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Object Disappearance Rules and Its Applications/Misconceptions

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ABSTRACT This study aims to examine early childhood teacher candidates' rules governing the object disappearance phenomenon, including the three dimensions involved in disappearance considering teacher candidates' reasoning. The objective is to find if any relationship can be established between teacher candidates' theoretical disappearance rules and actual disappearance rule applications and misconceptions. Both theoretical construction(s) and a variety of applications concerning selected astronomy-related phenomena were considered as part of the study. The survey research design was utilized. Two hundred Turkish early childhood teacher candidates participated in the study. Teacher candidates demonstrated a tendency to explain the disappearance phenomenon utilizing fewer dimensions but their explanations were functional. They erroneously utilized scientific rules to interpret phenomena, incorrectly matching rules to the appropriate phenomenon because they lacked the necessary scientific knowledge concerning that phenomenon, thus creating misconceptions. Misconceptions were sustained by disappearance rules forming an integrated firm mental construction.

INTRODUCTION

Students are generally expected to compose scientific mental constructions based on their everyday experiences, including concepts that are taught at school (Driver et al. 1994). For meaningful learning in science, students need to go beyond repeating clichéd verbal sequences, such as "hot air rises". They are expected to adhere to the construction of rules that are fundamental in the specific learning process, to apply them in novel situations appropriately, and to broaden their knowledge in realizing theories. Research showed that this is not always the case in learning and teaching science subjects. Accordingly, many studies have revealed that instead of scientifically acceptable theories, students possess erroneous rules and misconceptions or naive ideas and theories (Korur 2015).

Theoretical Background

Many researchers' aims have been to discover the factors generating problematic learning outcome misconceptions and they have looked for a pattern explaining students' responses. Students' responses can be categorized by type of reasoning into three groups of internal, external, and both. Those factors specifically related to characteristics of the learner are internal (Lemmer et al. 2003). Responses dependent on external factors are created through teaching (Veselinovska 2012). The third type of response includes both of these factors. Clarification of whether either or both factors are more dominant in creating erroneous learning outcomes was not considered as part of this study. Instead, the study concentrated specifically on internal factors.

Studies aiming to categorize internal factors that explain students' science ideas have revealed different explanations. Lemmer et al. (2003) summarized some of the important learner features as, "Animistic", endowing things with consciousness and life, "anthropomorphic", giving human form or qualities to nonhuman things, "teleological", (purposeful) giving answers attributing end purpose, and "egocentric", having the inability to view situations from others' perspectives. Other features were also reported, for example, in Vosniadou and Brewer (1990) as, "artificialistic", believing that everything is organized for the good of humans and "theological", attributing things to a god. Similarly, an "attributive" feature can be found in Piaget (1963), which is the tendency to attribute things to those in power or authorities. There are other features, which are thought have a more direct role in rule establishment. For example, Driver et al. (1998) summarized some students' features in constructing mental models that impede theory consolidation. They showed that students are directly affected by what they perceive instead of finding the need to seek hidden patterns and only consider limited aspects of a situation, focusing on changes and not on the steady state. They tend to draw linear causal sequences and not complex ones. Most researchers found that students are context dependent and that students consider

different rules while explaining those that are scientifically or actually related (Watson et al. 1997; Engel Clough and Driver 1986). Contrary to context dependency, Mohapatra (1988) described students' tendency to overgeneralize a concept. The tendency to overgeneralize knowledge was also found in very early research by Inhelder and Piaget. Inhelder and Piaget (1964: 124) showed that young students tend to overgeneralize their rules immediately after learning them. For example, a 9-year-old in a sequence test said, "You always take the one which is by itself." On the other hand, Stavy and Tirosh (2000) proposed the intuitive rules theory to explain students' misunderstandings concerning science and mathematics. The intuitive rules theory claims that students' responses depend on the external features of the task at hand and not in related concepts and ideas or alternative conceptions. For example, they explain students' response to the free-fall phenomenon using an intuitive rule theory. They show that students respond with "the heavier, the faster" because of the intuitive rule "more A, more B" without thinking about the scientific content of the phenomenon. This discussion shows that there is a dilemma about whether what is revealed really reflects the students' thinking concerning the concepts held or is the result of poor rule application.

