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The Use of the Reflective Diaries in Science Lessons from the Perspectives of Eighth Grade Students

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The science teaching program in Turkey is restated with the effect of constructivist approach and science textbooks are prepared in accordance with this new program. Furthermore, reflective diaries using many techniques have started to be used in the teaching process. Reflective diaries have also started to be used in science education. The basic purpose of this research was to determine whether the use of reflective diaries changes eighth grade secondary school students' views towards the science course or not. The method used in this study was that of qualitative research. Also, phenomenology was used as the design of the study. Thirty eight students from a secondary school in Kayseri participated in this study. Data were collected by using document analysis and semi-structured interviews. Data were analyzed by using content analysis. Codes, themes, and categories were used during data analysis. The results were discussed by means of codes, themes, and categories. According to our findings, reflective diaries have changed participants' views towards the science course positively. It was observed that all participants achieved meaningful learning on the stages of mitotic division and the importance of this division for organisms. The implications were discussed.

Keywords: meaningful learning, reflective diaries, phenomenology, science education, qualitative research, constructivism

INTRODUCTION

In the learning process, while some students achieve meaningful learning by using visual, audio, and physical tools, others develop it as an individual. Moreover, some students stimulate meaningful learning by interacting with others. In addition, meaningful learning can occur only when the students can associate their knowledge with the knowledge provided by their teacher. In other words, students must familiarize their old concepts and new concepts meaningfully in order to promote

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meaningful learning (Matthews, 1993; Posner, Strike, Hewsen & Gertzog, 1982; Taber, 2003). Therefore, students need to become active in the learning process and structuralize information by themselves through teaching activities prepared in accordance with their learning styles (Southerland & Gess-Newsome, 1999; Richardson, 1997; Taber, 2008). In time, effective learning strategies are needed for learners since they can perform meaningful learning by using them. Learning strategies include activities which aim to facilitate the self-learning of students. In line with this purpose, students should acquire skills on organizing and integrating the information obtained. The variety of learning strategies available ensures that students perceive their aspects which are similar with and distinct from those of each other. Students become aware of their own distinctness and can see strengths and weaknesses (Taber, 2008). Therefore, teachers need to enhance the efficiency of the teaching process by employing different teaching strategies since these different teaching strategies can overcome the problem of learning difficulty and increase meaningful learning (Garcia, 2005; Hewson & Hewson, 1983; Treagust, Harrison, & Venville, 1996). One of these strategies is the use of the reflective diaries. Their reflective diaries can be used to promote meaningful learning (Mason & Boscolo, 2000). In this context, the definition of the reflective diaries, which provided a basis for this research, can be given as follows: A writing activity created by the students through forming the concepts in their own world, making observations, receiving the formal education given by the teacher in a classroom setting and being affected by many sources such as the perspectives of their parents and trial and error (Avcı, 2008; Chirema, 2007; Myers, 2001).

The main purpose of reflective diaries use is to reflect the dimensions of analysis, definition, and evaluation in regard to the learning experiences and academic achievements of individuals (Stiggins, 2006). When students take notes in the learning process, their thoughts gain clarity. The use of a diary also ensures recording and repeating what has been learned. Moreover, students discover exactly what they think; they express what they have learned in words, pictures, numbers and handicrafts; in doing so, they perceive their level of development in a concrete way (Ministry of National Education, 2009, p. 50-51). Furthermore, students can write about the events, experiences and emotions that occurred in lessons, and additionally they can explain what they have learned in the lesson in a written form. Likewise, students freely express their thoughts and feelings in line with the information they have learned during lessons by using their own words in the diaries (Klein, 1999; Tynjala, 1998).By using a reflective diaries, students have the opportunity to perceive their personal development in the education process as well as what, how and how much they have learned (Avcı, 2008; Crawford, Saul, Mathews & Makinster, 2005). Also, students have the opportunity to perceive their level of improvement and realize at which point they were mistaken and what needs improvement. Moreover, students might reflect on their learning objectives and enhance their critical thinking (Rivard & Straw, 2000). In addition, they might integrate theory with practice, become scientifically literate, promote their professional growth, make clear interpretations in a much deeper manner and facilitate meaningful learning (Chin & Brown, 2000; Hand, Prain, Lawrence, & Yore, 1999; Kea & Bacon, 1999; Tang, 2002). Therefore, the present study hopes to provide a contribution to literature by examining whether reflective diaries promote meaningful learning, after taking into consideration students' views regarding this use of them.

There are many studies which uses writing activities in the education and teaching process (Eker & Coşkun, 2012; Günel, Atilla & Büyükkasap, 2009; Günel, Uzoğlu & Büyükkasap, 2009; Hand & Prain, 2002; Holliday, Yore & Alverman, 1994; Torrance, Thomas, & Robinson, 1994). For instance, Holliday, Yore and Alverman (1994) claim that writing practices should be adapted to science lessons in such a manner that assists students to understand science and to build up science knowledge.

Furthermore, according to Hand and Prain (2002), writing practices for learning in science allow students the opportunity to understand the information they have learned in an idiosyncratic way without repetition. Researchers have also stated that students enhance meaningful learning by means of writing practices by creating stronger links among concepts.

When the literature on the use of reflective diaries at elementary education level was reviewed (Bayrak & Koçak Usluel, 2011; Çardak, 2010; Eker, 2012; Eker & Coşkun, 2012), it was observed that studies are based on the effect of the reflective diaries on reflective thinking, self-regulation, metacognitive thinking, attitude, and achievement. For instance, Çardak (2010); researched the effect of the use of a science diary in fifth grade students on the attitude and success of students. Ayyıldız (2010) studied the effect of learning diaries in the elimination of misconceptions in regard to the unit 'hello geometry' in the scope of sixth grade math lessons. Eker and Coşkun (2012) researched the effect of keeping lesson diaries on the academic success of fourth grade students within the course of 'I Am Learning About My History' in Social Sciences lessons. In the questionnaire conducted with seventh grade secondary school students on the educational function of diaries within the process of self-regulation, Eker (2012) stated that diaries can be used as a tool to improve the self-regulation skills and strategies of students. Akkoç et al. (2010) evaluated the science diaries of pre-service biology teachers in biology practical laboratory lessons. Ekiz (2006) identified the opinions of pre-service classroom teachers by means of reflective diaries on how they perceived themselves and others during their teaching practices.

When the above mentioned literature is reviewed, it can be asserted that the concept of the reflective diaries (Ekiz, 2006; Koç & Yıldız, 2012) has similarities with concepts such as the lesson diaries (Eker, 2012; Eker & Coşkun, 2012), learning diaries (Ayyıldız, 2010), and science diaries (Akkoç et al., 2010; Çardak, 2010). Furthermore, it is seen that studies on the use of the reflective diaries have been conducted in different disciplines such as maths (Ayyıldız, 2010), social studies (Eker, 2012; Eker & Coşkun, 2012), and science (Akkoç et al., 2010; Çardak, 2010).

