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Designing Science Instruction based on Creative Drama: The Effect on 6th Grade Students' Understanding and Elimination of Misconceptions

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ABSTRACT

Since having a potential to give students an opportunity to be actively involved in the science learning and leads students to look the scientific phenomena in different perspectives, this study was carried out to investigate the effectiveness of creative drama based science instruction on 6th grade students understanding of the Earth, Moon, and Sun concepts and eliminating the misconceptions on these concepts. In addition, the effectiveness of creative drama based instruction was also examined with regard to students' cognitive dimensions such as knowing, applying, and reasoning on the Earth, Moon, and Sun concepts. After the four-week treatment, the Earth, Moon, and Sun Concept Test (EMSCT) that included items categorized as knowing, applying, and reasoning items and covered some of the misconceptions on the related concepts was applied to 82 students in both control (42 students) and the experimental (40 students) groups from four different 6th grade classes. Since there were more than one dependent variable and to control the type-one error, MANOVA (Multivariate Analysis of Variance) was used. The results revealed that students who were taught by creative drama based instruction showed significantly higher performance than the students who were taught by traditional instruction with respect to acquisition of the scientific concepts on the Earth, Moon, and Sun and elimination of the misconceptions related to these concepts. However, significant differences were not established with respect to all cognitive dimensions labeled as knowing, applying, and reasoning.

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Keywords:
Creative drama, science education, misconceptions in science education, the earth, moon, and sun concepts, science cognitive dimensions.

Introduction

The developments in the globalized world have transformed the productivity types that require individuals who possess new competencies. Without doubt, science education is defined one of the major field that contributes the formation of these competencies. It was indicated in the literature that understanding the concepts clearly and developing conceptual framework that was combined with students' ideas have not been achieved by traditional instruction (Teichert & Stacy, 2002). Contemporary teaching strategies based on constructivism have aroused to satisfy the necessities to attain the competencies that are required in the worldwide labor market. Because of these, the frontier countries of the knowledge-based society have renewed or evolved their science education curricula to actively involve their students in the process of learning.

Social constructivism expresses that learning process is aroused by the interaction of individuals' language and cognition with the individuals' social environment. Therefore, the quality of interaction of an individual with their peers and other individuals in the society believed as a determinant on how an individual show differences from the others (Vygotsky, 1986). In other words, social constructivism claims that learning occurs as result of the social interactions that can be mediated by activities and cultural tools,

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such as language (Vygotsky, 1978). Vygotsky who is believed as founder of social constructivism stated the concept of "zone of proximal development (ZPD)" which has been defined by him as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers" (Vygotsky, 1978, p. 86). Vygotsky (1978) believed that if students who are in the ZPD are attained appropriate teaching strategies and activities, students likely have enough boost in learning.

Creative Drama and Its Applications on Science Education

Using drama process to teach to the school subjects generally defined as Drama-in-Education (Heathcote & Bolton, 1995). One of the techniques that are used in the Drama-in-Education is "creative drama". This technique includes performing improvisations about an event or a concept that were formed by participants' past experiences. Using of movements and speech spontaneously to create a character or an object in a particular situation has been defined as "improvisation" (Gallagher, 1997). Students are encouraged to be actively involved in the learning environment (Courtney, 1990) and look the phenomena from different perspective in creative drama based instruction. In addition, students see particular situations from sociological perspective by acting different roles. Furthermore, creative drama based instruction has a great potential to provide a framework that students engage the learning process, construct knowledge on their own, and relate daily life experiences with their learning process. Moreover, as the social constructivism has claimed, the construction of the knowledge is promoted by social interaction that is encouraged by creative drama by verbal/nonverbal communication. Science education is the one of field that creative drama based instruction has been used to facilitate meaningful learning (Taskın-Can, 2013).

