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EXAMINING THE EFFECTS OF THE LEARNING STATION METHOD ON 7TH GRADE STUDENTS' CONCEPTUAL UNDERSTANDING LEVELS REGARDING THE LIGHT UNIT

Kübra Karacalı[1i],
Nermin Bulunuz[2],
Mustafa Özkan[3]
[1]Ministry of Education,
Eskişehir, Turkey
[2]Uludag University,
Faculty of Education,
Department of Mathematics and
Science Education,
Bursa, Turkey
[3]Uludag University,
Faculty of Education,
Department of Mathematics and
Science Education,
Bursa, Turkey

Abstract:
This study aims to determine the effects of the learning station method on seventh grade students' conceptual understanding levels regarding the light unit and their views about this technique. Mixed method integrating both quantitative and qualitative methods was used in the research. In the quantitative part of the research quasi-experimental pretest-posttest control group design was employed. The study group of the research consisted of 41 7th grade students attending a middle school in Eskişehir (22 experimental, 19 control group). Four open-ended questions prepared by the researcher teacher were applied to both groups as pretest and posttest. Pretest data of the experimental and control groups were compared and no significant difference between average test scores was detected. The analysis of average posttest scores of the two groups revealed that the average score of the experimental group, who learned the light unit with the learning station method, was higher than the control group, who learned the same unit with the current program. Additionally, semi-structured interviews were conducted with five students randomly selected from the experimental group. The students expressed in their answers that science lesson conducted with learning stations was efficient and fun and they learned the topic more permanently

[i] Correspondence: email nermin.bulunuz@gmail.com, k.celik87@hotmail.com

than usual. Extensive use of learning station method with diverse activities is recommended to all science teachers as a result of the study.

Keywords: light, misconceptions, learning stations, science

1. Introduction

Rapid change in science and technology, the changing needs of individuals and society, improvements and developments in learning-teaching theories and approaches have all influenced the expected roles of individuals directly. This change created the necessity for individuals who produce knowledge, functionally apply this knowledge to life, solve problems, think critically, are entrepreneurs, are determined, have communication skills, contribute to society and culture (MEB, 2018). Beside scientific process and life skills, 2018 Science curriculum also highlights innovative and entrepreneurial thinking skills. According to this curriculum, students are expected to experiment at product development stage, to record the quantitative and qualitative data and observations they obtain from the experiments and to evaluate the recorded data with graph reading or creating skills. Therefore, the methods and techniques teachers are supposed to use have become quite important. The new curriculum also changed the order of the units, organizing learning fields from space to body, so as to convey knowledge in an enjoyable and real life related manner to students (MEB, 2018). This new approach places learning station method, which is an alternative teaching technique, to a primary position.

1.1. Learning Station Method

The learning station method started with Montessori in the early 1900s, received an important place as a significant technique in the literature after being influenced by Piaget's and Vygotsky's constructivist ideas (Demir, 2008). Terms such as learning centers (Lebak, 2005); science centers, learning circle (Irwin, Nucci & Beckett, 2003); science discovery centers or corners (Radeloff, 2001); station technique (Albayrak, 2016; Erdağı, 2014;); station learning method (Benek, 2012); learning stations (Bulunuz, 2006; Bulunuz & Jarrett, 2010) are used interchangeably in the literature.

In the light of various definitions in the literature, station method can be described as "*a student centered learning technique based on completing a half finished task, where the students examine the topic from different angles by participating in the lesson actively, in interactive groups with a number of materials, where they are responsible for their own learning and are encouraged to research and discover*" (Benek, 2012; Burden, 1992; Fehrle & Schulz, 1997; Demir, 2008; Demirörs, 2007; Güneş, 2009; Gözütok, 2006, Sears, 2007). Demirörs (2007) classified learning stations as exterior station, stable station, parallel station, engine station, control and service station, variable learning station and selection station.

1.2. Applying the Learning Station Method

In order to provide permanent conceptual understanding of abstract and difficult topics in the learning station method, students simultaneously visit the learning stations in the given time, use their sense organs and interact with their group friends (Morgil, 2002). Students either work individually or in small groups during learning stations. At the stations, the students can create products, learn concepts and do activities independently from the previous group. The station method can successfully be applied to teach a new topic, reinforce a learned topic (Benek, 2012), to complete given tasks (Hall & Zentall, 2000), to teach a socio-scientific topic (Köseoğlu, Soran & Storer, 2009).

Class level and purpose of the lesson are taken into consideration when organizing groups and selecting tasks. Students visit the learning stations as a group. It is essential to pay attention to organize the groups as heterogenic as possible and to gather students with different cognitive levels and diverse interests in each group. Visiting the learning stations in groups, provides efficient group work, accelerates the mutual learning of students in accordance with the social constructivist theory, helps them detect their own mistakes and therefore gives them the opportunity to check themselves. Exterior stations may be set up if more data needs to be collected. Stations can be placed in locations such as libraries, science laboratories, hallways and yards. Exterior stations are quite beneficial in experiencing in-class topics in real life (Ocak, 2008).