It was observed that the studies conducted on the use of the reflective diaries for science lessons were mainly performed in the fifth, sixth or seventh grades (Akkoç et al, 2010; Çardak,2010; Çavuş & Özden, 2012), while there was no research on the use of the reflective diaries at eighth grade level. Furthermore, the reflective diaries was also used at the end of lessons and within the lesson hour in some research studies to understand its effect. As for this study, the reflective diaries was given as a homework assignment so as to allow sufficient time for the students to come up with ideas.

When the literature is examined, there is little qualitative study which investigates the point of views of students regarding reflective diaries use (Çavuş & Özden, 2012; Ekiz, 2006). Therefore, this study will be of assistance to the future researches by filling the gap in this field.

Purpose

The primary purpose of this study is to attempt to determine whether or not the use of reflective diaries in science lessons by eighth grade students changes the views towards science lessons and contributes to meaningful learning. Accordingly, the points of views of eighth grade students were researched by means of reflective diaries, open-ended questions regarding the use of reflective diaries in science lesson and semi-structured interviews. In line with our main purpose, the secondary questions given below were asked:

i. What are the views of eighth grade students on the use of reflective diaries?
ii. How does the use of reflective diaries contribute to the meaningful learning of students?

METHOD

Research pattern

This study was carried out within the scope of "phenomenology", a qualitative research pattern. The phenomenology pattern focuses on phenomena which we are aware of, but of which we do not as yet have an in-depth or detailed understanding. Individual perceptions or perspectives on a specific phenomenon have been revealed and interpreted in phenomenology studies in general (Yıldırım & Şimşek, 2005). In other words, phenomenology creates an appropriate research basis for studies which are not entirely remote to us, but which we cannot grasp the full meaning of. The phenomenology pattern was also preferred in this study as the research was conducted to determine how the perceptions of eighth grade students to science lessons are affected by the use of reflective diaries.

Sample

The participants of the study comprised 38 eighth grade students who received science lessons in a private secondary school in the Kayseri province of Turkey during the 2013-2014 academic year, in the autumn term. Students were coded as K-1, K-2…K-38 on the document analysis forms applied to the students. The personal information of students is as follows:

- 21 students were girls, and 17 were boys.
- The ages of students ranged between 13 and 14.

On the other hand, semi-structured interviews were held with four students at the end of the term, i.e. subsequent to the completion of the use of reflective diaries. These participants were K-30, K-1, K-19 and K-17. All interviewees were female.

Data collection instruments

The data collection tools of this research included the reflective diaries which were used as document analysis, as individual questionnaire consisting of open-ended questions regarding the use of reflective diaries for science lessons and semi-structured interviews. Hence, data triangulation was ensured by using multiple data collection instruments (Patton, 2002).

Reflective Diaries. The lessons, which lasted for 40 minutes in the unit 'Cell Division and Heritage', were carried out for six weeks in the classroom. Each student in the study group kept ten reflective diaries so as to determine whether or not these lessons were understood. The contents of these diaries consisted of the following subjects: mitotic division, types of mitotic division, asexual reproduction, types of asexual reproduction, meiosis, stages of meiosis, sexual reproduction, types of sexual reproduction, organisms reproducing sexually, DNA and genetic code, and genetic engineering. The teacher of the lesson explained how to keep reflective diaries to the students at the beginning of the term. The students expressed whether they had understood the concepts taught during the lesson that day by using images, cartoons, poems and stories. Furthermore, students were told that the diaries should have the date and a parent's signature. Students were also told that their own ideas were of importance and it was emphasized that they should not cite from any other resources. In this way, the teacher attempted to determine to what extent the students listened to the lessons, their misconceptions, and if meaningful learning was achieved.

Questionnaire on the Use of the Reflective Diary. The questionnaire form was developed by the researchers so as to determine the perspectives of students on science lessons through the use of reflective diaries by 8th grade students. The

document analysis form (questionnaire) which included 12 open-ended questions was submitted for control to science teaching experts, the required corrections were made and the finalized form was applied to all of the participants. Steps to ensure the internal validity (credibility) of the study were taken by means of the procedures carried out until the application itself. The questionnaire was applied for one lesson hour to the participants after the use of the reflective diaries.

Semi-Structured Interview. The semi-structured interview was preferred in the study to obtain detailed information from the participants. During the interview the member-checking process was performed in order to enhance the internal validity (credibility) of the research (Marshall & Rossman, 2006; Merriam, 2009). The questions of the semi-structured interview form were developed by the researchers and were prepared in line with the open-ended questions in the questionnaire. This form consists of 11 questions and probing questions. The questions in the questionnaire were asked in exactly the same way to the participants during the interview so that variation could be achieved through the use of multiple data collection tools in order to the enhance the validity of the research. For instance, a participant who stated that the use of reflective diaries changed his/her perspective towards the science lesson yet whose reflective diaries did not prove so was asked to explain the situation during the interview. Therefore, an improved in-depth review was conducted. The interview lasted about 20 minutes in a silent and calm classroom environment with four participants after the application of the questionnaire. Before the interview, the participants were provided with a comfortable environment in which they could express themselves. Furthermore, the interviews were recorded and transcribed later on. The participants with whom interviews were held were K-30 who had a high level of academic success and made effective use of the reflective diary; K-1 who had a high level of academic success but made ineffective use of the reflective diary; K-19 who had a low level of academic success but made effective use of the reflective diary and K-17 with low level of academic success and ineffective use of the reflective diary.

Data analysis

Descriptive analysis was used for the reflective diaries. The reflective diaries of the participants were collected and recorded on computer media by means of a scanner. To what extent the subject was understood and whether the concepts were learned meaningfully by the participants was determined by examining the reflective diaries. One of the researchers read the reflective diaries of the students and examined whether students performed meaningful learning in terms of acquisition of the related concept. This examination was done by assessing students' understanding, which they expressed by means of schema, figures, pictures, and caricatures. Also, the researcher examined were able to whether students synthesize their new knowledge and old knowledge and use their new knowledge in their daily life (Brooks & Brooks, 2001).

The data obtained from the questionnaire were analyzed by coding with content analysis and creating themes. In this framework, data were defined, and similar data were gathered under the themes (Yıldırım & Şimşek, 2005). The data were classified under these themes so as to render them meaningful to the reader. Coding and theme development were undertaken by the researchers. Who came together and finalized the themes and codes by coming to a joint agreement. Therefore, consistency with the research question and purpose was maintained, unnecessary coding was eliminated and new coding was included where necessary with the purpose of enhancing the internal validity (credibility) of the research. The identified codes, themes and

categories are given in Table-1. The student answers supporting the codes and the themes are given in the results section.

The thoughts of the students with whom semi-structured interviews were held were analyzed descriptively. These thoughts were presented as sections with support or conflict with the codes developed based on the findings of the questionnaire. The identities of the participants were masked by coding and the thoughts of the students were given as direct quotations. Therefore, the external validity (transferability) of the research was ensured. Furthermore, the expressions which supported the student answers given to 6th and 12th questions in the questionnaire in particular were identified and asked to the students who were interviewed. The thoughts of the students with regard to these expressions are given in the results section as descriptive analysis. A science educator also examined the raw data, method and findings of the research in terms of consistency so as to increase the external reliability (trustworthiness) of the research.

