# Examining fifth-grade students' level of associating some daily-life events with "changes of state"

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## Abstract

This study aims to examine fifth grade students' level of associating daily life events with the subject "changes of state" in the science curriculum. Among the qualitative research methods, special case method was used in the study. Seven open-ended questions about the changing states of matter were used for data collection. These open-ended questions were prepared based on daily life events. They were administered to 107 fifth grade students studying at a secondary school in Erzurum city center in the 2014-2015 academic year. Descriptive analysis was used for data analysis. The results of the analysis revealed that most of the fifth

grade students were unable to associate changes of state with daily life events. The study also concluded that it would be better to teach the science subjects related to changing states of matter by means of associating them with daily life.

**Key Words:** Change of state, daily life, fifth grade secondary students, science course.

# Introduction

Preparing individuals for life and helping them to make sense of daily-life events are among the principal objectives of education. Science and science-related subjects are extremely important in achieving these objectives. Science courses aim to help students to gain the necessary skills to provide logical and creative solutions to the problems they may encounter in daily life as well as providing theoretical knowledge they can use in the course (Pınarbaşı, Doymuş, Canpolat & Bayrakçeken, 1998). The purposes of the science curriculum developed by the Turkish Ministry of National Education in 2013 included "ensuring that students take responsibility for daily-life problems and use their science-related knowledge, science process skills and other life skills in solving these problems".

One of the main objectives of science teaching is to help students to use information that they have learned in their everyday life (İlkörücü-Göçmençelebi & Özkan, 2009). While teaching the subjects, it is more effective if examples from daily life are provided and scenarios are built (Evcim, 2010). Meaningful learning by means of associating knowledge with daily-life events helps knowledge to be stored in the long-term memory (Ay, 2008). In other words, students with the ability to explain daily-life events can be said to achieve meaningful learning (Coşkun, 2010). In addition, students who are able to use their knowledge in their everyday lives are considered to be more highly motivated towards their courses (McCombs, 1996), and their learning is more effective (Fortus, Krajcik, Charles, Marx & Mamlok-Naaman, 2005). To this end, science teachers have recently begun to demonstrate the connection between concepts and everyday life to their students (Haynicz, Flecher & Rebello, 2006).

### Studies About Daily-Life Events

The level of association of students' knowledge with daily-life events is an indicator of to what extent the education provided departs from rote learning. The

knowledge given to students throughout their education becomes permanent to the extent that it can be associated with daily-life events, and this knowledge can be used more easily for interpreting new situations (Özmen, 2003). Although the international literature includes a limited number of studies conducted on students' level of associating science concepts with daily life (İlkörücü-Göçmençelebi, 2007), there have been many studies conducted on this topic in Turkey (Bozkurt, 2008; Coştu, Ünal & Ayas, 2007; Enginar, Saka & Sesli, 2002; Hürcan & Önder, 2012; İlkörücü-Göçmençelebi, 2007; Özmen, 2003; Pekdağ et al., 2013; Taşdemir & Demirbaş, 2010; Yadigaroğlu & Demircioğlu, 2012). Enginar, Saka and Sesli (2002) reported that second-grade high-school students failed to sufficiently associate the concepts of biology with daily life. The study by Özmen (2003) also revealed that university students failed to use acid-base concepts to explain daily-life events to the desired extent. Coştu, Ünal and Ayas (2007) also reported that instruction enriched with teacher-guided group discussions on daily-life problems enhanced students' ability to interpret daily-life events. Similarly, in the study by İlkörücü-Göçmençelebi (2007), sixth-grade elementary students' level of associating the biological knowledge provided to them in the science course with daily life was not found to be very high. Another study conducted by Bozkurt (2008) examined high-school students' level of associating physics concepts with daily life, and revealed that they were able to associate the concepts of optics only at a medium level. The study by Hürcan and Önder (2012) examined the seventh-grade elementary students' level of associating the science concepts they learned in the science and technology course with daily-life events and discovered that they failed to associate them at the desired level. The study conducted by Yadigaroğlu and Demircioğlu (2012) to examine pre-service chemistry teachers' level of associating their chemistry knowledge with daily life found that they had difficulty in doing so. Pekdağ et al. (2013) also tried to examine university students' level of associating their chemistry knowledge with daily life and to determine whether academic success had an impact on the level of association. They found that the students failed to sufficiently associate their chemistry knowledge with everyday situations.