Object permanence is the realization that an object may continue to exist even when it is removed from the view. This starts at the age of 2.5 months (Baillargeon 2004). Proper rules explaining the disappearance of any object are prominent in science learning. For example, students apply these rules to infer how water disappears and then reappears (Osborne 1996). Motion and illumination related subjects also require disappearance knowledge. Therefore, early childhood teachers who teach 3 to 6-year-old children are required to include appropriate activity examples that enhance the children's thinking. The first step is to use objects familiar to the children to discuss factors that have a role in the disappearance of an object. Achievement in the first step will help construct or reconstruct schemes related to the phenomenon. The following are four examples where candidates can broaden their schemes in accordance with constructivist theories. These are discovering the reasons behind the formation of the day and night cycle, the moon's sudden disappearance or appearance during daytime while the sun is still visible, the solar eclipse, and the lunar eclipse. Progress in these goals primarily requires appropriate teaching. Accordingly, teachers and teacher candidates should be equipped with the relevant knowledge and skills in order to apply their knowledge concerning object disappearance.

Research Findings in Astronomy

Teaching astronomy concepts is considered important in research (Korur 2015; Korur et al. 2016; Gurbuz 2016; Kruse 2016). Various research studies have revealed that a large number of students have difficulties with learning astronomy (Baysen and Dagli 2014; Bektasli 2016; Sackes et al. 2016). However, from the astronomy misconceptions found in previous research, only those related to this particular study will be highlighted here.

Day/Night

For the transition from day to night, the sun goes behind a hill or mountain (Baxter 1989), behind clouds (Vosniadou and Brewer 1990), to the west, under the sea, or down (below the earth) (Valanides et al. 2000). Geocentrism is when the sun revolves around the earth (Jones et al. 1987). An agent comes between the observer and the sun, and the sun is covered by clouds (Vosniadou and Brewer 1990), the moon (Baxter 1989), or night (Vosniadou and Brewer 1990). The earth rotates around the sun once a day (Baxter 1989), the earth rotates and stops for a while, or the earth rotates and the sun moves up/down (Vosniadou and Brewer 1990). Examples related with artificialistic reasoning are so that people can sleep (Valanides et al. 2000), or the sun goes to the other side of earth to shine there (Vosniadou and Brewer 1990). Examples related with animistic reasoning is that the sun goes to sleep, turns off, goes away (Vosniadou and Brewer 1990), or knows when it is daytime (Piaget 1963). An example related to theological reasoning is that a god made it that way (Vosniadou and Brewer 1990).

Visibility of the Moon in Daytime

Different research findings can be found in literature concerned with the visibility of the moon during the day. While working with elementary students, Taylor et al. (2003) reported that almost all of the students knew that the moon

could be seen during the day. While working with pre-service teachers, Bekiroglu (2007) and Suzuki (2003) reported that students thought that the moon could not be seen during the day. In addition, Taylor et al. (2003) found that only a few students thought that the moon is in the daytime sky as often as it is in the nighttime sky.

Solar Eclipse

Taylor et al. (2003) found that only half of the students in their study could give a scientific explanation (for example, the moon moving between the earth and the sun) for solar eclipses. Solar eclipses occur once every year (Mohapatra 1991). Total solar eclipses occur during the full moon (Kanli 2014; Trumper 2001).

Lunar Eclipse

Taylor et al. (2003) found that only a few students in their study could give a scientific explanation (for example, the earth moving between the sun and the moon) for lunar eclipses. Researchers showed that students often confuse the formation of lunar eclipses with solar eclipses (Kucukozer 2010) and lunar phases (Trundle 2002). For the formation of a lunar eclipse, Kucukozer et al. (2010) report that either the sun moves between the earth and the moon, the moon is covered by the clouds, or another planet moves between the earth and the moon. Another example was found by Trumper (2001), where junior high school students believed that moon phases occur when the moon moves into the shadow of the sun.