Table 1. Categories, themes and codes identified based on findings obtained from questionnaire data

	Category					
	Thoughts on Reflective Diaries			**Thoughts on Reflective Diaries Use**		
	Themes			**Themes**		
	Definition	**Aim**	**Characteristics**	**Emotion**	**Thought**	**Ways to Use It**
Code	Summary	Measurement and Assessment	Original	Loved	Coming to lessons as prepared	Animation
	Repetition notebook	Teaching	Understandable	Delightful	Active participation	Cartooning
		Monitoring	Based on imagination	Entertaining	Effective	Design
			Requiring organization	Original	Helpful	Subject repetition
			Demanding attention	Inflicting indolence	Idea generation	Writing
			Periodical homework assignment	Stressful	Reinforcement	Ability to draw pictures
				Catchy	Demanding care	

RESULTS

In this section, the findings regarding the reflective diaries created by the participants, the themes of the data obtained from the questions addressed within the scope of the questionnaire, as well as the findings obtained from the interview and reflective diaries about the 6th and 12th questions in the questionnaire are given.

Results regarding the reflective diaries created by the participants

In the scope of this study, the reflective diaries of students were examined in detail. Ten reflective diaries which were given as homework to all students throughout the "Cell Division and Heritage" unit were collected and examined. Researchers conducted analysis to determine if the objectives of this unit were learned meaningfully by students or not. When the reflective diaries of the participants were examined for the objective "understands the stages of mitotic division and the importance of this division for organisms", it was observed that 30 of these participants achieved meaningful learning. For instance, the fact that K-32 could show the stages of mitotic division by drawing and write under which circumstances mitotic division is important for organisms is an indicator of the fact that meaningful learning was achieved. The following sentence of K-32 can be given as an example: *"…firstly, chromosomes match each other and these chromosomes are withdrawn and separated to the poles due to the spindle yarn. Then, two new nuclei occur in the cytoplasm and cytoplasm thinks that these nuclei are too much for it. Therefore, it constricted and two new and separated cells occur".* An excerpt from the exemplary reflective diaries of K-32 about these outcomes is given in Figure-1.

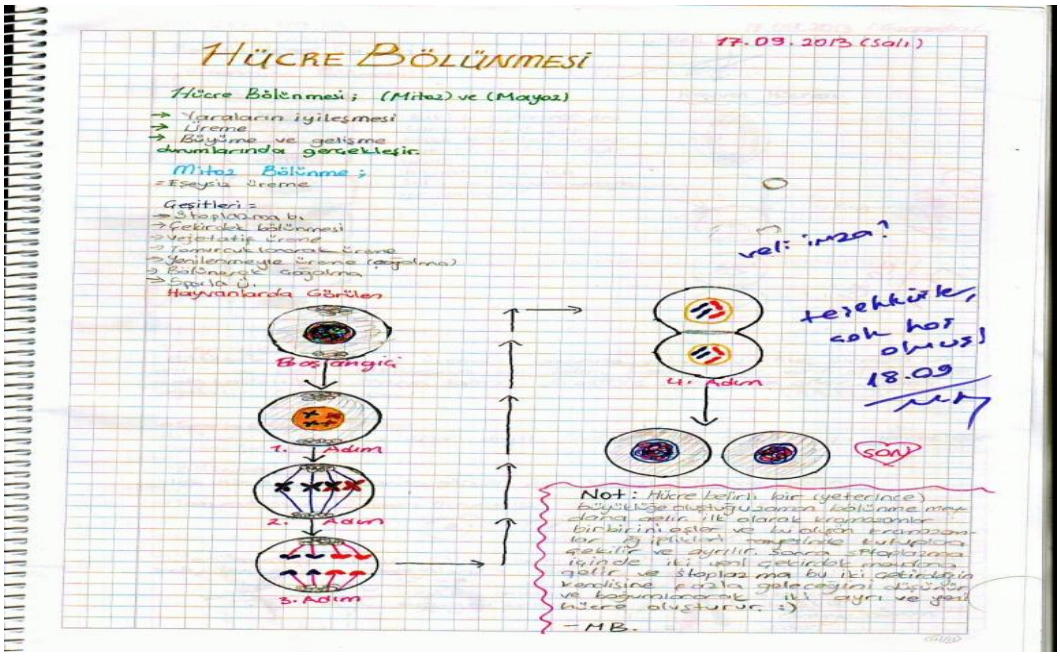


Figure 1. Exemplary reflective diaries of K-32 about mitotic division

Researchers found that twenty eight participants learned "the reasons for inherited diseases in human beings meaningfully. For instance, K-30 explained the crossing regarding color blindness, which is an inherited disease. An excerpt from the reflective diaries of K-30 regarding these outcomes is given in Figure-2. In this section, the findings of the reflective diaries of only two participants (K-30 and K-32) are presented. It can be said that this is a limitation of the present study.



Figure 2. Exemplary reflective diaries of K-30 about inherited diseases

Results about questionnaire and interview data

The data obtained from the questionnaire were presented with two categories which are the student's thoughts on the reflective diary and thoughts on reflective diary use. The findings of these categories are presented below, respectively.

The Thoughts of the Participants on the Reflective Diary. The thoughts of the participants on the reflective diaries were grouped as thoughts on the definition of the reflective diaries (definition), thoughts on the intended use of the reflective diaries (aim), and thoughts on the characteristics of the reflective diaries (characteristics).

Table 2. Themes and codes regarding the category of thoughts on reflective diaries

Category	Theme	Code	No. of Participants	Participant %
Thoughts on Reflective Diaries	Definition	Summary	10	26.32
		Repetition Notebook	22	57.89
	Aim	Assessment	5	13.16
		Learning	22	57.89
		Monitoring	19	50.00
	Characteristics	Original	13	34.21
		Having imagination used	4	10.53
		Requiring organization	4	10.53
		Period of homework assignment	14	36.84

Definition: As can be seen in Table- 2, the answer to the question "*What do you think a reflective diary is?*" was given as a repetition notebook by 57.89 % of the participants, while 26.32 % answered that it was a notebook in which the science subjects that had been taught were summarized. While student K-9 stated that the reflective diary was a repetition notebook in the following sentence: "The r*eflective*

diary is used for the repetition of the subjects taught to students but which can be learned based on one's own imagination", student K-12 stated "*It is used for taking notes of what we remember about the subjects we have been taught every day. It is good and ensures repeating these".* Similarly, K-9 supported this opinion in the following: "*It is used to repeat the subjects we have been taught in a manner I like I would like the subjects we have been taught, and by understanding. Because… the aim is to repeat in an understandable way".* On the other hand, K-5 defined the reflective diaries as an summary notebook which is an indicator of the achievement of meaningful learning by saying "*I believe that the use of the reflective diary is an interesting practice which gets us to summarize the daily subject we have covered on the daily subject our own and learn in this way …"* In a way which supports this opinion, K-8 came up with the definition "*A tool which aims to summarize the subjects we were taught at school on that day and to make us understand these."* The findings obtained from the interview are in agreement with these. For example, K-30 expressed her thoughts as "*I normally don't like repeating work, I think that it is boring to read over what you were taught that day and to write it down. However, the reflective diary doesn't involve doing this, but it still ensures repeating what we learned in lessons*".