In the literature, some of the studies have been conducted to investigate the effectiveness of creative drama as a strategy to facilitate science learning for some of the science concepts and improve students' understanding of nature of science (Çokadar & Yılmaz, 2010; Hendrix, Eick & Shannon, 2012; KasPolisini & Spector 1992, Ozdemir & Ustündag, 2007; Taskın-Can, 2013). For example, Çokadar and Yılmaz (2010) were designed an experimental study to investigate the effect of instruction based on creative drama on seventh grade students' understanding of ecology and matter cycle concepts. In this study, students who were instructed based on creative drama exposed better understanding on ecology concepts than students who were not in this group. In addition, Taşkın-Can (2013) conducted a study to expose effectiveness of creative drama based instruction on fifth grade students' understandings on the light and sound unit. Statistically significant mean differences were reported in the favor of creative based instruction group after three-week treatment. Moreover, Ozdemir and Ustündağ (2007) carried out a study to examine whether creative drama as a teaching method contributes students to learn life story and the contributions of famous scientists in science and technology.

Misconceptions in Science Education

Since an individual actively constructs the knowledge on the basis of what is already hold in the mind (Duit & Tregaust, 1998), existing knowledge about phenomena and concepts to be taught is crucial in subsequent learning (Tsai, 1996). There is a consistency in the science education research that before students come to science classes they already have an existing knowledge about the concepts that will be taught (Novak, 2002; Savinainen, Scott, & Viiri, 2004). However, these existent ideas and concepts generally show an inconsistency when compared with the accepted scientific conceptions (Duit, 2002) and commonly labeled as misconceptions (Sungur, Tekkaya, & Geban, 2001). Investigating and eliminating the misconceptions by contemporary science instruction based on constructivism have become one of the main purposes of science education research (Chiu, Chou, & Liu, 2002).

One of the important learning domains that were defined in science curriculum of Turkey is "Earth and Space". This learning domain at the science curriculum of 6th grade includes some concepts related Earth, Moon, and the Sun. Students responsible to learn "the shape and the size of Earth, Moon, and Sun by creating their own model", "the layers of the Earth and their properties by designing an Earth model", and "the movements of the Moon and its phases". The concepts related to these subjects can be stated as abstract concepts that are not grasped easily by students. In addition, some of the phenomena related to these concepts that are not observable directly may cause misconceptions. In the literature, some of the misconceptions were defined related to movement of earth and moon, phases of moon, layers of the earth,

and also the Sun (Dai & Capie, 1990; Philips, 1991; Hermann & Lewis, 2003; Kalkan & Kiroglu, 2007; Plait, 2002). Table 1 summarizes the misconceptions related to these concepts.

Table 1. Misconceptions on the Earth, Moon, and Sun related Concepts.

Misconceptions about the Moon • The Moon appears larger on the horizon than when it is high in the sky. • The Moon becomes larger on the horizon because it is closer to Earth. • The Moon is only visible at night. • The Moon makes its own light (The Moon makes light the same way the Sun does).
Misconceptions about Phases of the Moon • Different countries see different phases of the Moon on the same day. • The Moon does not rotate. • The Moon takes one day to orbit the Earth (The Moon goes around the earth in a single day) • The Moon orbits the Sun instead of the Earth • Phases of the Moon are caused by a shadow from the Earth, clouds, or the Earth's or Moon's rotation
Misconceptions about Earth and its movement • The Earth's revolution around the sun causes night and day • The four seasons are the result of the changing distance of the earth from the Sun (Seasons are caused by the Earth's distance from the Sun). • If the earth does not rotate, seasons would be different.
Misconceptions about Layers of the Earth • We do not live on Earth; it is in the sky. • Crust and Lithosphere (or plates) are synonymous terms. • Earth's core is hollow, or that large hollow spaces occur deep within Earth.
Misconceptions about Sun and its movement • Day and night are caused by the Sun going around the Earth. • The Sun does not rotate • A shadow changes when the Sun moves. • The sun stays up in the sky longer in summer than in the winter. • When the Sun goes down, the moon goes up.