In the station method, the topic is divided into parts and every student in the class contributes to the study by working in interactive groups. Groups take on and continue the activities which previous groups left unfinished and a joint product is created by each group contributing in completing the task (Hesapcıoğlu, 2008). Stations may be obligatory or optional. In obligatory stations, students work in groups of 2-3 people visiting all stations. In optional stations, on the other hand, students work based on voluntariness. Groups may conduct activities under teacher supervision on some occasions (Morgil, Yılmaz & Yörük, 2002).

1.3. Points to Take into Account Applying the Learning Station Method

If a teacher decides to use the learning station method, he/she needs to make some preparations in advance. In his study, Ocak (2008) explains the role of the teacher elaborately. The researcher emphasizes that the main duty of the teacher in this technique is to construct the process, tasks and materials; that the teacher is a facilitator instead of a knowledge conveyor and that familiarizing the students with materials and activity may take some time. Learning stations can be arranged in different ways depending on the topic structure, student number and needs. While different stations can be set up at the same time in one class, one single station for an entire unit can be set up too. Stations may differ according to the experience of the teacher, topic structure and available resources (Ocak, 2017). As learning supported with sense organs is believed to be more permanent, stations are designed to attract multiple sense organs and supported with observations. Learning stations improve discussion skills of students and provide social learning (Morgil et al., 2002). Individual differences of the students are taken into consideration helping them to actively participate in the lessons. Enabling working both with the group and individually, this technique allows students to learn at their own pace according their interest. Moreover, students get the chance to conduct various activities on one topic and to utilize and improve different skills (Albayrak, 2016). However, too prolonged or frequent use of learning stations may lead to lose its benefits (Ocak, 2014), while poorly organized groups may create tumult, especially in crowded classrooms (Benek, 2012; Erdağı, 2014). Students with low academic levels may experience difficulties during the lesson, as activities are usually done in the application step (Sönmez, 2007; Batdı, 2012).

1.4. Learning Station Based Learning and Science Education

Today, where science and technology develop rapidly, science education is carried out with various techniques, methods and approaches. According to Graf (2000), the learning station method, which is a successful one among these techniques, receives appreciation from students, both in terms of content and method. Therefore, it has special significance in chemistry and science education of the 21st century (as cited in Morgil et al., 2002).

Stations can be arranged for students to conduct experiments in science and technology lessons and these stations can be made intriguing by supplying them with appropriate equipment. This increases willingness of students to participate in the lessons, each student contributes to the learning of their friends. Since all students visit the stations, they all get the opportunity to use experiment material and tools and execute the experiments themselves (Ocak, 2014). Activities at the stations may be for reaching diverse targets or gaining different behaviors. As an example, in a science lesson aiming to explore the structure of plants, in the first station activities may be designed to discover roots, in the second to discover the stem and in the third the leaves (Kryza, Stephens, & Duncan, 2007).

Research about learning station method in science education in Turkey focuses on specific objectives and topics. Among all research the most used variable along with "learning station method" is "academic success". The effects of the learning station method in science education are investigated on the academic success of the students (Albayrak, 2016; Benek, 2012; Çakmak, 2018; Erdağı, 2014; Güneş, 2009; Morgil et al., 2002; Yüksel, 2017); their knowledge permanency levels (Demir & Gürol, 2015; Güneş, 2009; Ocak, 2010); their attitude towards the topic and utilized technique (Akıllı, Keskin & Ay, 2017; Albayrak, 2016); their in-class performance of using the method (Benek, 2012; Demircioğlu & Vural, 2013; Erdağı & Önel, 2015); the opinions of students and pre-service teachers (Benek, 2012; Çakmak & Demir, 2016; Çakmak, 2018; Erdağı & Önel, 2015; Genç, 2013; Yüksel, 2017); and student motivation (Akıllı et al., 2017). Researchers in our country predominantly concentrate on learners and conduct studies according to the learning of the learners. This indicates that instead of constructing theories, the researchers in our country rather focus on the deficiencies of the education system and ways to improve it (Avcıoğlu, 2011).

1.5. Misconceptions in Science

Students construct new knowledge on their old knowledge. Old knowledge may sometimes cause difficulties in learning new concepts. When facing a problem, a student may create a solution which makes sense to him/her and complies with what he/she learned before, unaware of the fact that this method might not be scientifically valid. These situations lead to developing misconceptions. Misconceptions usually cause students to develop incorrect experiences about science concepts. Misconceptions make it difficult to acquire new concepts and students tend to be reluctant to replace the old misconceptions (Yağbasan & Gülçiçek, 2003).

As science lesson is composed of integrated disciplines with a complex structure, includes abstract concepts and environment and technology as part of its content, it may be complicated for students to comprehend some concepts (Özsevgeç, 2007). In case not corrected immediately after being developed, misconceptions cause dissensions in the following academic career.