Aim: The intended use of the reflective diary was seen as learning about science subjects, ensuring that the studying of the student is monitored by teachers or parents and determining to what extent the subject has been learned by the students based on the answers given to the questionnaire question "*How would you summarize the rules for using the reflective diary?"* The fact that reflective diary use was aimed at learning science subjects was stated by K-7 as follows: "*The subjects are understood better with repetition",* K-11 as; "*… because we learn the subjects more profoundly.",* K-9 as; "*…It ensures that we have a better understanding of science lessons".*

The results showed that the students had to write in their reflective diaries since it was checked by parents and teachers. K-1 stated "*It is very good that we have our parents have to sign it, because they look at what we have done …"* K-14 also stated that: "*…Maybe only the parent's signature and date can prove useful. The date will show when we did it, and our family will see it as well."* The statements given by K-19 in the interview also support the finding:

> "At the outset, the reflective diary has rules and these are not boring. For example, parents' signature, date… These are very good because the family can see how their child did their homework. In addition, they can control it regularly and also I like keeping reflective diaries. It helps me, it is useful, I can benefit in any subject. It ensures that I reiterate the subjects".

In respect to the fact that the intended use of the reflective diary is to determine to what extent the subjects were learned by students, K-6 stated *'Reflective diaries helps to show you about the fact that you haven't learned a subject.'* while K-1 expressed her thoughts as 'A method which measures if the subject was understood and is remembered easily *…'* to indicate that meaningful learning takes place. Similarly, K-29 expressed his/her opinions in this regard by the sentence; "Using a r*eflective diaries is an activity which summarizes how and how much the subject was understood in a nice way".* In this context, K-34 emphasized that the intended use of the reflective diary is both teaching and assessment with the statement "*I think the reflective diary is an in-depth teaching activity of what was understood and to what extent, in the science lesson of that day and what portion of the lessons can be remembered without repeating."*. The statements given by K-30 in the interview also support K-34;

> "I don't think there is such a thing as you merely write down what you have understood, which means that you do what you have understood. Having understood a lot doesn't change anything. Eventually both those who understood a lot and a little will do it, maybe the quality will differ but both will show what they have understood …."

Characteristics: The participants stated that the reflective diaries were effective in making them use their imagination. Therefore, the participants claimed that meaningful learning was achieved by using their own expressions. K-13 explained his/her thoughts on this by saying, "*I write down whatever I remember each day without referring to the text",* while K-30 said, "The r*eflective diary is an unrestricted homework task which allows you to generate a few relaxing ideas about daily homework and makes you feel free. Isn't it dreamlike?*" The statements of K-30 in the interview are similar. Unlike these two participants, K-14 stated her opinion on the fact that originality makes reflective diaries use more difficult by saying; "*Repeating what we have learned on a daily basis. However, I merely write down information since I am not very creative*". K-17 also stated that coming up with ideas and originality makes reflective diaries use more difficult by saying; "*I could not fully grasp what I should write down since these were rather to me new, or more precisely, I couldn't come up with much, therefore I couldn't write quite much at all."* in the findings obtained from the interview.

The Thoughts of the Participants Regarding Reflective Diaries Use. The thoughts of the participants regarding reflective diaries use are grouped as emotions, thoughts and ways to use it and are given in Table-3.

Table 3. Themes and codes regarding the thoughts on reflective diaries use

Category	Theme	Code	No. of participants	Participant %
Thoughts on Reflective Diaries Use	Emotion	Loved	9	23.68
		Enjoyable	2	5.26
		Entertaining	9	23.68
		Original	9	23.68
		Inflicts indolence	5	13.16
	Thought	Makes you remember	20	52.63
		Coming to lesson prepared	6	15.79
		Active participation	5	13.16
		Helpful	8	21.05
		Generating ideas	6	15.79
		Reinforcement	21	55.26
	Ways to use it	Requires care	5	13.16
		Animation	3	7.89
		Drawing cartoons	5	13.16
		Repeating subjects	2	5.26
		Writing	11	28.95
		Ability to draw	11	28.95

Emotion: According to the answers given by the participants to the questions "*Are there any difficult aspects of reflective diaries use for you? Are there any aspects that you like?*", it was stated that it was not difficult and made science lesson entertaining and enjoyable. For instance, the following statements were given by five of the participants: K-1: "*Yes, it feels more enjoyable and understandable",* K-6: "*Writing is always difficult",* K-16:"*… I find the reflective diary entertaining",* K-17: *"Yes, it becomes more entertaining, we explain by scribbling down",* K-3: "*Yes, it becomes more entertaining".* Based on the findings obtained from the interview, K-17 said: *"…a method which ensures that students learn in a nice and entertaining way."* and K-19 said: "*I started having more fun while keeping it."* This show the reflective diary makes science lesson entertaining and enjoyable.

Thought: Participants stated that the subjects for which they used the reflective diary were remembered, therefore they came to the lessons in a prepared state and this ensured active participation in the lessons. For instance, K-11 said "*Writing down what I can remember everyday makes me learn the subjects more deeply"* and K-16 said "*I believe that the reflective diary is a really good thing, because, I remember what I have written in the reflective diary during exams as if I wrote it down 15 minutes ago"* to express that they can remember the subject for which the reflective diary was used in a more permanent way. In this context, K-8 stated her opinion by saying "*… I don't repeat the topics and solve test problems before the topic is completed, like other students do. I remember the subjects very well since the draw-book is kept on a daily basis"*. In addition to the thoughts of the other participants, K-30 stated her thoughts on this subject and said that the reflective diary enhances remembering with the following statement;

> "Absolutely. I always imagine something in my mind anyway. I am living in my imaginary world and the reflective diary … it is in between my world and this world, which means it is special, unique, "free". It is where I make fun of all of the subjects. It helps me remember in exams by recalling how I made fun of the subjects."

K-1 also expressed her thoughts on this subject by saying; "*It makes me understand in an easier way, and I also become happy. I feel that I remember the subjects better*". Similarly, K-17 stated that reflective diaries use enhances "remembering" with the sentences; "*I had forgotten about mitosis division, but I just recalled it at that moment, which is how I could solve it easily in the exam".* Furthermore, K-2, K-9 and K-21 stated their thoughts on the fact that reflective diaries use renders students more active in science lessons as follows: K-2: "*…Because we come to the lessons prepared since we have repeated the subjects beforehand",* K-9: "*… My participation in the lesson increases when I repeat the subject. For example, I raise my hand more frequently", and* K-21 said "*…It ensures preparing for the lesson beforehand".*

Out of the eight participants who were of the opinion that using their reflective diaries with care enhances effectiveness and advantages (K-1, K-3, K-5, K-19, K-8, K-18, K-36, and K-30), K-5 gave the following explanation: "*When I partially keep it to learn the homework, I mean when I pay attention to the content rather than writing"* to state his/her thoughts, K-3 stated; "*I like such things, therefore I try to use the diary carefully"*. The statements given by K-1 and K-19 during the interview are similar.