Significance an the Purpose of the Study

When the nature of the topics and the concepts related to movement of the Earth and the Moon, phases of the Moon, layers of the Earth, and the concepts related to the Sun were examined, it was realized that these concepts could be convenient to design an instruction based on creative drama. There has been no study in the literature that examine the effectiveness of creative drama based instruction on 6th grade students' understanding of concepts related to the Earth, Moon, and Sun. In addition to these, creative drama based science instruction can be effective for eliminating students misconceptions related to movement of the Earth, Moon and Sun and the phases of Moon. Therefore, the main purpose of this study was to investigate the effectiveness of creative drama based science instruction on 6th grade students' understanding the concepts related to the Earth, Moon, and Sun and their movements and eliminating of misconceptions related to these concepts.

Methods

Subjects of the Study

One of the private schools was selected from Ankara district in Turkey for the sample of the study. Private schools in Ankara district generally have well-designed learning facilities such as well-equipped laboratories, classrooms with technological devices (smart boards, projectors, computers, internet access etc), drama halls, sports environments. The socioeconomic status of the students' families is generally high. There were eight 6th grade classrooms in the schools. Four of them were randomly selected among them. The students were not assigned randomly to the experimental and control group since the classes had been

already formed at the beginning of the instructional year. Nevertheless, the experimental and the control group were formed randomly. The sample of the study consisted of 82 students who 34 of them were male and 48 of them were female from four classes. Two of the classes were assigned as control group and two of the classes were assigned as experimental group. As a result, 42 sixth grade students from two classes that involve 17 male and 25 female composed control group and 42 sixth grade students from two classes that involve 17 male and 23 female composed experimental group. Students in experimental groups were instructed by creative drama based instruction whereas the control groups were used the instruction based on traditional methods.

Data Collection

The Earth, Moon, and Sun Concept Test (EMSCT): 20 multiple choice items, 12 of them were taken from a large scale assessment which lots of private schools participated (SEBİT-KDU, 2012-2014) and 8 of them were developed by researchers by examining related textbooks. The table of specification of the test includes two dimensions, first one was the content dimension of the items, and the second one was defined as cognitive dimension of the items in the EMSCT. Content dimension includes "shape and the size of the Earth, Moon, and Sun (4 items)", "movements of the Earth, Moon, and Sun (4 items)", "Phases of the Moon (6 items)" and "Layers of the Earth (6 items)". The second dimension of the EMSCT that was defined as cognitive dimension consists of "knowing (5 items)", "applying (8 items)" and "reasoning (7 items)" levels. The first cognitive domain (knowing) refers students' knowledge on science facts, procedures, and concepts. The second domain that was labeled as "applying" covers the students' ability of applying knowledge and conceptual understanding of a science problem. The last domain that was named as "reasoning" needs students to deal with unfamiliar situations, complex contexts, and multistep science problems (Mullis, Martin, Ruddock, O'Sullivan, & Preuschoff, 2009). In addition to these, all items in EMSCT were multiple-choice items that include one correct answer and three distracters which some of them reflected students' misconceptions (Table 1) about the related concepts defined from the literature (Dai & Capie, 1990; Hermann & Lewis, 2003; Kalkan & Kiroglu, 2007; Philips, 1991; Plait, 2002). EMSCT had been applied to a group of students (70 students) as a pilot test before it was used for its actual aim to evaluate reliability and validity aspects. A value of 0.763 that is interpreted as a good in low-stake tests was yielded as Cronbach-alpha reliability from the data gathered in the pilot study.

Treatment

The treatment was completed 4 weeks period that one-week includes four 40-minutes sessions per week. As it was mentioned above four classes were selected for this study and whereas two of them were labeled as experimental group in which creative drama based science instruction was implemented, two of the classes were named as control group in which the instruction was designed with respect to traditional methods.

As it was indicated lot of experimental studies in science education field which investigate the effectiveness of a contemporary teaching methodology, in this study, students in the traditional group delivered lecture method to learn the concepts related to the Earth, Moon, and the Sun. In this group, teachers have preferred to explain the related concepts and relied on the textbooks without any effort to reveal or focus on students' misconceptions on the related concepts. Teachers generally wrote the definitions of the concepts to the board and students were responsible to fill the worksheets that were distributed by teachers. In this group, it was observed that knowledge was believed as a fact and teachers were responsible to transfer related knowledge (facts) to students mind that contains nothing about the related concepts. Discussions hold during the lessons has generally driven by teachers' questions for the concepts that were not covered clearly. At the end of sessions, few multiple-choice item were presented by teacher to solidify the taught concepts.