Objectives of the Study

This study aimed to find early childhood teacher candidates' rules governing the object disappearance phenomenon by finding how teacher candidates' rules can be found to be theoretical constructions, how they utilize these rules in applications and relate theoretical rules and application rules. In addition, it also aimed to discover how the candidates' rules and their probable misconceptions are interrelated, if at all. This study searched the reasoning behind misconception formation, considering and relating rules found as theoretical constructions and their applications deliberately, together, and in advance.

The present study is a study of human culture encompassing learning of language, knowledge and beliefs. It considered rules affecting the object disappearance phenomenon including the three dimensions that have a role in disappearance, namely, the object that is to be seen, the observer, and the medium where object viewing takes place. In order to be able to interpret early childhood teacher candidates' rule knowledge concerning this issue, this study dealt with both early childhood teacher candidates' theoretical constructions and an evenly distributed variety of applications, which are at the outset conventionally accepted as the rules' applications themselves. Thus, firstly, regardless of being scientific or not, this study sought to determine how early childhood teacher candidates included the three dimensions in their theoretical constructions as rules for disappearance, and secondly, if and how they included these dimensions in selected phenomenon explanations related to the disappearance of an object. The study's main aim was to find if any relation could be drawn between theoretical disappearance rules and selected disappearance rule applications (day/night formation, visibility of the moon during daytime, solar eclipse, and lunar eclipse) and disappearance rules/misconceptions. The following questions, grouped as descriptive and inferential, concerning the features of the object that is to be seen, the observer, and the medium where the observation took place formed the basis of the study,

Descriptive (D) Research Questions

D1. Which dimension and object disappearance rules are found in theoretical question explanations?

D2. Which dimension and object disapp-earance rules are found in selected application explanations, namely, formation of day/night, moon's visibility during the day, formation of solar eclipse and formation of lunar eclipse?

D3. What are the reasoning and the frequencies of the reasoning underlying each application rule?

D4. Which dimensions and rules are applied correctly to form the scientific conceptions and which of those are applied to form misconceptions?

D5. Which misconceptions do the teacher candidates have and which of those are already found in the literature?

Inferential (I) Research Questions

I1. Is there any significant difference between the number of dimensions (1; 2; 3) teacher candidates utilized to explain object disappearance theoretically?

I2. Is there any significant difference in the number of teacher candidates including, i) Object to be seen ii) Observer and iii) Medium, where object viewing takes place, dimensions in their theoretical and application explanations?

I3. Is there any significant difference in the number of the three dimensions (object, observer, medium) teacher candidates included in their explanations of, i) Theoretical question and ii) Application questions.

METHODOLOGY

This study aimed to identify students' disappearance rules to find out their characteristics. As the study required data collection from a sample of people to represent the population (in this case early childhood teacher candidates) in a non-in-depth approach with closed-ended questions and extensive statistical analysis to be carried out, the Quantitative Survey Research design was chosen for the present study. This design has the advantages of economy, with a rapid turnaround in data collection. The data is collected at one point in time (Creswell 2014:157).

Participants

Turkish early childhood teacher candidates (n=200) in their third (n=120) and fourth (n=80) year participated voluntarily in the study. All the candidates filled in the questionnaire properly, and were accepted as participants of the study. Their gender was not considered as a variable discriminating in the present study. The Turkish early childhood teacher curriculum does not include any astronomy-related courses or any pure science subjects but does include science teaching methods in the first semester of the third year.