Despite the fact that the concept of "Light" is widely used in daily life, knowledge of many students is detected to include contradictions and discrepancies (Yıldız, 2000). Furthermore, the concepts of the light unit are abstract for the most part. This study presents the types of misconceptions students have, how they form, suggestions on how the conceptual change can be facilitated and how teachers can minimize the misconceptions of students in the learning and teaching environment.

This study conducted a sample application of the learning station method, which is a modern learning approach, keeping the students active during the entire learning process, enabling them to learn on their own, giving the opportunity to work in peer learning groups, and answers to the following research questions were sought:

1) What prior knowledge do the students in the experimental and control groups have regarding the "Light" unit?
2) Is there a significant difference between the posttest answers of the experimental and control groups?
3) Is the learning station method more effective in supporting conceptual development and eliminating misconceptions of students than the curriculum recommended by MEB applied to the control group?
4) What are the views of the students regarding learning stations?

1.6. Significance of the Research

The concept of "Light" is the topic with the most misconceptions today. So as to eliminate these misconceptions and provide students more permanent and correct knowledge, ways were searched on how to teach this topic and a number of methods were suggested. The effects of teaching the concept of "Light" with the normal curriculum recommended by MEB and the learning station method were identified in this research.

1.7. Purpose of the Research

This study was conducted with the purpose to determine the effects of the learning station method designed for the light unit on the seventh grade students' conceptual understanding levels and to identify the student views on the learning station method.

2. Material and Methods

2.1. Type of Research

Mixed method integrating both quantitative and qualitative methods was used in the research. In the quantitative part of the research quasi-experimental pretest-posttest control group design was employed. The learning station method was applied to the experimental group; the current education program recommended by MEB was applied to the control group.

2.2. Space and Sample

The study group of the research consists of 41 7th graders attending a secondary school in the city center of Eskişehir in 2014-2015 academic year. The study group was divided randomly into two and the experimental group included 22 students, the control group included 19 students.

2.3. Data Collection Tool

In order to measure the knowledge levels of the students regarding the light unit, an "achievement test" of 4 open-ended questions was prepared by the researcher teacher. These open-ended questions were applied to both groups as pretest and posttest. The questions in the achievement test are as follows:

Question 1: What is the reason for the salesmen in the farmers market to use red tents on over the tomato stands or the butchers using red light on meat? Please explain.

Question 2: How do you explain different colors emerging in the water of the sprinkler in sunny weathers?

Question 3: A lifeguard working at a beach sees someone drowning in the sea. The lifeguard going to save the person realizes that his/her movements on land are faster and easier than movements in the sea. How can you associate this phenomenon to light passing from air to water?

Question 4: Is there any difference between your image reflecting from a lake on a windy day and your image reflecting from a plane mirror? Please explain the reason.

After applying the learning station method, a semi-structured interview of 4 open-ended questions was conducted with the students of the experimental group to determine their opinions and thoughts regarding the technique. This type of interview was selected as it allows students to express their thoughts freely and to reveal the scientific thoughts and misconceptions of the students (Bauner & Schoon, 1993).

Semi-structured interviews were conducted with students selected from the sample to deepen the research. The students were selected randomly in order to better reflect the sample. When preparing the interview questions, the misconceptions detected in the answers of the achievement test and frequently observed in the literature were taken into consideration. Interviews were conducted in the presence of only the researcher teacher and the participating students in the classroom within one lesson period. Sufficient time was given to the students to get adapted to the environment and the reason for the interview was explained prior to starting it. Students taking part in the interview were named as S1, S2, S3... Beside the pre-determined questions, some other questions were also asked to the students according to their answers. The questions below were asked the students in the semi-structured interviews:

1) What is your assessment on the science lesson conducted with the learning station method?
2) Did you come across any difficulties or negative situations while doing the activities of the learning stations? (Finding resource, finding material, communication etc.) What were they? Please explain.
3) How did the learning station method affect your learning of topics you deem difficult to learn?
4) Do you think the learning station method should be used in other lessons as well? Please explain.

2.4. Rubric

The rubric used in this study was prepared by the researcher teacher. It was prepared before the achievement test was applied as pretest-posttest, with four criteria according to the answers the students may give and was designed to show what scores the students will receive for various answers. At this step, the most and least successful answers were determined and each criterion was graded with scores from 0 to 3. In the rubric the scores were determined as: 0 for leaving the answer blank, 1 for misconceptions, 2 for incomplete answers, 3 for complete correct scientific answers (with explanation). Thus, the minimum score to receive from the rubric is 0, the maximum score is 12. Views regarding the prepared rubric were gathered from science teachers, assessment and evaluation experts and specialists working on language. The rubric provided objectivity in scoring and elimination of ambiguities (For the rubric see Appendix 1).

2.5. Application Process of Learning Stations and Data Analysis

Four learning stations were used in the classroom of the experimental group. Before the technique was applied, students were informed in detail about how the lesson is going to be conducted and points to take into consideration while visiting the stations. Prior to the activity start, all material and equipment were supplied, prepared and placed at each station. Instructions for each station were written by the researcher teacher and students were asked to attentively read and orderly follow the instructions. For the activities in the stations to be conducted, 2 lesson periods were designated. The students of the experimental group received the opportunity to visit all four stations,

deepen their knowledge and to create products. (For learning station instructions see Appendix 2). Names of the used stations are listed below:
1) Learning station: No way out of water;
2) Learning station: Reflection;
3) Learning station: Combine the colors;
4) Learning station: Color wheel.