As is indicated in Table-3, 55.21% of the participants stated that the reflective diary was a good way to repeat the science subjects that were taught, that day in response to the questionnaire question "*Did using the reflective diary facilitate your learning of science subjects?"* For instance, K-16 answered: "*Yes, it reinforces learning, I remember what I have written word by word"* while K-34 stated: "*…I can repeat the subjects which were taught, …I can focus on the new subject that we will be taught in the lesson more efficiently if I do not have any gaps in my knowledge (which I don't have) after keeping the reflective diary.".* The statements of the remaining six participants who support the finding were as follows:

> K-10; "*Yes, because I understand my shortcomings and the subjects since I repeat these."*
>
> K-7; "*Using the reflective diary helps me to learn science concepts because we repeat these. Subjects are understood in an easier way".*
>
> K-4; "*Yes it helps me to repeat the science subjects and learn more efficiently. It leads me to a better understanding of the subjects through reinforcement."*
>
> K-29; "The r*eflective diary helps me to understand the subject. I can see which points I didn't understand or misunderstood. It makes me comprehend the lesson more efficiently".*

K-22; "*I believe that it is helpful, repeating the subjects is very important. It is more enjoyable than solving test problems."*
K-9; "*My imagination is improving and I can picture the experiments in my mind. It made me learn the subjects by understanding them."*

Ways of use the reflective diary: According to the findings obtained from participant statements, the students repeated the subjects by writing, drawing pictures and cartoons while they were using the reflective diaries. Furthermore, the finding in regard to the fact that the students who drew comic strips or pictures while they were using the reflective diaries achieved a better understanding of the subjects was reached based on the data obtained from the interviews. Three of the participant statements on this subject were as follows: K-1: "*It ensures that I remember the rules and such by writing them down in a better way for example by drawing a cartoon",* K-30: *"Scenario, so I am fictionalizing, so it is in the imaginary world. I am trying to transfer these thoughts to the reflective diary. I remember them more efficiently; they are my thoughts after all. For example, when I try to remember something in the middle of an exam, I can remember it in an easier way by saying 'I drew it in that way' It is very important in this sense",* K-17; "*I use my reflective science diary for repeating what I have been taught when I arrive home after science lesson. Then, let's say, there is a symbol, I paint that symbol and write its explanation below such as; this is like this or that."*

It was shown that some of the students who wrote in their reflective diaries got tired or bored of writing. The statements of four participants on this subject as follows:

K-9; "*I like writing but it makes my hand ache after a while (Also, I don't feel like doing it as I am very lazy)".*
K-22; "*Writing on a daily basis as well as writing each and every subject is difficult."*
K-6; "*I cannot come up with something to write all the time"*
K-20; "*I mean, writing requires some kind of effort but it doesn't matter that much since we are learning. I think writing in lessons would be ridiculous because we would proceed slowly and I wouldn't be able to listen to the lesson while trying to write everything down as well."*

Students who preferred to draw pictures or comic strips while using the reflective diary stated that drawing caused them to lose a lot of time or they couldn't express what they thought in an accurate way. In this sense the following statement was given by K-19 during the interview *"I mean, sometimes I don't know what to scribble down or more precisely, the things I come up with are so beautiful in my mind but I cannot form them as I would like to, I mean I cannot accomplish what I wanted*". Three of the statements given during the questionnaire by the participants who support this finding are as follows:

K-25; "*Keeping a reflective diary every day and drawing pictures are difficult for me",*
K-19; "The r*eflective diary helps, because I make up funny things when I cannot remember anything else about the subject and I remember then. However, sometimes I can't come up with any ideas, so I have a difficult time in doing it or else I come up with very good ideas but I can't draw them. Otherwise, I think that the reflective science notebook is a very good idea",*
K-11; "*Yes, I spend a lot of time while drawing pictures".*

Unlike the thoughts of the other participants, K-30 stated her thoughts on the use of the reflective diary as, "The r*eflective diary made me interested in science, of course. You are in your own world. You make fun of the subjects and mock them it is unbelievably enjoyable and an awesome way to remember, and my favorite part is that I can do things that are not included in any lessons. Freestyle, I mean be free, design, live, imagine"*. The statements of K-30 during the interview support this case as well;

> "I usually draw comic strips. I usually draw pictures by making fun of the subjects, I mean it is a scenario; I am fictionalizing them in the imaginary world. I am trying to write my thoughts down in the reflective diaries. They are easily remembered as they are my own thoughts anyways. For example, when I try to remember something in the middle of an exam, I can remember it in an easier way by saying I have drawn it there."

Results on question six (Q6) and question 12 (Q12) of the questionnaire

Together with the results provided from the questionnaire, the answers of participants on Q6 and Q12 were examined in detail because these two answers ensured more detailed information for the research. The questions are as follows Q6: *"Did the reflective diary affect your point of view on science?"* and Q12: *"What kind of conclusion do you make when you compare your first and last diary homework?"* The participants' answers, reflective diaries and the results of interviews were examined comparatively. Eight participants out of 38 (K-30, K-31, K-33, K-34, K-35, K-35, K-36, and K-37) indicated that they paid similar attention to the reflective diaries from the first to the last. For example, the answer of K-30 was as follows: "*There is not a big difference, indeed I did not change. My imaginary world and thoughts are still the same, how would my thoughts change! But of course my level has changed (positively)".* The dialog which supports the ideas of K-30 during the interview is presented below:

> *Researcher:* Well, is there any difference between the first and the last reflective diaries, when you compare?
> *K-30:* Yes there is, I drew some kind of comic strips in both, but I was scared of how I would deal with the subjects, however you gradually relax, and are happy that something good like this exists,
> *Researcher:* Do you think that you improved yourself?
> *K-30:* Absolutely.
> *Researcher:* But there is a point here, during the questionnaire on the document analysis form that we did before, where you indicated that there was no difference between your first and last reflective diaries, or rather for that your imaginary world has not changed...
> *K-30:* Yes, That's true; all in all my personality has not changed,
> *Researcher:* So, there is stability?
> *K-30:* Yes, but all of their subjects are the same,
> *Researcher:* Yes.
> *K-30:* All in all I am the one who made them all, but their quality was changed. Well, my point of view is changing, so it becomes better.
> *Researcher:* You improved yourself".

When the results provided from the interview, the questionnaire and the first and last reflective diaries of K-30 were compared, it was found that the initial and the latest diaries support the statements of the participant in the questionnaire and also in the interview. The initial (Figure-3) and the latest (Figure-4) reflective diaries of the participants were compared in accordance with the usage of concepts, compliance with rules of use (parent's sign, date), arrangement of the diaries due to its length and contents, and usage of correct definitions and drawings related with the concepts; was also found that the first and last diaries were similar to each other in terms of

quality. When the reflective diaries of these eight participants were examined considering these criteria, similar results were found.