Questionnaire

Four closed-ended questions were prepared to reveal the teacher candidates' disappearance rules, taking into consideration the object that is to be seen, the observer, the medium where object viewing takes place, and how they incorporate their disappearance rules in the selected phenomena. To improve the validity of the questionnaire, it was initially completed by 30 primary school teacher candidates. Analysis of the written responses showed that most teacher candidates reasoned that the observer in the first question had a health problem that caused the disappearance. Therefore, the final questionnaire was redesigned after this pilot study by adding that "…In the experiment the observer did not have any health problems, including problems with vision…" as the study aimed to reveal that teacher candidates' thinking depends on only the three dimensions mentioned above. The first question, which asks about teacher candidates' thinking, did not include concrete examples because the researchers wanted to identify whether or not teacher candidates hold their rules as theoretical constructions. When teacher candidates gave theoretical explanations, these were accepted as reflecting their theoretical constructions. The remaining three questions were asked in order to reveal how teacher candidates apply their disappearance rules to four different astronomy-related phenomena. Teacher candidates were also asked to draw figures to demonstrate their thinking.

Procedure

The questionnaires were implemented during the spring term, meaning that all the participants had already completed their science teaching methods class. Each teacher candidate responded to the questionnaire alone in their class. Teacher candidates were told that they were free to participate in the study and all were willing to participate. They were given enough blank paper and the duration of one lesson to complete it, although most teacher candidates finished within twenty minutes.

Data Analysis

Descriptive data including frequency and percentages of candidates was summarized in Table 1. This shows the number of candidates and their reasoning for disappearance, for both theoretical and application questions. For the theoretical question, because the candidates were asked and gave more than one type of disappearance reasoning, the summation of the frequencies and percentages do not add up to 200 or 100 percent respectively. Table 1 also sum-

marizes the relationship between the dimension for disappearance and the rule for selected phenomena held by the candidates. In addition, the misconceptions held by the candidates concerning the rules of the phenomena are also shown. Figure 1 depicts figures representing teacher candidates' erroneous thinking and misconceptions. Some of these were depicted by teacher candidates themselves in their responses.

An inferential statistics test, chi-square, was carried out concerning the frequencies of teacher candidates in responding, to yield an association between two variables measured by categories, so that inferences could be drawn from the sample to a population. This test was chosen because the distribution was not normal ($p= 0.005$ or $p= 0.001$) (Creswell 2014: 163-165).

Only a few teacher candidates elaborated on their explanation to the first question (theoretical question). For example, only one teacher candidate stated that something larger than the object to be seen, such as a curtain, comes in between the observer and the object to be seen, thus obscuring vision. Thus, none of the other teacher candidates exemplified while responding to the first question. This finding may be used to deduce that teacher candidates do not see a need to interpret by giving examples but instead give theoretical explanations, which is parallel with the aim of the theoretical question.

For the reliability of the analysis a total of 10 candidates were randomly chosen, five from each group, and the papers were analyzed by the researcher and by a colleague in terms of the three categories. After reaching a consensus on each paper, no further verification was required and the researcher performed the rest of the analysis alone.

FINDINGS

The findings are presented here according to the research questions. Thus, the results will be grouped as Descriptive and Inferential Research Results.

Descriptive Research Findings

D. 1. Teacher candidates utilized three theoretical disappearance rules in their explanations namely, object's displacement, observer's displacement, and environmental illumination (environmental darkening and environmental glittering), utilizing the three dimensions namely object to be seen, observer and medium where object viewing takes place in (Table 1). The most utilized dimension was the medium where object viewing takes place, while the observer dimension was the least utilized dimension. Responses including medium as a dimension for disappearance were more varied. Three kinds of responses appeared and candidates either stated only one (i or ii or iii), two (i+ii, i+iii, ii+iii) or three of them (i+ii+iii) in their responses. The teacher candidates' reasoning for disappearance can generally be categorized as displacement and illumination. Displacement reasoning included either displacement of the object that is to be seen or another object covering it, preventing the object's visibility. Illumination reasoning included either environmental darkness or glittering.