3. Findings

3.1. Findings Regarding the First Sub-Problem

The achievement test on the light unit was applied to the students of the experimental and control group as pretest. Answers given by the two groups in the pretest were compared with independent samples t-test and no significant difference was detected between the pretest scores of the two groups. Table I below presents the results of the independent samples t-test:

Table 1: Comparison of Pretest Scores of Experimental and Control Groups

Test	Group	N	X	sd	df	t	p
Pretest scores	Control Group	19	2,63	1,34			
	Experimental Group	22	2,27	1,35	39	,850	,400

Table 1 shows that the average score of the experimental group from pretest is 2,27 and the average score of the control group is 2,63. Analysis revealed no significant relationship between the average scores of "light achievement test" of the experimental and control groups (p>0,05). According to these results, students of the experimental and control groups may be regarded initially similar. Furthermore, pretest answers to the 1st and 2nd questions of the experimental and control group students were examined on question basis. Examples of student answers, their frequency and percentage values are given in Table 2.

Table 2: Misconception Examples, Frequency and Percentage Values Observed in the Pretest

Experimental Group			Control Group		
1. Question	f	%	1. Question	f	%
"So that the red light is absorbed..."	2	9.09	"So that meat looks better and the expiration date is extended…"	3	15.78
"The red light is shone on the meat…"	1	4.54	"As red light draws the Sun…"	1	5.26
"Because red is an attractive color…"	1	4.54	"So that they aren't heated…"	1	5.26
"The light nourishes, prevents them to spoil fast"	3	13.63	"So that the meat doesn't spoil fast…"	1	5.26
"As it gets energy and oxygen from the Sun ..."	1	4.54	"Not to show the rotten parts of tomatoes…"	1	5.26
"So that sunlight doesn't pass through the tents…"	1	4.54	"So that meat doesn't lose its color…	1	5.26

2. Question	f	%	2. Question	f	%
"As sunlight hits the ground…"	1	4.54	"Color of water changing when sunlight strikes water…"	1	5.26
"Light beams come from different directions…"	2	9.09	"Water doesn't absorb but reflects colors coming from white light…"	5	26.31
"After rainbow the Sun becomes colorful…"	1	4.54	"Because there are colorful lightbulbs…"	1	5.26
"Water is white and different colors emerge in white color…"	1	4.54	"It reveals the colors the water has swallowed…"	1	5.26
"So that the sprinkler is eye-catching…"	1	4.54	"As a result of water and sun clashing"	1	5.26
"Because there is chlorine..."	1	4.54	"Those are the colors reflecting from the rainbow"	1	5.26
3. Question	**f**	**%**	**3. Question**	**f**	**%**
"There are more particles in the water"	3	13.63	"There is friction in water"	1	5.26
"As there is pressure in water, our speed decreases, but on sand our speed doesn't change because there is no pressure"	2	9.09	"As the pressure of sand is less than the pressure of water …"	2	10.52
"There are minerals in water"	1	4.54	"Due to the depth of water…"	1	5.26
"Sand particles are more combined"	1	4.54	"They are trained for it.."	1	5.26
"Air is loose…"	1	4.54	"Light enters water as semi-transparent, it enters air directly"	1	5.26
"People have difficulties because there are waves in the sea …"	1	4.54	" People have difficulties because there are waves in the sea …"	1	5.26
4. Question	**f**	**%**	**4. Question**	**f**	**%**
"Our body may appear bigger due to wind…"	1	4.54	"We see a bigger version of ourselves in the lake"	1	5.26
"When the surface is solid it seems clearer, more real, when it is liquid the image is not that clear …"	1	4.54	"It is colorful on the mirror, black in the lake"	1	5.26
"As the lake is dark…"	3	13.63	"As the lake is more wavy …"	3	15.78
"Water gets wavy…"	4	18.18	"Mirror reflects light"	1	5.26
"It is reverse on the lake…"	1	4.54	"As the weather is too hot…"	1	5.26

Prior knowledge of seventh graders regarding different concepts of "light" unit is presented in Table 2. Analyzing the obtained data indicated that both the experimental and the control groups had misconceptions on absorption, reflection, speed and refraction of light. The percentage and frequency values of students of the experimental and control groups using these misconceptions were observed to be close to each other which supports the results of Table 1.

3.2. Findings Regarding the Second Sub-Problem

Light achievement test was applied to the students of the experimental and control groups as pretest and posttest, and according to the second sub-problem, the test scores before and after the activity of both groups were examined in order to determine whether there was significant relationship between them. Dependent samples t-test was conducted for statistical comparison of pretest-posttest scores of students. Findings were summarized in Table 3.