The studies mentioned above all examined to what extent students at different educational stages associate their knowledge with daily life. In contrast, Yılmaz's (2008) study reported that among the topics of chemistry, changing states of matter was the one that sixth-grade students most frequently failed to associate with daily life. Therefore, we can say that students are not able to associate "changes of state" with daily life to the desired extent.

In Turkey, compulsory education was extended from eight years to 12 years with the adoption of the "4+4+4 model" in the 2012-2013 academic year, where primary education was rearranged and divided into two parts, i.e., elementary education and secondary education. Elementary education covers grades one to four, while secondary education covers grades five to eight.

With this new arrangement, science courses began to be taught from the third grade (Ministry of National Education [MoNE], 2013). Therefore, students first meet science and science-related concepts in the third grade. "States of matter" is among the subjects covered by the third-grade science curriculum, together with other subjects such as "sense organs", "forces", "light and sound", "living creatures", "electricity in our life" and "our world". In the third grade, students are asked to classify materials as solids, liquids or gases. In the fourth grade, they are expected to explain the phenomena of melting and freezing by means of the effects of heat. In the fifth grade, the aim is that students should be able to explain melting, freezing, boiling, condensation, evaporation, sublimation and deposition based on their knowledge of heat exchange (MoNE, 2013). As mentioned above, the topic "changes of state" is incorporated into science curricula from the elementary level to the university level.

Therefore, various studies have been conducted at different levels of education to examine the extent to which changes of state concepts are associated with daily-life events. Beşoluk and Önder (2010) examined high-school students' level of using basic concepts related to changes of state in scientifically explaining some of the events they encounter in everyday life. They found that students did not learn these concepts in accordance with the scientific facts and failed to sufficiently associate them with daily-life events. Ayas and Çoştu (2001) investigated the first-grade high-school students' level of understanding of the concepts of evaporation, condensation and boiling, and found that students limited the condensation and boiling phenomena to the case of water, and thought that these changes of state could not occur in other liquids such as alcohols and that temperature would rise during the process of boiling. The study by Boz (2004) also examined the sixth-, eighth- and 11th-grade students' level of understanding of condensation. At the end of the study, it was found that most of the sixth- and eighth-grade students did not understand how vapour coming from boiling water condensed on a plate. Buluş-Kırıkkaya and Güllü (2008) also conducted a study to identify the misconceptions of fifth-grade elementary students about heat vs temperature and

evaporation vs boiling. They reported that students had many misconceptions about the differences between heat and temperature, and boiling and evaporation.

It is in the nature of learning that misunderstanding basic concepts may cause students to fail in properly learning other higher-level concepts and to face a dilemma while relating new knowledge to their existing knowledge (Canpolat & Pınarbaşı, 2012). Therefore, correct learning of basic concepts is a must if students' future learning is to be successful. One of the ways to ensure this is to associate scientific knowledge learned at school with daily-life events (Ayas & Özmen, 1998). The level of associating knowledge learned at school with daily-life events is important in facilitating the lives of individuals and showing whether or not the knowledge has been absorbed (Pınarbaşı et al., 1998). Based on the findings of these studies, we can say that students are not able to associate the concepts taught in the science course with daily life, at least not at the desired level (Hürcan & Önder, 2012; Lay et al., 2013; Pekdağ et al., 2013). However, relating what they have learned to daily life enhances children's interest in, and attitude towards, science (Black, 2009; Roediger, 2000). In order to achieve meaningful learning, students must associate the concepts they have learned with the daily-life events that impress them (Ayas & Özmen, 1998). Associating science courses with events in everyday life can help teachers encourage successful learning in their students (Mayoh & Knutton, 1997).

## Aim of the Study

Teaching basic science concepts correctly and accurately during elementary and secondary education is important for helping students understand the more detailed and complicated subjects they will encounter in the later stages of education. Proper construction of basic science concepts in the mind will also help students solve the problems they face and associate their knowledge with their everyday life (Beşoluk & Önder, 2010). Since the topic "changes of state" involves learning information which can be used for interpreting many daily-life events (Coştu, Ünal & Ayas, 2007) and since there are only a limited number of studies in the literature conducted with fifth-grade secondary students, this study aims to examine fifth-grade students' level of associating the changes of state topic with some daily-life events.