On the other hand, in experimental group, the students' misconceptions on the Earth, Moon, and Sun concepts were revealed from the literature (Table 1). The creative drama based instruction that was implemented in the experimental group was designed by taking consideration to eliminate these misconceptions. The instruction applied in the experimental group consisted four different workshops. These workshops were conducted based on the levels of creative drama and its components in the line with science education requirements. In this study, the workshops that were implemented in the experimental group were designed based on the levels that were exhibited by Adıguzel (2013) among the proposed ones

in the literature. The levels of creative drama were defined as: (1) preparation (warm-up) in which the main aim is create an incorporation in the group and preparation for the next level, (2) improvisation in which covered all the individual performances that emerged, determined, and formed to be exposed to others, and (3) evaluation (discussion) in which the thoughts and the different feelings on the whole process, its importance, and quality is discussed. In addition, the components of the creative drama were compiled with regard to the studies in the literature (Adıguzel, 2006a, 2006b; San, 2003; Ustundağ, 2006). There components of the creative drama were determined as: methods of the drama, dramatic moment, acting as it is, the roles of teachers and students, group works, rehearsals, the impacts of live process. These levels and components of creative drama were also used in a study implemented by Ozdemir and Ustündag (2007) in science education.

Two researchers from the field of science education and an expert on the creative drama examined the workshops implemented in the experimental groups. Some of revisions were made based on their opinions then the workshops were implemented in the experimental group. A workshop that was designed based on creative drama science instruction is presented below:

Subject: The Earth, Moon, and the Sun

Concepts: Phases of the Moon

Duration. 120 minutes (3 lesson hours)

Participants: 11-12 years old students (6th grade level students)

Location: A private school's drama hall in Ankara

Materials: Carton box, a vase, a torch, a ball, prepared handouts, background cartons, colored markers.

Methods: Role-playing, improvisations, writing during the role-play

Objectives: Students will be able to describe the movements of the Moon; students will be able to know the phases of the Moon; students will be able to explain how the phases of the Moon occur; students will be able to create a model that shows the phases of the Moon; students will be able to improve their empathy skills; students will be able to demonstrate effective hand, face, and body language; students will be able to share their feelings and thoughts in an effective way with the others in the group.

1st Level: Preparation (Warm-up)

Activity 1: Spaceship

Students sit on small chairs or on the floor of the drama hall. Teacher tells the students to imagine a spaceship that they are going to travel by it to the space for doing "Moon observation". However, since the spaceship is small, the captain (teacher) of spaceship allows students to take limited materials. Captain (teacher) asks students tell their names and one material that will be taken. Captain tell students that there is a secret rule of the game and only the students who realize this rule will deserve to be in the spaceship. Students line up in front of the spaceship. The secret rule of the play is students who find related materials beginning with the letters of their first name allowed to be in the spaceship. If they do not say a related material beginning their names' first letter, they will not be in the spaceship.

The game continues until students find a related material to take with them. Before the journey starts, captain distributes to students hands outs that include scientist notes during the observations of the Moon. After the hands outs are examined the journey to the space begins. A big ball that represents the Moon is placed in the middle of the drama hall. Some of the students leave the spaceship at the space to do spacewalk and observe the universe. And the game is over. Table 2 includes the notes of scientists in the handouts.

Table 2. Scientist's notes during their observations to the Moon

Observation notes by Scientist
1st day: I have never seen the Moon as beautiful before. It seems more big and brighter. The roundness of its looking (whole moon) makes its appearance more beautiful.
5th day: It is not looking as a whole. I was wondering why the appearance of the moon has changed. I will search this when I return to the home.
10th day: A piece of the Moon disappears day by day. I am wondering this appearance is the same from the all places.
14th day: The Moon does not appear as a whole anymore. It looks so thin. I am not sure whether I can see the Moon as a whole.
15th day: The Moon looks like so thin. I think it leaves us. But, I always observe it everyday and I am looking forward see it again.