D. 2. Teacher candidates included three disappearance rules in their explanations of the question for the formation of day/night namely, object's displacement, observer's displacement, and environmental darkening, utilizing the three dimensions, namely object, observer and medium where object viewing takes place in (Table 1). The most utilized dimension was observer while less utilized the medium dimension.

Teacher candidates included two disappearance rules in their explanations applied to the question of the moon's visibility during the day, namely, object's displacement and environmental darkening, utilizing the two dimensions, namely object and medium where object viewing takes place in (Table 1). The most utilized dimension was medium, while the least was object dimension.

Teacher candidates included three disappearance rules in their explanations applied to the question for the formation of a solar eclipse, namely, object's displacement, observer's displacement and environmental darkening, utilizing the three dimensions, namely object, observer and medium where object viewing takes place in (Table 1). The most utilized dimension was the medium, while a few utilized object and observer dimensions.

Teacher candidates included two disappearance rules in their explanations of the question of the formation of a lunar eclipse, namely, object's displacement and environmental darkening, utilizing the two dimensions, namely object and medium where object viewing takes place in (Table 1). The most utilized dimension was the medium while object dimension was utilized less.

Table 1: Distribution of dimensions, disappearance rules and related disappearance reasoning [C: Concept; M: Misconception]

Question	*Dimension*		*Disappearance rule*	*f*	*%*
1. Theoretical	Object		Object's displacement	57	29
	Observer		Observer's displacement	33	17
			i) Environmental Darkening: Another object, larger than the one to be seen, is placed between the observer and the object	96	48
			ii) Environment Darkening	9	5
	Medium	Environmental Illumination	iii)Environmental Glittering	3	2
			i+ii	21	11
			i+iii	5	3
			ii+iii	2	1
			i+ii+iii	5	3

	Dimension	*Disappearance rule*	*Disappearance reasoning*		*f*	*%*
2,3,4. Application						
2 Day/night	Object (the sun)	Object' s Displacement	The sun rotates around the earth M		4	2
			The earth rotates around its own axis C		166	83
			Vertical flat earth rotates around its own axis M		6	3
	Observer	Observer's Displacement	The earth rotates around the sun M		8	4
			Clouds cover the earth to form night M		4	2
	Medium	Environmental Darkening	The moon is *not* visible during daytime. Moon's displacement to the other side of the earth M		36	18
3. Moon's Visibility during the Day	Object (the moon)	Object's displacement	-		0	0
	Observer		The moon is visible during daytime. Depends on the environmental illumination intensity C			
	Medium	-			142	71
		Environmental Darkening				
Solar Eclipse		Object	Object's Displacement	Sun's displacement to the in between the earth and the moon and casts shadow on the moon M	3	2
		Observer	Observer's Displacement	People displacement to the other side of the moon, because the earth rotates c	5	3
		Medium		Moon's displacement in between the sun and the earth C	43	72
			Environmental Darkening	Earth's displacement in between the moon and the sun (The earth casts shadow on the sun) M	6	3
				The clouds cover the sun M	3	2
				The moon's displacement to the	22	11
Lunar Eclipse		Object	Object's Displacement	The moon's displacement to the other side of the earth C		
				The Moon' displacement so far away, only little light reaches the earth M	3	2
		Observer	-	-	0	0
		Medium		Earth's displacement so far away, only little light reaches the earthy M	78	39
			Environmental Darkening	Sun's displacement in between the earth and the moon and casts shadow on the moon M	14	7

D. 3. The disappearance reasoning and frequencies of the related reasoning of phenomena are given in Table 1. According to Table 1, for the formation of day/night, "The earth rotates around its own axis", for the moon visibility in the day, "The moon is visible during daytime depending on the environmental illumination intensity", for the formation of solar eclipse,

"Moon's displacement in between the sun and the earth" and finally for the formation of lunar eclipse, "Earth's displacement in between the sun and the moon" are the most utilized forms of reasoning, which are all scientifically correct. "The moon is not visible during daytime. Moon's displacement to the other side of the earth" is the most frequently stated misconception concerning the moon's visibility.