Table 3: Comparison of Pretest-Posttest Scores of Experimental and Control Groups

Group	Test	N	X	sd.	df.	t	p
Control Group	Pretest	19	2,63	1,34	18	-3,249	,004
	Posttest	19	3,94	1,68			
Experimental Group	Pretest	22	2,27	1,35	21	-7,077	,000
	Posttest	22	5,09	1,50			

The results of the dependent samples t-test revealed that the average pretest score of the control group was 2,63 and the average posttest score rose to 3,94. Significant difference was observed between two results ($p<0,05$). Average pretest scores of the experimental group was 2,27, whereas their average posttest score rose to 5,09, showing significant difference as well ($p<0,05$). These findings indicate both the learning station method and traditional approaches are effective for 7th graders to learn concepts of the light unit and increase their academic success.

3.3. Findings Regarding the Third Sub-Problem

In the research, light achievement test was applied to both groups as posttest. Concerning the third sub-problem, it was examined whether the learning station method was more effective than the teaching program recommended by MEB, which was applied to the control group, with regard to supporting the conceptual improvement and reducing misconceptions of students. In order to determine which of the two methods was more effective, independent samples t-test was applied to the average posttest scores of experimental and control groups. Table 4 summarizes independent samples t-test results.

Table 4: Comparison of Posttest Scores of Experimental and Control Groups

Test	Group	N	X	sd	df	t	p
Posttest scores	Control group	19	3,94	1,68	39	-2,294	,027
	Experimental group	22	5,09	1,50			

Independent samples t-test results, presented above, show significant difference between two groups in favor of the experimental group ($p<0,05$). Average posttest score of the experimental group is 5,09, while it is 3,94 of the control group. These results suggest that, when teaching the light unit, the learning station method is a more effective method than the traditional teaching program in terms of increasing knowledge levels of seventh graders and reducing their misconceptions they had in the pretest. Answers to the posttest of experimental and control groups were analyzed on question basis. Examples of students answers, answer frequency and percentage values are presented below in Table 5.

Table 5: Misconception Examples, Frequency and Percentage Values of the Posttest

Experimental Group				**Control Group**			
Nr	**1. Question**	**f**	**%**	**Nr**	**1. Question**	**f**	**%**
1	"So that sunlight doesn't pass through the tents…"	1	4.54	1	"As red light draws the Sun…"	2	10.52
Nr	**2. Question**	**f**	**%**	**Nr**	**2. Question**	**f**	**%**
1	"Because there is chlorine in pool water..."	1	4.54	1	"Water doesn't absorb but reflects colors coming from white light…"	2	10.52
2	"Light refracts in air…"	1	4.54	2	"As a result of water and sun clashing"	1	5.26
3	"The lightbulb in the pool radiates colorful light..."	1	4.54	3	"Light refracts in air…"	1	5.26
Nr	**3. Question**	**f**	**%**	**Nr**	**3. Question**	**f**	**%**
1	"As there is more pressure in water…"	3	13.63	1	"As the pressure of sand is less than the pressure of water …"	2	10.52
2	"Water is denser…"	1	4.54	2	"Due to the depth of water…"	1	5.26
3	"Movement becomes difficult as water particles in sea merge."	1	4.54	3	" People have difficulties because there are waves in the sea …"	1	5.26
				4	"They are trained for it..."	1	5.26
Nr	**4. Question**	**f**	**%**	**Nr**	**4. Question**	**f**	**%**
1	"Light refracts as the water is wavy…"	1	4.54	1	"As the lake is more wavy …"	2	10.52
2	"The wind moves the lake and the image is deformed…"	2	9.09	2	"It is colorful on the mirror, black in the lake"	1	5.26
3				3	"Mirror reflects light"	1	5.26

When compared to the pretest, Table 5 shows decrease in posttest percentage and frequency values of misconceptions of the students regarding the "Light" unit. Furthermore, frequency and percentage values in Table 5 exhibit that control group students have more misconceptions than experimental group students. Considering the analysis results, it can be deduced that the learning station method applied to the experimental group is more effective than the teaching program recommended by MEB applied to the control group. These results support the results in Table 4.

3.4. Findings Regarding the Fourth Sub-Problem

The answers of the experimental group to the semi-structured interview questions regarding learning stations were analyzed descriptively. Some of these answers were selected and presented as direct quotations. Questions asked to the experimental group students and their corresponding answers are given below:

A. What is your assessment on the science lesson conducted with the learning station method?

The answers to the question above indicate that students enjoyed the lesson with this technique. They expressed this method makes it possible for them to actively participate in and enjoy the lesson and that through the activities they understand the topic easily. Students also conveyed that activities were simple, easily understandable; they had to constantly communicate and interact to share the materials at the stations, knowledge and skills. Student expressions explicitly reveal that feeling part of the activity increases self-confidence and motivation. Views of students S2 and S3 are given as related examples below.