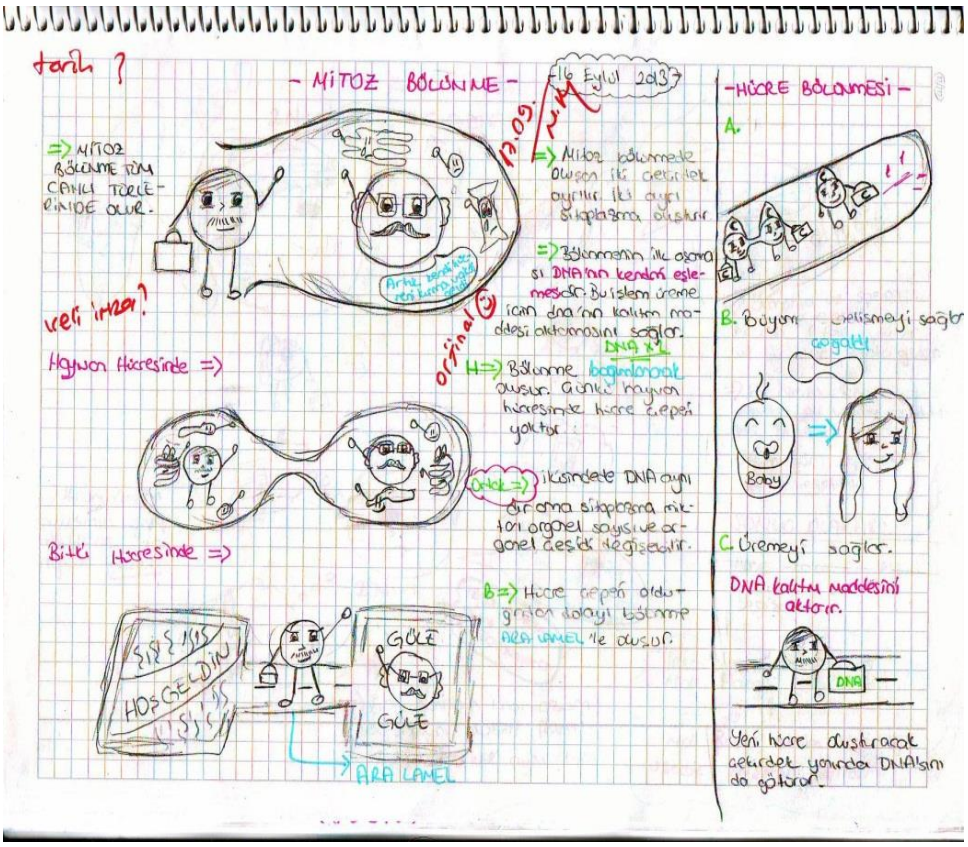


Figure 3. Initial reflective diaries of K-5

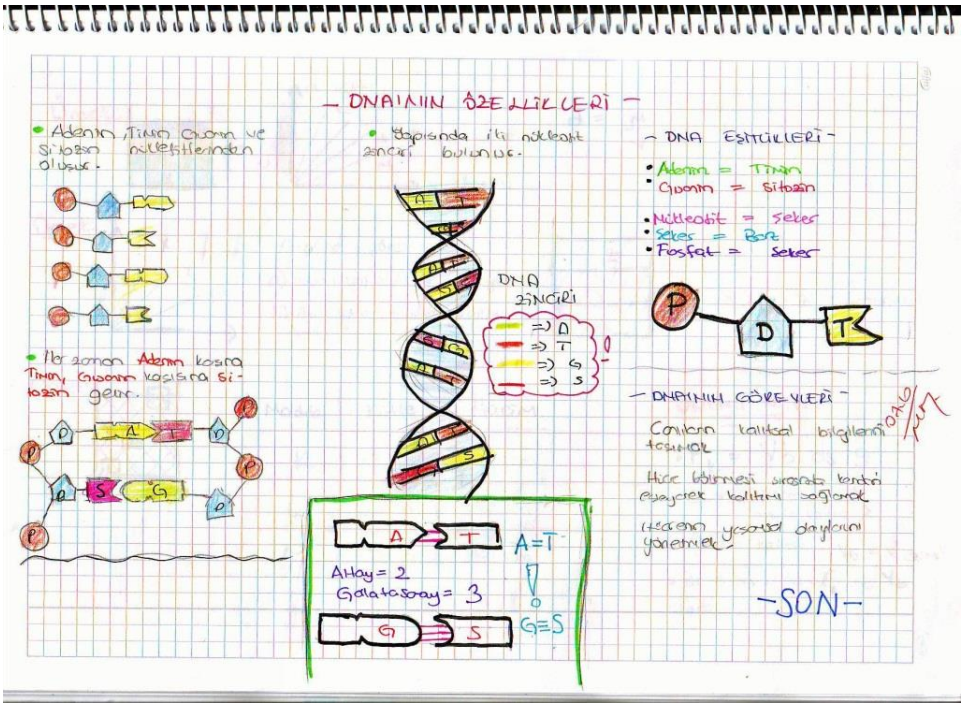


Figure 4. Latest reflective diaries of K-30

Seven participants (K-5, K-8, K-13, K-18, K-21, and K-22) stated that they paid more attention to their initial reflective diaries, and after some time, especially for their latest diaries, they did not pay much attention. In other words, they kept them in a perfunctory way. The statement on the subject of K-5 in the questionnaire was; "*My first draft was really detailed. I spent hours on it, but studying by writing is not helpful to me, so I did the last homework in order to get a plus".* The initial and the latest reflective diaries homework assignments of K-5 are shown in Figure-5 and in Figure-6 respectively and they support the statements of the participant.