# Method

Qualitative research methods allow the production of a wealth of detailed information about a relatively small number of people and cases, thus facilitating in-depth understanding of the cases or situations studied (Patton, 2002). The case study method is adopted for this descriptive research. This method is suitable for individually-conducted studies as it allows for an in-depth study of an aspect of a problem within a short period of time (Çepni, 2009). The case study method is defined by Yin (2003) as an empirical inquiry which investigates a contemporary phenomenon within its real-life context. In this study, we chose to use a descriptive model as it aims to define the person, event or phenomenon studied as it is, without any intervention (Lincoln & Guba, 1985). The study's sample consisted of 107 fifth-grade students studying at a secondary school in Erzurum city centre in the 2014-2015 academic year. The students were chosen using convenience sampling.

### *Data Collection Tool*

In this study, which examined the fifth-grade students' level of associating some daily-life events with changes of state, seven open-ended questions based on the curriculum were used. Data collection tools consisting of open-ended questions are commonly used, especially to determine levels of understanding of concepts and prevailing misconceptions (Ayas & Özmen, 2002). The questions were submitted for comments to two science experts and two science teachers who were all specialists in their fields. After examining the questions, they expressed the opinion that the questions were sufficient to measure the intended outcomes. In this type of study, one of the measures often taken to increase research quality is an expert review, i.e., peer debriefing (Yıldırım, 2010). Five of the questions were taken from the science coursebook prepared by the MoNE for fifth graders, while the other two were prepared by the researcher. (The Ministry of National Education foresees the use of different coursebooks in different regions. The questions were taken from the coursebook used in the school in which this study was conducted.) The first question requires the students to choose situations related to evaporation and write down their reasons. The second question investigates whether they understand heat exchange during the process of evaporation. The third question is about the melting phenomenon, while the fourth question is about dew formation and evaporation and asks about the relationship of given situations to these events. The fifth question is about sublimation and asks the students to explain this event. (Solid naphthalene is

placed inside unused beds and quilts when the seasons change in the city where the study has been carried out. This question has been used so that the pupils are familiar with the situation from their parents' actions.) The sixth question is about deposition and asks the students to give examples from daily life and explain this event. Finally, the seventh question is about the relationship between freezing and heat exchange. The questions in the data collection tool are presented in Table 1.

**Table 1.** The questions in the data collection tool

| Question number | Change of state to which the question is related |
|---|---|
| 1 | Evaporation |
| 2 | Evaporation |
| 3 | Melting |
| 4 | Evaporation- Condensation |
| 5 | Sublimation |
| 6 | Deposition |
| 7 | Freezing |

### *Data Analysis*

The responses of students to the open-ended questions were carefully analysed. Descriptive analysis was used. In descriptive analysis, the data are summarized and interpreted based on pre-determined themes (Yıldırım & Şimşek, 2006). In the analysis of the responses to the open-ended questions used in this study, existing categories from the literature were used. In this sense, the student's responses were analysed based on four categories, i.e., Full Understanding, Partial Understanding, Misunderstanding and Unanswered, as employed by Özmen, Ayas and Coştu (2002) and Özmen (2003). These four categories are explained by Özmen (2003) as follows:

**Full Understanding**: Responses that include some or all of the scientific ideas regarding the question are placed into this category.

**Partial Understanding**: Responses that are acceptable, but not totally valid, are placed into this category.

**Misunderstanding**: Responses that include irrelevant, irrational or wrong information are placed into this category.

**Unanswered**: Responses that are left blank or have little relevance to the question and lack scientific value, are placed into this category.

A total of 15 sheets including the students' responses were analysed by the researcher and two different science instructors (10 sheets for each) based on these categories. The findings of the analyses were compared with each other and a significant correlation was found between the findings from each of the assessors. In nine of the 10 answer sheets evaluated by the assessors, student answers were placed into the same categories. Accordingly, it can be said that there is very good correlation between the assessors' findings. The remaining answer sheets were analysed by the researcher.