D. 4. Table 1 shows which one of these dimensions and rules were applied correctly to form the scientific conceptions (C) and which of those were applied wrongly to form misconceptions (M). For example, according to Table 1 those who applied the object dimension and object displacement rule did it wrongly to form a misconception that "the sun rotates around the earth" to form the day/night cycle. Most of the teacher candidates applied the observer dimension and observer's displacement rules correctly to conclude that "the earth rotates around its own axis" to form the day/night cycle.

Teacher candidates utilized glittering in their theoretical explanations, and they did not utilize this explanation type in their application situations. Most of the teacher candidates who used the object to be seen dimension in their explanations did it erroneously, leading to misconceptions. Four types of explanations are evident concerning this dimension and all are found to be functional, as they explain the observed event but do it erroneously and are incompatible with scientific evidence. The functionality of the reasoning was found in all other responses. While some concluded with scientific conceptions, others concluded with misconceptions.

D.5. Figure 1, including Figure 1.1 to Figure 1.15, depicts the misconceptions the teacher candidates have and states those already found and not found in the literature. Misconceptions 1.1 to 1.9 were not found elsewhere while Figures 1.10 to 1.15 repeat the literature findings mentioned above. Although flat earth thinking was found in numerous studies (for example, Vosniadou and Brewer 1990), none of them described a two-sided (front and back) vertical flat earth model (Figure 1.1) as was found in the present study. This model states that the earth is two-sided and people live only on one side (front) but not on the other (back). For example, one of the teacher candidates said that "the earth rotates on its own axis and turns its face to the sun for the creation of day, so people experience daytime, and then turns its back for the creation of night, so people experience nighttime." Vertical flat sun thinking (Fig. 1.2), where the sun's face emits rays but the other side does not, was also evident. "When we face the sun's face it is day and when we face its back it is night." Thinking that the earth casts a shadow on the sun (Fig. 1.3) is consistent with vertical earth thinking. The moon is always there (Fig. 1.4) but can only be seen from time to time when environmental illumination is lower. Note that for conceptual change there is a need to change all related schemata. It seems that some teacher candidates in this study learned that the moon can be seen during daytime but they did not go further to find related reasoning and applied (new) erroneous thinking. Another finding that impedes conceptions shows the effect of the language used. In the Turkish language, the concept "*tutmak*" is an equivocal word used to mean, "to hold something" and also "eclipse."

The earth and the moon "hold" the sun between them for the formation of a solar eclipse (Fig. 1.5) and the earth and the sun "hold" the moon for the formation of a lunar eclipse (Fig. 1.6). Kucukozer et al. (2010) reported the same language problem for lunar eclipse but did not include the sun and the earth as the holders. Other explanations are that the sun moves to the other side of the moon (Fig. 1.7) or that cloud cover the earth for the formation of night (Fig. 1.8). The moon moves so far away that little light reaches the earth, thus forming a lunar eclipse (Fig. 1.9).

Thus, the study shows that a wider range of misconception possibilities is to be found. These notions, which are given to explain teacher candidates' thinking and are well grounded by extensive research findings concerning cosmic bodies, the sun, the earth, and the moon, are not yet completed.

Some other findings consistent with previous literature are that the sun casts a shadow on the moon (Fig. 1.10), consistent with vertical flat sun thinking, that the sun moves between the earth and the moon (Fig. 1.11), that the earth rotates around the sun for the formation of day/night (Fig. 1.12), that the moon is not visible during the day (Fig. 1.13), that clouds cover the sun for the formation of the day/night cycle (Fig. 1.14), and that the sun rotates around the earth (Fig. 1.15).

