understanding with specific misconceptions.

It is concluded that more students had misconceptions in the control group than the experimental group in the posttest regarding the why the same face of the moon is always seen when viewed from the earth. In the posttest, it was highlighted that a high number of students in the control group regarding how the phases of the moon occur left the question blank /they gave meaningless answers which would not be an answer to the question/as the repetition of the question.

Based on the results stated above, it is concluded that the reflective science diaries applied to the experimental group was more effective in increasing the students' achievement about the movements of the moon, the phases of the moon and the reasons for their formation and the reason why the same face of the moon is always seen when viewed from the earth. In addition, it was concluded that the reflective science diaries were more effective in eliminating misconceptions about the phases of the moon and the reason for seeing the same face of the moon when viewed from the earth. It was noted that the method applied to the control group enabled the students to partially understand the topic of the movements of the moon, but not enough for their sound understanding. It has been concluded that observing the moon for 29 days and drawing the observations into their diaries was found be more effective in learning the phases of the moon.

The research provides an opportunity to see the changes in the achievement of the students and their misconceptions in the teaching process where the reflective science diaries used. It is suggested that reflective diaries should be used in science education since reflective diaries encourage students to think, allow students to see their own performances and their own development.

It is suggested that the reflective diaries should frequently be used in science education since they enable the teacher to see the learning process through the eyes of the students and make the necessary regulations accordingly. Moreover, these diaries increase the success of the students. In addition, it may be possible to use science diaries as a tool to evaluate achievement in science education with the development of the content of the diaries.

The effect of reflective science diaries in this research on the attitudes and motivations of students towards science could be examined. In addition, the effect of science diaries on the anxiety of students about the lesson can be investigated with the opinion that the science diaries will decrease the concerns of the students about the lesson by enabling them to see the parts they have difficulty in the course.

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