# Findings

This section presents the ratios of the students' responses to the open-ended questions based on the categories mentioned above. First the questions will be presented and then the ratios of the responses. The first open-ended question was as follows:

*While fishing, Yiğit lost his balance and fell into the river. Some friends of Yiğit made the following recommendations to him for drying his wet clothes:*
*Ali: It is sufficient to dry them in the sun, because water evaporates at any temperature.*
*Yunus: Water boils at 100°C and only evaporates at this tempereature. Therefore, you need to heat your clothes at 100°C, if you want to dry them.*
*Beyza: You should take off your clothes immediately, or you will get cold.*
*Tuba: Your clothes do not dry when you are wearing them. You should hang them out to dry on the balcony.*

Among the responses to the first question, the response "He should follow Ali and Beyza's recommendations" was considered to be in the full understanding category, because evaporation occurs at any temperature. Furthermore, Yiğit should also take off his clothes immediately since the wet clothes will cause him to get cold. The responses stating that he should only follow Ali's recommendation were placed into the partial understanding category, while the other responses indicatedmisunderstanding. One of the responses in the full understanding category

was as follows: "…He should do what Ali and Beyza says. Ali's idea is right, because water evaporates at any temperature. Beyza's recommendation is also true, because clothes need heat to dry and they get that heat from the body...". One of the responses in the partial understanding category was as follows: "…Since water evaporates at any temperature, Ali is right. Beyza is also right, because if Yiğit does not take off his wet clothes, moisture passes to his body…". One of the responses in the misunderstanding category was as follows: "…He should take off his clothes and hang them out on the balcony, because they dry when they are hung...". Table 2 shows the distribution of the responses.

**Table 2.** Ratios of the responses to the first question

| Full Understanding | Partial Understanding | Misunderstanding | Unanswered |
|---|---|---|---|
| 33% | 49% | 16% | 2% |

The second question was as follows:

*Yunus Emre was playing basketball. His mother saw that his uniform was wet with sweat. She told him to change his uniform and towel himself so that he does not get cold. Please explain the reason why Yunus Emre will get cold if he does not take off his wet uniform.*

The students were expected to explain the reason as follows: "While the wet uniform is drying, it draws heat from Yunus Emre's body, causing him to get cold". Responses similar to this were placed in the full understanding category. On the other hand, those such as: "Water will get dry on his body", were included in the partial understanding category, while other responses indicated misunderstanding. One of the responses in the full understanding category was as follows: *"...Since sweat is made up of water, the body's heat exchanges with sweat, causing Yunus Emre to get cold…"*. One of the responses in the partial understanding category was as follows: *"...because water will dry on his body…"*. One of the responses in the misunderstanding category was as follows: *"...After a while, his dampened uniform will get cold due to the effect of wind, causing him to get cold…"*. The distribution of the responses to the second question is as follows:

**Table 3.** Ratios of the responses to the second question

| Full Understanding | Partial Understanding | Misunderstanding | Unanswered |
|---|---|---|---|
| 14% | 8% | 76% | 2% |

The third question was as follows:

*On a spring day, Fatma heard while watching the news on the TV that the stream in their village located on the slopes of a high mountain where she and her father went fishing in the summer overflowed, leaving the croplands around the village underwater. She was curious about the reason why the stream overflowed. Then she remembered that the mountain had been covered with snow during the winter. How do you think Fatma explained the overflow? Please explain in detail.*

Responses indicating full understanding would be something like: "Snow melts and changes from a solid to a liquid state. It might be the reason for the overflow." Responses such as: "Snow fills the stream with water" were included in the partial understanding category, while the other responses indicated misunderstanding. One of the responses in the full understanding category was as follows: *"…When the sun rises, snow melts and those places are submerged…"*. One of the responses in the partial understanding category was as follows: *"…snow fills the stream with water…"*. One of the responses in the misunderstanding category was as follows: *"…since there are heavy rains in the spring, streams overflow…"*. Table 4 shows the distribution of the responses to the third question.

**Table 4.** Ratios of the responses to the third question

| Full Understanding | Partial Understanding | Misunderstanding | Unanswered |
|---|---|---|---|
| 57% | 8% | 25% | 10% |

The fourth question was as follows:

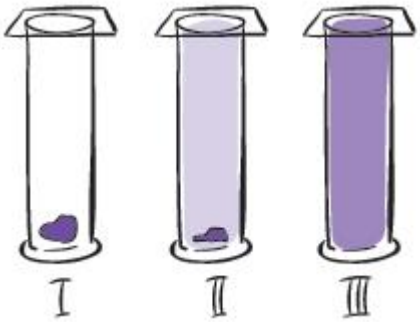
*Mahmut went to his garden in the early hours of the morning and saw that there were water droplets on the tomatoes, although it was not raining. When he came by the garden again in the afternoon, he did not see any water droplets. What do you think the reason for these two situations is? Please explain in detail.*

The students were expected to express the idea that there were drops of dew on the tomatoes during the early hours of the morning and then the layer of dew evaporated. Such responses were included in the full understanding category. The responses that contained information only about the formation of dew or about evaporation were placed in the partial understanding category. One of the responses in the full understanding category was as follows: *"…There were drops of dew on the tomatoes due to the weather, then they evaporated when it got warmer…"*. One of the responses in the partial understanding category was as follows: *"…The reason is that the rain drops on the tomatoes evaporated after a while. Therefore, the drops on the tomatoes disappeared…"*. One of the responses in the misunderstanding category was as follows: *"…It is because of the process of sublimation. Sublimation is the transition of a substance from the gas to the gas phase due to the loss of heat…"*. Table 5 shows the ratios of the responses to the fourth question.