Inferential Research Findings

I1. One hundred teacher candidates included only one dimension, 49 included two dimensions, and 40 teacher candidates did not men-

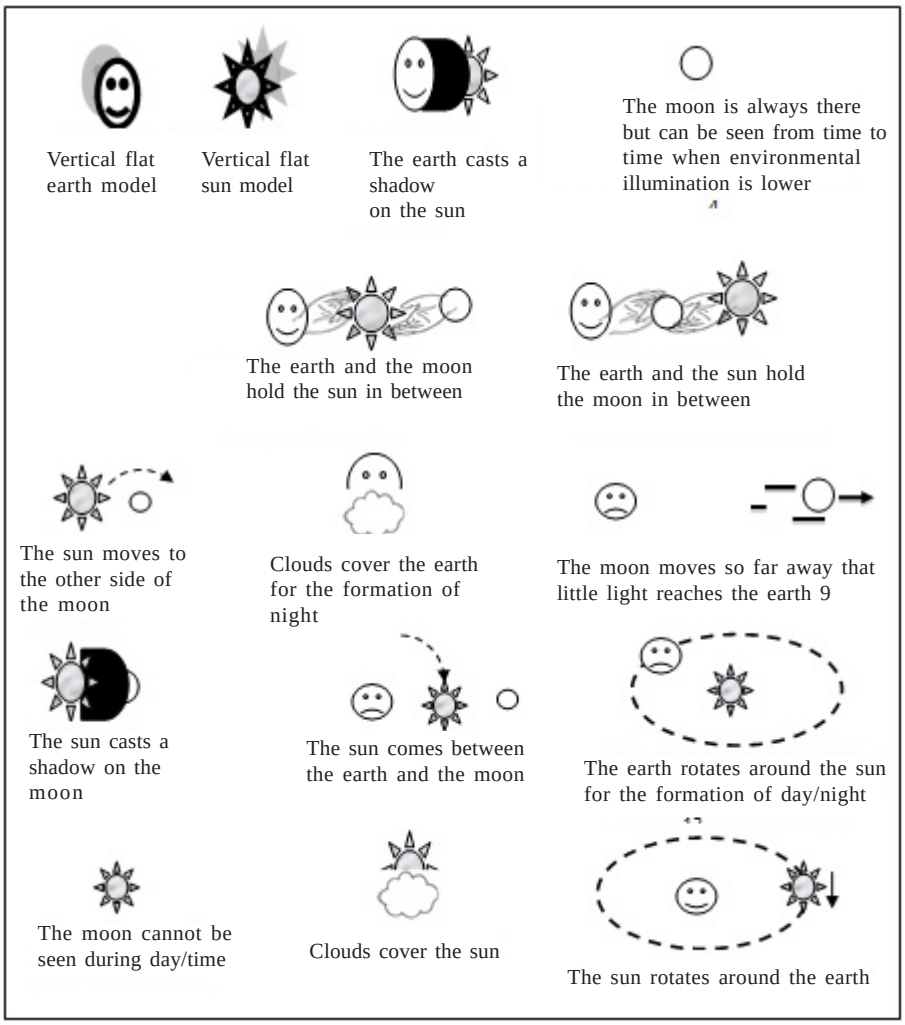

Fig. 1. Figures representing teacher candidates' erroneous thinking. Misconceptions
Source: Author

tion any of the dimensions. Only 11 of the teacher candidates included three dimensions in their theoretical explanations. The chi-square analysis result showed that the differences in the number of dimensions the teacher candidates included were significant ($\chi^{\wedge 2}(3) = 82.4$, $p<0.001$) and the most teacher candidates tended to explain disappearance phenomena with only one dimension ($f=100$), $\chi^{\wedge 2}(1) = 10.0$, $p<0.005$). In other words, teacher candidates tended to explain disappearance phenomena with fewer dimensions.

I2i. Significantly fewer teacher candidates included the object to be seen dimension in both their theory ($\chi^{\wedge 2}(1) = 38.7$, $p<0.001$) and application explanations ($\chi^{\wedge 2}=37.0$, $p<0.001$).