Activity 2: The Earth, Moon, and Sun

The groups are formed and each group involves five students. Students make a circle by holding hands to each other. Teacher tells students to be the Earth. Since all places are dark in the Earth, it needs a light source. Therefore, students designate a Sun and a Moon among the each group of students. Than, the students distributed to the different places on the drama hall and the game begins with the music. All the students who are labeled as the Earth try to find the Sun and the Moon and try to place themselves between the students who are labeled as the Sun and the Moon to get the light from the Sun. The game continues for a while then, at the end of the game, teacher asks students why the Moon appears some nights in sky and why it does not appear some nights. Based on the students' answers, teacher explains the reason; as the Moon is not a light source, it only reflects the Sun's light to the Earth.

2nd Level: Improvisation

Activity 3: Light

Teacher put the carton box on a table that located in the middle of the drama hall. A vase is placed in the carton box. The vase should not get light in the box. Teacher tells to students *"you have to use torch to see the vase that located in the dark. Therefore, light is needed to see the things. When the torch is directed to the vase, you can see the only parts of vase that get the light. Since a person who looks on the vase idly can only see the lighted parts of the vase, the shape of the vase seems differently. In addition, when the place of the source of the light changes, the appearance of lighted parts of the vase will also change"*. Than, students observe the vase in the carton box lighted by the torch from place to place.

Follow-up Evaluation:

Students make a circle among themselves group by group. Teacher asks students to explain the similarities between the vase and the Moon. The discussion environment is created in all the circles. Teacher acts as a moderator that directs the discussion. Then, all the groups (circles) come together and defend their group views.

Activity 4. Show the Phases of the Moon

Four different places on the drama hall's walls are determined and four different posters that each one includes a phases of the Moon's picture and its properties are hanged on to these walls. Each wall is defined as:

1st wall: New Moon; 2nd wall: First Quarter; 3rd wall: Full Moon; 4th wall. Last Quarter.

Students are divided into four. Each group of students is distributed to the all walls one by one. Teacher requires students to examine each poster on the walls carefully. Than students are required to do appropriate physical movements with respect to the closest wall on which the related phase is defined. Students improvise their motions with regard to closest written properties of phases to the Moon on the walls. Students are also required to write three words to the poster that comes to their mind simultaneously related closest phases to the Moon. All the groups are responsible to do improvisations and write three words on the posters.

After the workshop is finished, students come together as circles with the created groups on the drama hall floor. Each poster is randomly put in to the middle of the circles. Each circle has one poster. Then, students require making improvisations based on the written words by groups to explain the phases of the Moon. Teacher gives time for the preparation. Then the improvisations are performed.

3rd Level: Evaluation

Activity 5: Names of Phases of the Moon

Students come together and line up as a "U". Teacher tell students to close each other as become face to face. Students who become face to face tell one of the phases of the Moon name simultaneously. If two students say the same phase, they are eliminated from the game. The game is continued as the last two students remain. The remaining students are winners of the game.

Activity 6: Drawing the Moon Phases

A competition is held in the class. Students line up group-by-group and each group involve eight students. Teacher distributes a blank poster to each group. When the game begins, the first person in each group, draw one of the phases of the Moon to the poster and pass to the student behind. Student at the behind should write the name of the pictured phase of the Moon and pass it to the behind student. Third students draw the sequenced phase of the Moon and pass it behind. The game is continued to complete all the phases and the names of the phases. The group who complete all the phases and the names of the phases right is the winner.