**Table 5.** Ratios of the responses to the fourth question

| Full Understanding | Partial Understanding | Misunderstanding | Unanswered |
|---|---|---|---|
| 18% | 38% | 39% | 5% |

The fifth question was as follows:




*There is solid iodine in the first tube with the lid on. The state of iodine changed as shown in the second picture after 10 min and in the third picture after 30 minutes without any moisture. Which phase change occurred during this period? Please explain your reasons in detail.*

The students were expected to state the reason as "sublimation". Such responses were included in the full understanding category. Some of the students said that sublimation occurred only when the substance changed from state I into state II. Such responses were included in the partial understanding category, while the other responses were placed in the misunderstanding category. One of the responses in the full understanding category was as follows: *"…There was no air inside the tube and*

*iodine started to evaporate slowly after 10 min. After 30 min, iodine evaporated completely…"*. One of the responses in the partial understanding category was as follows: *"…The reason is evaporation, because heat decreases as time passes…"*. One of the responses in the misunderstanding category was as follows: *"…These changes, iodine absorbed heat and first melted after 10 min, and then completely turned into a water state after 30 min…"*. Table 6 shows the ratios of the responses to the fifth question.

**Table 6.** Ratios of the responses to the fifth question

| Full Understanding | Partial Understanding | Misunderstanding | Unanswered |
|---|---|---|---|
| 22% | 9% | 66% | 3% |

The sixth question was as follows:

*Ahmet ran into the situation shown in the following images. He saw that the leaves and the windshield of his car were as shown, when he went out to work in the morning. How do you think Ahmet explains this situation? Please explain your reasons in detail.*

The students were expected to express the fact that it was due to deposition which occurs when a gas becomes a solid without going through the liquid state of matter. Such responses were included in the full understanding category. The responses of the students who were not able to explain how deposition occurs were included in the partial understanding category, while the responses including irrelevant information were placed in the misunderstanding category. One of the responses in the full understanding category was as follows: *"…Deposition is the process where water vapour from air deposits directly into a solid…"*.One of the responses in the partial understanding category was as follows: *"…The weather got cold and lost heat. Therefore, it got cold and then the water particles froze, leading to the formation of*

*small particles…"*. One of the responses in the misunderstanding category was as follows: *"…The leaf froze due to the air pressure. The windshield of the car froze as the vapour in the air condensed…"*. Table 7 shows the ratios of the responses to the sixth question.

**Table 7.** Ratios of the responses to the sixth question

| Full Understanding | Partial Understanding | Misunderstanding | Unanswered |
|---|---|---|---|
| 23% | 29% | 43% | 5% |

The seventh question was as follows:

*In the winter, a large bowl of water is put at the exact centre of fruit and vegetable warehouses. What could be the reason for this? Please explain your reasons in detail.*

The students were expected to say that heat is released when water freezes into ice, thus the fruits and vegetables are kept from freezing. Such responses were included in the full understanding category. The responses which only stated the necessity of putting a bowl of water in order to prevent fruits from freezing were included in the partial understanding category, while other responses were placed in the misunderstanding category. One of the responses in the full understanding category was as follows: *"…When water freezes, it releases heat to the fruits, thus fruits do not freeze…"*.One of the responses in the partial understanding category was as follows: *"…It is done to prevent fruits from freezing…"*.One of the responses in the misunderstanding category was as follows: *"…It is done to prevent foods from spoilage…"*. Table 8 shows the ratios of the responses to the seventh question.