I2ii. Significantly more teacher candidates did not include the observer dimension in their theory explanations ($\chi^{\wedge 2}(1) = 90.0$, $p<0.001$). However, they did include the observer dimension in their application explanations ($\chi^{\wedge 2}(1) = 112.5$, $p<0.001$).

I2iii. Significantly more teacher candidates did include medium in both, their theory ($\chi^{\wedge 2}(1) = 33.6$, $p<0.001$) and application explanations ($\chi^{\wedge 2} = 118.6$, $p<0.001$).

These findings show that fewer teacher candidates consistently included the object to be seen as a dimension in their theoretical and application explanations. There is an inconsistency in the number of teacher candidates who included observer as a dimension for disappearance in favor of application explanations. Most teacher candidates consistently included medium as a dimension in their theoretical explanations and also applied it.

I3i. Significantly more teacher candidates included the medium dimension in their theoretical explanations than the object ($\div^2$ =15.8, $p<0.001$) and observer dimension.

I3ii. More teacher candidates included the observer dimension in their application explanations than the object dimension while more teacher candidates included the medium dimension in their application explanations than the object dimension. It was found that almost the same number of teacher candidates included medium and observer dimensions in their application explanations.

These findings show that teacher candidates utilize the medium dimension more than the other two dimensions in their theoretical explanations, which means that they tend to explain the disappearance of an object using the medium dimension. Teacher candidates were found to utilize the observer and medium dimensions on an equal basis and more than the object dimension in explaining the disappearance of an object.

DISCUSSION

Researchers try to implement new ways to enhance astronomy conceptions and they put importance on astronomy misconceptions as well. Researchers (For example, Fouche 2015) try to understand reasoning leading to misconceptions as the present study. One of them considering astronomy phenomena superficially, found in the present study is consistent with for example what Stavy and Tirosh (2000) have previously stated. Stavy and Tirosh (2000) also stated that teacher candidates utilize intuitive rules when explaining a phenomenon. However, this time, as explained above, learners utilize scientific rules to interpret phenomenon.

It is remarkable to note here that this assertion is valid in the context of the present study, which will be broadened by further research and does not mean that Stavy and Tirosh are incorrect in their assertion. Similarly, although extensive research has been carried out concerning astronomy knowledge with the aim of finding commonalities among learners' thinking, the present study demonstrated that the ideas presented in previous literature are still incomplete (Gurbuz 2016). It is important to teach learners to consider every probable rule found as a dimension or reason affecting an event. However, this study demonstrates that learners still need support in matching the proper rule with the related event in order to interpret that event correctly. In other words, explicit approach, rather than implicit, enhances rule learning and makes it volatile to transfer to other contexts (Robinson 1997; Sætrevik 2006; Tas and Coskun 2014). Thus, there is a need to support learners by filling the gap between their theoretical knowledge and its application. To accomplish this aim it is necessary to not only go beyond repeating verbal sequences to learners to be memorized, but also show them contradictory situations utilizing well-designed interventions. For example, designing an experiment showing that environmental illumination intensity may impede their vision would be enough to persuade learners to believe in the moon's appearance during daytime.

CONCLUSION

Teacher candidates know the three scientific disappearance rules. Their responses were functional and tended to explain the disappearance phenomenon with fewer dimensions. The medium dimension is most commonly used, guiding teacher candidates' disappearance reasoning. There is an inconsistency between teacher candidates' theory and application concerning the object to be seen and observer dimensions, while the medium dimension was found to be consistently included. Teacher candidates considered the four events independent of humans, but attributed it to great forces, such as god. On the other hand, teacher candidates are able to utilize an idea to explain an issue but this does not necessarily guarantee its existence as a theoretical mental construction, and vice versa. Teacher candidates may regard the phenomena superficially.

The present research study asserted, "Learners utilize scientific rules to interpret phenomenon but do so erroneously, incorrectly matching the (theoretical) rule with the wrong phenomenon (application) because they lack the appropriate scientific knowledge concerning such phenomenon, thus creating misconeptions."

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