Views of student S2: *"...everything was very enjoyable. I learnt better at each station, because it felt like a game and it is also very nice as a lesson. I worked in the class freely.As I was able to do the tasks the teacher wanted us to do, I decided to study more for science lessons."*

Views of student S3: *"...I comprehended the topic more easily and quickly learned the topics that normally are hard to learn. I improved my research and hand skills. I was very happy to get the experiment result. I also got the chance to speak to my group friend a lot, who I hadn't much talked to until now."*

B. Did you come across any difficulties or negative situations while doing the activities of the learning stations? (Finding resource, finding material, communication etc.) What were they? Please explain.

The answers given to the question above revealed that at some points there were chaos and loud noise, due to the crowdedness of the classroom; students had communication problems, difficulty in managing time; some students did not want to participate, as they already knew the outcomes of the experiments. Below, views of S1 and S5 are presented as examples.

Views of S1: *"...there were communication problems and some friends wanted work on their own. This caused unrest and chaos. I also didn't want to participate in the activity of which I knew the result, so I was bored."*

Views of S5: *"...we had some uncertainties. We lost too much time while contemplating which hindered us from finishing the tasks on time."*

C. How did the learning station method affect your learning of topics you deem difficult to learn?

The answers to the question above were analyzed. The analysis showed that the learning station method, if used properly, is allowing students to take actively part in the process and is effective, which facilitates easier learning. This result indicates students have different expectations from the education system and monotonous education methods should be discarded. Related views of S4 and S2 are given below.

Views of S4: *"...I learned easier. I was able to think differently while preparing for the activities, besides, as I was communicating with my friends during the activities, I was able to ask and learn the parts I didn't understand."*

Views of S2:*"...I could see the reasons and results of what we learned with my own eyes, through the activities, which intensified the learning and increased my self confidence."*

D. Do you think the learning station method should be used in other lessons as well? Please explain.

Regarding the question above, students expressed that using the learning station method could be beneficial if implemented in other lessons as well; just as in Science, it could increase their success in other difficult lessons, such as Mathematics or English.

They claimed that this method could be preferred especially for teaching abstract and difficult lessons, which would make permanent learning enjoyable and they were not bored of the Science lesson thanks to this technique. Views of S1 and S2 are exhibited as examples below.

Views of S1: *"...it should definitely be implemented. It would increase our success in lessons we have difficulties in learning, such as Methematics or English."*

Views of S2: *"...I didn't get bored at all in the science lesson in which we used the technique and I learned the topic. I wish other lessons were conducted like this, as it is both fun and efficient."*

4. Results and Discussion

This section comprises the results deduced from the findings of our study focusing on the effects of learning stations on conceptual understanding levels of seventh graders regarding the light unit. The conclusions are given in four parts considering the findings.

In the findings regarding the first sub-problem, it was analyzed whether the prior knowledge of the experimental and control group students resembled each other regarding the alternative concepts of the light unit. Average pretest score of the experimental group was calculated 2,27, while the score of the control group was 2,63. According to this result, no significant relationship was detected between the average scores of the two groups from the light achievement test in the pretest. Therefore, the academic skills regarding this unit of the students of the control and experimental groups were similar.

The misconception examples identified in the pretest of the two groups were compared. The given answers of the experimental group students revealed that 40.88% of the answers to the 1st question, 31.79% of the answers to the 2nd question, 40.88% of the answers to the 3rd question and 45.43% of the answers to the 4th question contained misconceptions. The given answers of the control group students showed that 42.08% of the answers to the 1st question, 52.61% of the answers to the 2nd question, 36.82% of the answers to the 3rd question and 36.82% of the answers to the 4th question contained misconceptions. Analyses disclosed students of both groups had misconceptions about "absorption, reflection, speed and refraction of light" and the percentage and frequency values of the usage rates of these misconceptions in both groups were similar.

The study of Yıldız (2000) investigated the misconceptions about light unit among 6th graders, in which 30% of the students participating in the research were found to have learned unscientific concepts. Similarly, alternative concepts were examined in the study "Misconceptions and Learning Difficulties of Primary Students Regarding Light, Seeing and Mirrors" of Şen (2003) and in the study "Misconceptions of High School Students about Light" of Büyükkasap, Düzgün and Ertuğrul (2001). Detecting similar alternative concepts about the light unit among the students, the findings of the mentioned studies were parallel to those of this study.

Regarding the second sub-problem, findings were analyzed to determine whether there was a significant relationship between the scores of the tests applied before and after the activity to the experimental and control groups. Analysis revealed that the control group increased its average score of the pretest 2,63, to 3,94 in the posttest which indicated significant difference between pretest and posttest. The average pretest score of the experimental group, who learned the light unit using learning stations, was 2,27, whereas their posttest average score rose to 5,09. Analysis, again, revealed that there was significant difference between pretest and posttest scores of the students in this group. From these findings, it can be concluded that both the teaching program recommended by MEB and learning station method improve academic success of 7th graders in teaching light unit. This result demonstrates similarities with the results of the study of Albayrak, Yalçın and Altun Yalçın (2017), in which they assert that both the regular program and learning stations increase students' academic success in terms of teaching 7th grade astronomy topics.