Results

One week before the treatment, EMSCT was applied to both the control group and the experimental group. Based on the gathered data, t-test was performed to understand whether there was a significant mean difference between control group and the experimental group with regard to students' EMSCT pre-test scores. It was found that there was no significant mean difference between control and experimental group with respect to students' understanding of the Earth, Moon, Sun concepts, $t(80) = -1.141$, $p > 0.05$. The pre-test mean scores in control group and the experimental group are (X_{CG} and X_{EG}) 11.59, 12,00, respectively. In addition to these, as it was mentioned previous parts, the EMSCT includes three types of items that were labeled with regard to students' cognitive dimension: knowing, applying, and reasoning. Therefore, knowing, applying, and reasoning scores were also produced based on students' response patterns. Three different t-test were conducted to investigate whether there was a significant mean difference between CG and EG with respect to students knowing, applying, and reasoning scores. It was found that there was no significant different between CG and EG with regard to students knowing, applying, and reasoning scores: knowing: $t(80) = 0.307$, $p > 0.05$ ($X_{CG} = 17.04$ and $X_{EG} = 16.80$); applying: $t(82) = -0.133$ ($X_{CG} = 13.15$ and $X_{EG} = 13.25$), $p > 0.05$; reasoning: $t(82) = -1.387$, $p > 0.05$ ($X_{CG} = 5.78$ and $X_{EG} = 6.85$).

After the four-week treatment period, EMSCT were applied to the both groups as a post-test and the data yielded were analyzed. Multivariate Analyses of Variance (MANOVA) was conducted to examine the effectiveness of drama-based instruction on understanding of the Earth, Moon, Sun concepts and student's cognitive dimensions such as knowing, applying, and reasoning in these concepts. Before interpreting the MANOVA results, the Box's test was examined to understand whether the multivariate normality assumption was confirmed. Box's Test results revealed that the multivariate normality assumption was met, $F(10, 30425) = 1.43$, $p > 0.05$. In addition, the results of MANOVA revealed that there was a significant mean difference between the control and experimental group with respect to students' understanding of the Earth, Moon, Sun concepts and scores on students cognitive dimensions defined as knowing, applying, reasoning, $F(4, 77) = 61.35$, $p < 0.05$. Whereas the control group mean score on EMSCT was found 11.85, the mean score of the experimental group was found 16.17. In addition, the control groups mean scores on students' cognitive dimensions such as knowing, applying, and reasoning were found as 17.23, 13.51, 6.12, respectively. On the other hand, the mean scores of the experimental group on cognitive dimensions such as knowing, applying, and reasoning were found 18.10, 15.50, 15.42, respectively.

Follow-up analyses of variance (the univariate ANOVAs on MANOVA output) were also produced to investigate the differences between control and experimental group based on the dependent variables separately. Interpreting the univariate ANOVAs on MANOVA output enables to control the Type I error (Green & Salkind, 2004). Consequently, the univariate ANOVA for students' total scores revealed that there is a significant mean different between CG and EG with respect to students total score on EMSCT, $F(1, 80) = 183.07$, $p <= 0.05$. For the knowing cognitive dimension, the univariate ANOVA indicated that there is no significant mean difference between CG and EG with respect to students' knowing scores on EMSCT, $F(1, 80) = 1.33$, $p(0,25) > 0.05$. For the applying cognitive dimension, as a result of the univariate ANOVA, there is a significant mean difference between CG and EG with regard to students' applying scores on EMSCT, $F(1, 80) = 9.55$, $p < 0.05$. Lastly, for the reasoning cognitive dimension, the univariate ANOVA results revealed that there is a significant mean difference between CG and EG in terms of students' reasoning scores on EMSCT, $F(1, 80) = 137.19$, $p < 0.05$.

Sixth grade science curriculum and students' misconceptions on the Earth, Moon, Sun concepts were taken into consideration during the construction of EMSCT. The item analysis was performed on post-test data to reveal the proportions of correct responses for control and experimental group. As mentioned previously, the items were categorized based on cognitive levels of the students such as knowing, applying, and reasoning. The item analyses results revealed that the percentages of correct responses were similar to each other for knowing items that attribute students' knowledge about scientific facts, concepts, and terms and required students to recall, define, and label for control and experimental groups. Similarly, the percentages of the correct responses in control and experimental groups are relatively similar (not as similar as at the knowing items) on applying items that require students to compare, to classify, and to apply scientific concepts and principles for finding solutions on a particular task. On the other hand, the percentages of the correct responses were higher on the reasoning items that require students to make a