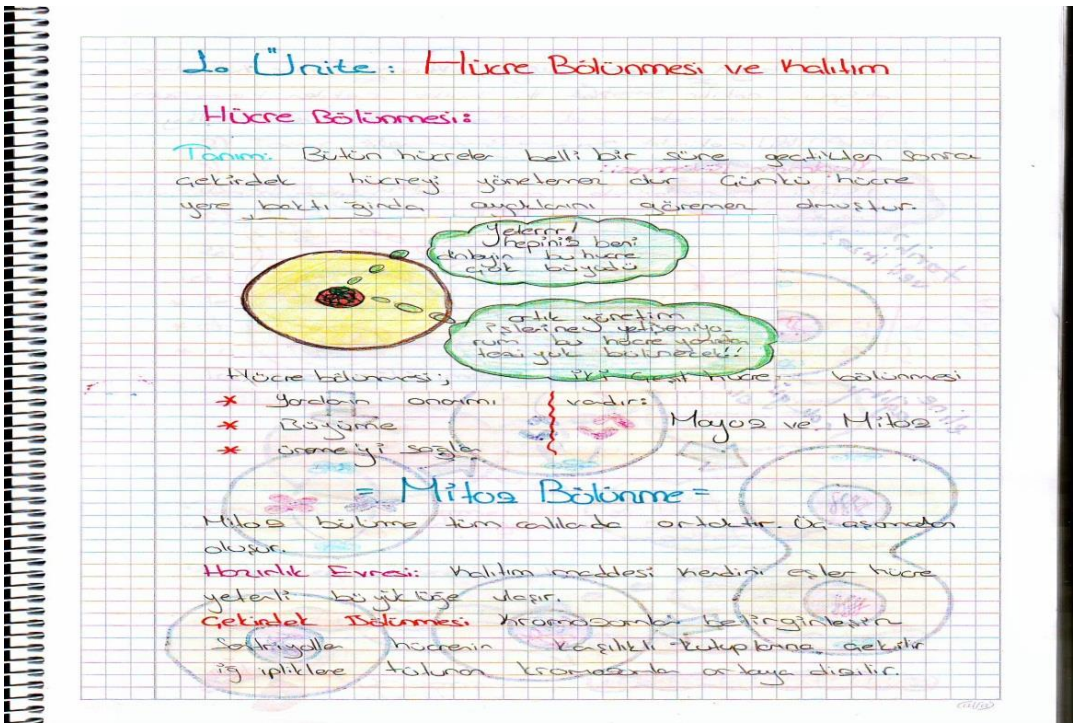


Figure 5. Initial reflective diaries of K-5

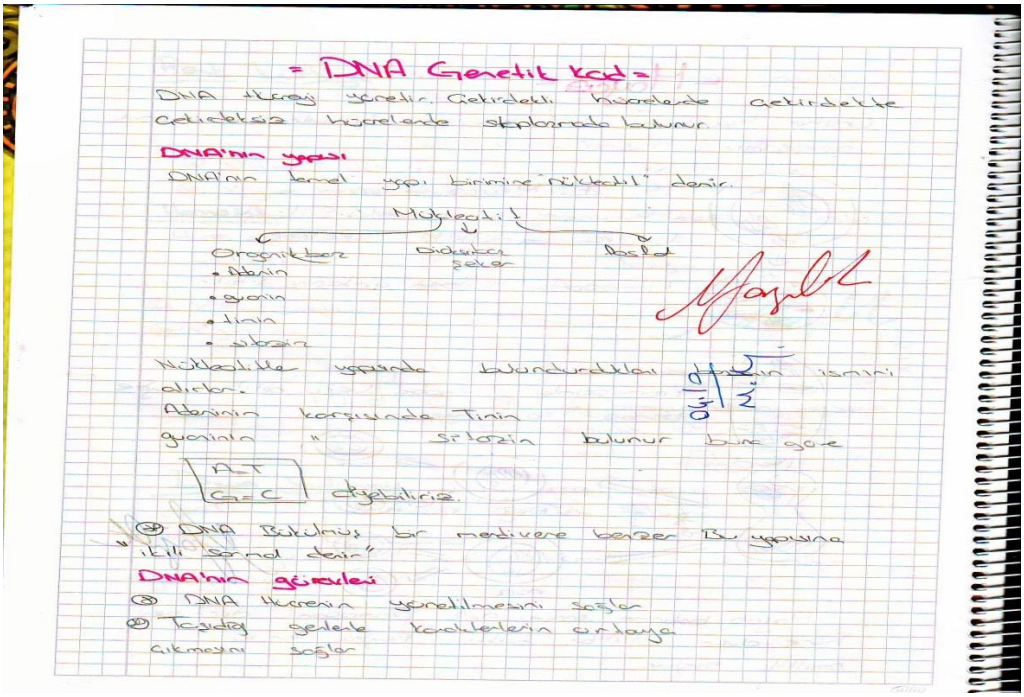


Figure 6. Latest reflective diaries of K-5

Seventeen participants (K-1, K-2, K-3, K-4, K-6, K-7, K-9, K-10, K-11, K-12, K-14, K-15, K-16, K-17, K-19, K-20, and K-29) indicated that they improved their reflective diaries as time progressed. These participants stated that their latest science diaries were much better than their first ones. The findings obtained from the interview held with K-17 are also in agreement with these statements. The initial and latest reflective diaries of K-17 are given in Figure-7 and Figure-8 and support the statements of the participant.





Figure 7. Initial reflective diaries of K-17 **Figure 8.** Latest reflective diaries of K-17

DISCUSSION and CONCLUSIONS

This study aims to research the use of the reflective diary in science lessons from the perspectives of eighth grade students and to determine whether or not the use of reflective diaries contributes to meaningful learning. This part was discussed in terms of the first and second sub-questions of the present study. The first sub-question is "What are the views of eighth grade students on the use of reflective diaries?" The second sub-question is "How does the use of reflective diaries contribute to meaningful learning of students?"

The Perspectives on the use of the reflective diary

When the answers given by the participants in the questionnaire regarding the use of reflective diaries were analyzed, it was determined that they defined the reflective diary as a notebook which allows repeating or summarizing the concepts learned in an understandable way. Furthermore, the participants interpreted the reflective diary as a form of homework which helps them to have a better understanding of the subjects, to learn the concepts and to realize to what extent they have learned a subject. According to the findings obtained from the questionnaire, it can be concluded that the participants had a positive perspective towards the use of the reflective diary. Students defined the reflective diary as a notebook. They summarized the concepts taught in lessons in the reflective diaries. This result is consistent with the results of the research conducted by Çavuş and Özden (2012) in order to determine the opinions of elementary school students on the use of a science diary. Furthermore, it was revealed that these students perceived the use of science diaries

as an activity used in order to enhance science lessons a since they arrived at the lesson in a prepared way and what they remained in their minds permanently.

When the findings obtained from the interviews were considered, it was observed that the participants viewed the reflective diary as a type of homework which is more helpful compared to other types. Moreover, they said that they in fact repeated the science concepts by this means and found it entertaining even though they usually dislike repeating subjects. This result is consistent with the results of Çavuş and Özden (2012).

Another result about the use of the reflective diary was obtained from Q6 and Q12 in the questionnaire. Accordingly, it was concluded that the participants had a positive perspective towards the use of reflective diaries. They (17 participants) improved themselves throughout the process and they gradually started using the reflective diaries in accordance with its intended use.

The contributions of the reflective diaries to meaningful learning

When the contributions of the reflective diaries to meaningful learning were examined, it was seen that all participants, excluding K-14 and K-17, could repeat or explain the concepts and apply them to new situations. At the same time, it was found that students generated ideas, drew comic strips by combining their imaginary world with the science subjects they had learned and achieved meaningful learning by this means while they were using reflective diaries. Therefore, the conclusion was reached that the use of the reflective diaries contributed to meaningful learning. However, there were stages many participants who were in fact between the "remembering" and the meaningful learning". Thus, there is a need for further study to examine whether or not meaningful learning occurs actually. In a similar vein, there are many studies that show the contribution of schema, figures, pictures, and caricatures in order to achieve meaningful learning (Brooks & Brooks, 2001; Steyn & Boer, 1998). For instance, according to Brooks and Brooks (2001), in the learning process, learners relate their new and old knowledge by using different schemas and frameworks. Therefore, they do not explore much new information. In this context, Steyn and Boer (1998) stated that students enjoyed using the mind map technique in their studies and they stated that the mind map facilitated their learning process.