The findings regarding the third sub-problem were analyzed in order to determine whether the learning station method was more efficient compared to the program recommended by MEB applied to the control group, in terms of supporting students' conceptual improvement and eliminating misconceptions. Results explicitly indicated significant difference between the groups, in favor of the experimental group. Average posttest score of the experimental group was 5,09, where, on the other hand, the average posttest score of the control group was calculated as 3,94; hence it is safe to say that learning stations are more effective than the program recommended by MEB, with regard to supporting students' conceptual development and eliminate misconceptions about the light unit. Examining the results of frequency and percentage scores of misconceptions in the posttest showed that the answers of the experimental group included misconceptions as follows: 4.54 % in the first question, 13.62% in the second question, 22.71% in the third question, 13.63% in the fourth question. The corresponding results regarding answers without scientific content of the control group were: 10.52% in the first question, 21.04% in the second question, 26.3% in the third question and 21.04% in the fourth question. Results reveal that the misconception rates dropped for both groups in the posttest compared to the pretest and findings are in favor of the experimental group. This result of learning stations being more effective than the regular program in increasing academic success of students in science lesson is similar to the results of the studies of Benek (2012), Albayrak (2016), Yüksel (2017) and Çakmak (2018).

In the findings regarding the fourth sub-problem, answers of the students to the interview questions about the learning station method were analyzed. Students stated they liked the method, deemed it necessary in teaching abstract concepts and enjoyed participating in the activities of the stations. They emphasized that this technique should be used in other lessons as well, the activities contributed to their communication skills during the learning process and that application was simple and easily understandable. The interviewed students expressed that they liked how the learning station method is conducted, that they understood the concepts of light unit easily owing to this method. Furthermore, they explained that this method improves education quality but, on the other hand, that they sometimes had difficulties with time management and observed a noisy environment from time to time. All these results are parallel to the results of other studies focusing on the views (thoughts) of students about learning stations (Benek & Kocakaya 2012; Çakmak & Demir, 2016; Çakmak, 2018; Erdağı & Önel, 2015; Yüksel, 2017).

5. Recommendations

The suggestions below are listed in the light of the conclusions attained through this research:

- It is suggested to use the learning station method in other units of science lesson at different class levels.
- Further study may focus on the effects of the learning station method on permanent learning of students and their attitude towards science lesson.
- Observation technique may be applied as a qualitative data collection tool and views of teachers and students regarding station method may be collected during this process.
- Learning stations may be applied with richer material and tools to much wider sample groups.
- Science teachers may be informed about the results of related studies and can be given opportunities of in-service training to gain pedagogic skills in order to apply these techniques on students.

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Appendix 1: Rubric

Table 6: Score Values of Answers Given According to the Rubric

Question 1: What is the reason for the salesmen in the farmers market to use red tents on over the tomato stands or the butchers using red light on meat? Please explain.

Answer	Answer Examples	Point
Correct/Complete Scientific Answer (with Explanation)	Light filter	3
Incomplete Answer	Light passing through transparent object, light absorption	2
Misconception	Light causes to spoil, red is an attractive color	1
Blank	No answer	0

Question 2: How do you explain different colors emerging in the water of the sprinkler in sunny weathers?

Answer	Answer Examples	Point
Correct/Complete Scientific Answer (with Explanation)	Light prism, light separating into its colors, light refraction	3
Incomplete Answer	Rainbow formation, CDs appearing colorful	2
Misconception	Water containing chlorine, sprinkler to be eye-catching	1
Blank	No answer	0

Question 3: A lifeguard working at a beach sees someone drowning in the sea. The lifeguard going to save the person realizes that his/her movements on land are faster and easier than movements in the sea. How can you associate this phenomenon to light passing from air to water?

Answer	Answer Examples	Point
Correct/ Complete Scientific Answer (with Explanation)	Speed of light changing according to environment	3
Incomplete Answer	Air and water having different densities	2
Misconception	More particles in water, pressure is higher in water	1
Blank	No answer	0

Question 4: Is there any difference between your image reflecting from a lake on a windy day and your image reflecting from a plane mirror? Please explain the reason.

Answer	Answer Examples	Point
Correct/Complete Scientific Answer (with Explanation)	Specular reflection, diffuse reflection	3
Incomplete Answer	Image appearance on rough and smooth surfaces	2
Misconception	Water becomes wavy, it depends on the surface being liquid or solid	1
Blank	No answer	0