decision, to make inference, to apply their concepts to the unfamiliar situations, to provide alternative solutions, and to integrate the knowledge in favor of the experimental group. For example, one of the reasoning item that related to the misconception of "the Moon takes one day to orbit the Earth" requires students to interpret the provided time intervals and the phases of the Moon for inferring the phase of the Moon in a specific date. Whereas 42.5% of students in control group answered this question correctly, 72.5% of the students in experimental group answered this item correctly after the treatment. In another reasoning item that is related to the misconception of "the Earth's revolution around the sun causes night and day" requires students to integrate knowledge on the movements of Earth and the Sun for designing a model. Similarly, the percentages of the students who answered this item correctly in control and experimental group are 26.2% and 85%, respectively.

Discussion

In light of the related evidence that was yielded in this study, creative drama-based science instruction leaded significantly better for understanding the science concepts related to the Earth, Moon, and Sun and for ruling out the misconceptions on these concepts than the traditionally designed science instruction. In the literature, many studies have revealed the similar findings that expressed the positive impacts of creative drama based science instruction with regard to understanding of science concepts (Çokadar & Yılmaz, 2010; Hendrix, Eick, & Shannon, 2012; Özdemir & Üstundag, 2007; Taskın-Can, 2013). The necessities of students' engagement to the learning process in which students interests and their curiosity are triggered by challenging students' current conceptions were expressed constructivism based instructional methodologies (Bybee, 1997; Posner et al., 1982). Active learning is gained an additional meaning through acting creatively on abstract concepts in science in which students is engaged by creative drama (Osmond, 2007; Walsh & Edwards 2009). Besides, in the instruction based on creative drama, studies have indicated that students perceive the learning process more interesting, enjoyable, and entertaining (Annarella, 1992; Freeman et al. 2003). In addition, the warm-up or preparation level of the creative drama based instruction enable students to review and recall their current and previous concepts of the students about the related subject. So, these can be stated some of the factors that lead creative drama based science instruction more effective for eliminating misconceptions and understanding concept better.

In addition, the importance of the social interaction and students' speech was also expressed in the social constructivism. According to the Vygotsky's theory, social interactions enable learners to internalize difficult problems, complex situations, and complicated processes (Vygotsky, 1978). That's why the science education community has specially focused on the social aspect of the construction process for last decades. Students personal, social, and educational improvements were also promoted by creative drama based instruction. Creative drama enables students working as a group during the learning process by interacting each other. In addition, one of the important factors that have potential to develop science literacy is the contribution of the language among the young children (Tippett, 2009). Social interaction where the scientific meaning arises by the interpretation of the events through previous knowledge is the prerequisite of language development. Therefore, in the current study, one of the reasons can be the social aspect of creative drama that lead students in the experimental group performed better than students who were instructed by traditional instruction with respect to understanding of the Earth, Moon, and the Sun concepts and eliminating misconceptions on these concepts.

Moreover, in the literature, it has been claimed that students' problem solving, critical thinking skills, linguistic and communicational skills, students' self-efficacy, empathy, and respect to other were improved by the creative drama activities (Walsh-Bowers, & Basso, 1999). And also, Ariel (2007) claimed that instead of memorization of the concepts, the understanding is emphasized by creative drama. Furthermore, reasoning skills, drawing conclusions, and formulating ideas are promoting by performing arts and visual arts (Gullat, 2007). The current study supports these findings by revealing the result of whereas students in both groups gain the similar scores in the knowing items, there was also a statistically significant and also the big difference in the favor of EG group on the scores of reasoning items which required students to use their critical thinking and problem solving skills.

Based on the experience that was gained with the implementation of this study, we suggest researchers that some of the science concepts and subjects are very convenient to design effective science instruction by

creative drama. Therefore, especially some of the abstract concepts enable researchers to design on creative based science instruction at various grade levels to investigate its effectiveness. We also recommend researchers to design these studies with larger samples and include the other variables such as students' science process skills, attitude toward science, their social skills etc. Finally, we recommend science teachers that learning to design science instruction based on creative drama facilitate their students to learn some of the abstract concepts in which critical thinking and reasoning skills were required.

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