The results of the studies conducted by Çardak (2010), Çavuş and Özden (2012), Eker and Coşkun (2012), Erduran Avcı and Akçay (2013) and Hohenshell, Hand and Staker, (2004) agree with the finding that the use of the reflective diary contributed to meaningful learning. As a result of the study conducted by Eker and Coşkun (2012) with fourth grade students, it was found that the experimental group students who kept a reflective diary showed a significant achievement when compared to the control group students who did not keep a diary. Therefore, Eker and Coşkun (2012) reached the conclusion that writing in the diary at the end of the lesson affected the permanency of the science concepts in a positive way. Çavuş and Özden (2012) concluded that science diaries are effective in respect to the development of individuals as science and technology literate individuals, the reinforcement of the information learned, the development of a positive attitude by students towards science, coming to lessons in a prepared way and fostering links among science subjects. Erduran Avcı and Akçay (2013) and Çardak (2010) also reported that the use of a reflective diary by students contributed to the permanency of the information that was learned. In this context, it can be suggested that the information learned by means of reflective diaries use is more permanent, which allows students to achieve meaningful learning.

When the literature is analyzed, this study differs from others in two aspects. Firstly, the majority of the studies in the literature (Bayrak & Koçak Usluel, 2011; Çardak, 2010; Eker & Coşkun, 2012; Günel, Atilla & Büyükkasap, 2009; Günel, Uzoğlu

& Büyükkasap, 2009; Kieft, Rijlaarsdam & Bergh, 2007) studied the effect of reflective diaries on meaningful learning by using the quantitative research method with an empirical pattern. However, in this study, the qualitative research method was used and whether meaningful learning was performed, according to the perspectives of participants, was determined. When the literature is reviewed, the rarity of qualitative studies (Çavuş & Özden, 2012; Erduran Avcı & Akçay, 2013) on the use of reflective diaries draws our attention. The study of Çavuş and Özden (2012), one of the qualitative studies, examines the contribution of reflective diaries to meaningful learning. Secondly, the reflective diaries were used immediately at the end of the relevant lesson in the aforementioned studies. Accordingly, participants of the studies could not completely reflect their thoughts in their diaries as they did not have sufficient time. In contrast, in this study, participants prepared their reflective diaries as homework, and as they had sufficient time to think, they reflected their thoughts deeply in terms of meaningful learning. For these reasons, it is thought that this study will contribute significantly to the literature.

One of our findings was that the use of the reflective diary may also help to determine what, how and how much was learned by students. Similarly, in a study conducted by Akkoç et al. (2010), students recorded the experiments they performed in a study at a biology laboratory in their science diaries in line with a particular aim and task. These records were checked by their teacher and students received feedback on what, how and how much they learned.

The results of the present study were discussed above in terms of meaningful learning. Now, the results of the findings obtained from the document analysis form will be discussed in terms of meaningful learning. It was found that the use of the reflective diary enabled participants to review and consolidate science topics. Furthermore, it was seen that the students restructured the concepts learned and performed meaningful learning by keeping a reflective diary. Therefore, students thought that their academic success in science classes would increase. Tuncel and Ayva (2009) stated that keeping a diary affected the success of students as it provides the opportunity to review the lesson. Similarly, Günel, Uzoğlu and Büyükkasap (2009) came to the conclusion that reviewing a subject increases a student's success. In this context, the results of the studies of Tuncel and Ayva (2009), and Günel, Uzoğlu and Büyükkasap (2009) on the use of reflective dairies are in agreement parallelism with the findings of this study. In a similar vein, Çardak (2010) found that there was a significant difference in favor of the experimental group when comparing the academic success of experimental group students using reflective diaries and that of control group students not using a reflective diary. Çardak (2010) also found out that the students with the opportunity to express topics in their own words and to repeat them in writing had greater academic success.

The results of the findings obtained from interviews shows that the use of a reflective diary helps meaningful learning as it allows subjects to be learned more easily, and it reshapes (cartooning, writing scripts) the concepts in the student's imaginary world (Brooks & Brooks, 2001; Steyn & Boer, 1998).

According to the findings of the document analysis form, it was found that the use of a reflective diary affected student's perspective on science positively. Thus, the positive perspective of students towards science will contribute to their meaningful learning. Çardak (2010) in researching the effect of the use of reflective dairy on academic success and on the attitudes towards science and technology lessons of sixth grade students found out that a positive increase was observed in the attitudes of experimental group students using reflective diaries for science and technology lessons.

SUGGESTIONS

Suggestions from the findings of the study

1. The factors which enable the perspectives of students to proceed in a positive direction on the use of reflective diaries, and how to ensure this situation continue may be researched.
2. The effect of reflective diaries on determining and eliminating misconceptions on science concepts may be researched.
3. The effect of the use of reflective diaries on achieving meaningful learning may be studied with a quantitative research method.

Suggestions for other researchers

1. This research, which was conducted in eighth grade students, could also be done in other grade levels.
2. This research was conducted considering a biology topic, but research on other science topics using reflective diaries could also be carried out. Thus, this is the limitation of this study.
3. The studies on the use of reflective diaries could also be conducted in lessons other than science.
4. In this research, the use of reflective diaries by eighth grade students was examined from the perspectives of the students towards science lessons by means of the qualitative research method. Quantitative studies may be carried out in similar subjects.
5. Studies for determining the affective domain features (attitude, behavior etc.) regarding the use of reflective diaries may be carried out.
6. Studies in which the reflective diary could be used as an assessment and evaluation instrument may be carried out.

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APPENDIX

DOCUMENT REVIEW FORM

Dear Participants,

We are conducting research to determine the perceptions of eighth grade students on the use of reflective diaries in science lessons. We would be pleased if you answer the questions below. All the information you provide in the form will only be used in this research. Your personal information will be kept confidential.

We thank you in advance for agreeing to participate in this research.

QUESTIONS

1. Can you give information on the educational status of your family?
2. How would you describe yourself as a student? Why?
3. Are eighth grade science subjects interesting for you? In other words, do they include topics that interest you? Why?
4. What is a reflective diary in your opinion?
5. How would you summarize the rules for using reflective diaries? Why are there rules?

6. Did the use of the reflective diary affect your perspective on science lesson? In what way?
7. Did the use of the reflective diary help you to learn science subjects? In what way?
8. Do you think that the reflective diary has affected your intra-curricular performance? How?
9. Does the use of reflective diary have the aspects you do not like/which are hard for you? Would you explain?
10. Does the use of reflective diary have the aspects you like? Which aspects?
11. What can be done to improve the use of the reflective diary? What are your expectations from your teacher on this subject?
12. How do you assess your work standard if you compare your first and last diaries homework? Are there any differences?