Appendix 2: Learning Station Instruction

1. Learning Station

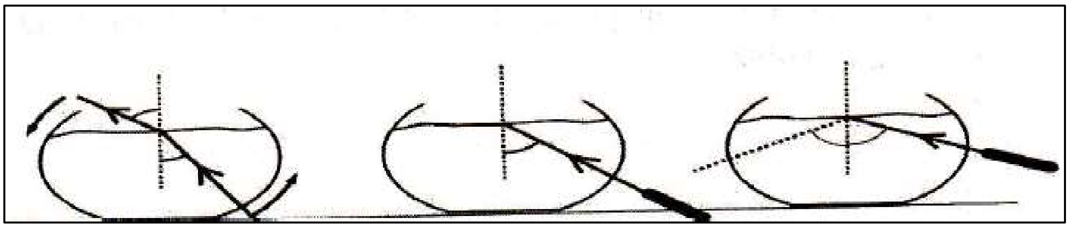

Figure 1: No way out of water

Materials and Tools:
*Glass Container
*Water
*Wooden Skewers
*A4-sized Papersheet
*Milk
*Laser Light
*Paper and Tape

Please follow the instructions below:
1) Fill three quarters of the glass container with water.
2) Add one or two drops of milk to the water (Milk is only used to make the laser light visible in water).
3) Stick the wooden skewer parallel to the side of the flash light.
4) Hold the laser light from bottom towards the top (from water towards air). At the same time your partner tries to catch the light coming out from the water on the white paper.
5) Increase the angle of the laser light gradually. Observe what happens.

2. Learning Station

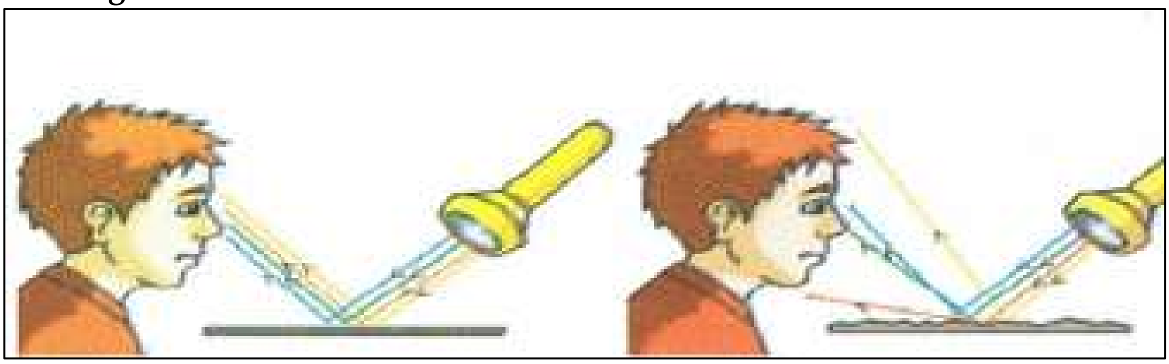

Figure 2: Reflection

Materials and Tools:
*Plane Mirror
*Aluminum Foil
*CD
*Flash Light *Matte Object
*Comb

Please follow the instructions below:
1) Examine your image on the plane mirror and CD.
2) Create parallel light beams by using the comb. Project light on the plane mirror and CD by holding the flash light behind the comb. Follow the path of light after reflecting from the mirror or CD.
3) Crinkle the aluminum foil. Examine your image on the foil.
4) Create parallel light beams by using the comb. Project light on the aluminum foil by holding the flash light behind the comb. Follow the path of light after reflecting from the foil.
5) Project light beams you create by using the comb on the matte object. Observe whether light beams are reflected.

3. Learning Station

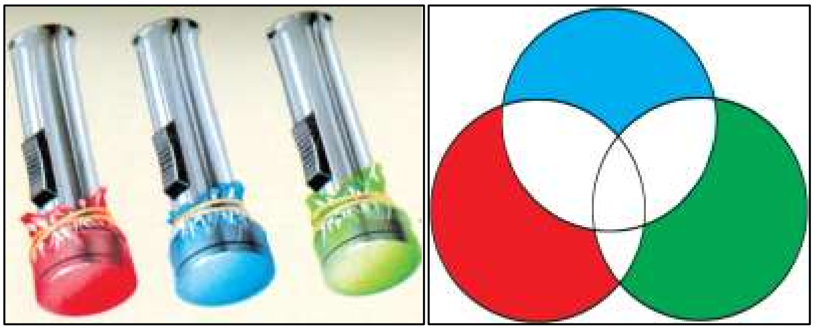

Figure 3: Combine the colors

Materials and Tools:
*Red, green and blue cellophane paper
*3 Flash Lights
*Screen

Please follow the instructions below:
1) Cover the flash lights with red, green and blue cellophane papers.
2) Light the screen with the flash lights as shown above to create double and triple intersections.
3) Observe the colors created by double intersections.
4) Observe the color created by the triple intersection.

4. Learning Station

Figure 4: Color wheel

Materials and Tools:
*White Cardboard
*Battery
*Colored Pencils
*A Small Piece of Wire
*Nail
*Electric Motor

Please follow the instructions below:
1) Cut a circle out of the cardboard.
2) Divide the circle in six equal parts.
3) Color one of the parts in red. Color the others in orange, yellow, blue and purple; with that order.
4) Insert a nail into the middle of the circle. Connect the wheel to the electric motor with the nail.
5) Slowly spin the wheel with your finger and observe the colors on the wheel.
6) Turn on the electric motor, spin the wheel quickly and observe what happens.