**Table 8.** Ratios of the responses to the seventh question

| Full Understanding | Partial Understanding | Misunderstanding | Unanswered |
|---|---|---|---|
| 24% | 9% | 63% | 4% |

# Discussion and Conclusion

This study was conducted to examine the fifth-grade students' level of associating some daily-life events with changes of state. At the end of the study, it was found that students were not able to sufficiently associate the given situations with daily-life events. In this sense, the findings of this study were in agreement with those of the studies conducted by Ayas and Özmen (1998) and Pınarbaşı et al. (1998). The first and second questions used in this study were about the phenomenon of evaporation, and the percentages of the responses to these questions included in the full understanding category were 33% and 14% respectively. Therefore, we can say that the students were not able to sufficiently associate evaporation with daily life. Bakırcı et al. (2010) also found that sixth-, seventh- and eighth-grade students were not able to sufficiently explain the given situation about evaporation. Şimşek (2007) also reported a similar finding. The findings of this study can be said to be in agreement with those of the two studies mentioned above. Although the first and second questions were about the process of evaporation, the difference in the ratio of responses to these questions included in the full understanding category might be due to the requirement of choosing one or more of the answers in the first question. Although a student who has a full understanding of the concept of evaporation is expected to give correct answers to both questions, the ratios were found to be different for the first and second questions. Therefore, teachers should use many examples from daily life, especially from their immediate environment, when teaching these basic concepts.

The third question was about the phenomenon of melting and it was intended to measure the students' level of associating the concept of melting with daily life. The findings revealed that 57% of the students were able to associate the concept with daily-life events at the full understanding level. The winter season is long and cold in the study location. Therefore, the students are accustomed to seeing frozen conditions over a period of a few days, and subsequently seeing the melting of the ice. This situation causes the examples given about the state changes related to melting and freezing to be better understood. The comparatively high percentage in the full understanding category might be due to the fact that students frequently encounter the melting phenomenon during their daily life. Frequent encounters with the melting of ice or snow might be the reason for such a high ratio of understanding. Another reason might be the examples of changes of state given in the courses, which were mostly about melting and freezing.

The fourth question involves explaining the phenomena of evaporation and condensation together. The ratio of the responses included in the full understanding category was found to be 18%. This is the second lowest ratio after the ratio of the responses to the second question which is about evaporation. Since evaporation and condensation are related concepts, the ratios of correct responses are close to each other. In the study by Bakırcı et al. (2010), sixth-, seventh- and eighth-grade students were asked to explain a given situation about the concept of condensation. Their findings showed that the students failed to sufficiently explain the situation. On the other hand, in the study by Boz (2004), sixth-, seventh- and 11th-grade students were asked to explain a given situation about the concept of condensation, and only the 11th-grade students (most of them) were able to sufficiently explain the situation. In the study by Hatzinikita and Koulaidis (1997), students aged 10 to 17 years were asked to explain the condensation phenomenon that occurs in a bottle just taken out the freezer. Their findings revealed that the ratio of students with the ability to explain was lower for the 12-year-old students, and higher for the 17-year-old students. The present study was also conducted with students about 12 years old, and our findings were in agreement with those of the other studies in the literature. The studies in the literature show that students may not exhibit the desired level of success in explaining the condensation phenomenon over almost all grades. This is one of the phenomena that students have most difficulty in understanding (Gopal, Kleinsmidt, Case & Musonge, 2004). The reason might be that students need to know that there is always water vapour in the air as well as knowing how condensation occurs (Boz, 2005). At this point, the focus is placed on the importance of associating these concepts with daily life (Campbell & Lubben, 2000; Coştu, Ünal & Ayas, 2007; Pınarbaşı et al., 1998; Yılmaz, 2008). Therefore, teachers should use examples from daily life as much as possible when teaching these concepts. The more science teaching is associated with daily life, the more meaningful the knowledge provided to the individuals will be (Yılmaz, 2012). In addition, it allows students to offer correct explanations for similar situations. In other words, providing only the definition of a concept is not sufficient to ensure its understanding.

The fifth question used in this study was about the concept of sublimation. The ratio of responses included in the full understanding category was found to be 22%. This ratio is somewhat higher than the ratios obtained from the questions about evaporation and condensation, but still is not sufficiently high. Although it was stated that there was no moisture in the tube, there were some responses related to melting, which indicates that the students did not properly understand the melting phenomenon. However, the ratio of correct responses to the third question is higher,

which is probably the result of students' familiarity with the melting of snow in their everyday life. Therefore, examples other than those which are only about the melting of ice or freezing of water must be provided when teaching the phenomena of melting and freezing. It was unexpected to see that the ratio of responses to the question about sublimation included in the full understanding category was higher than that for the responses to the questions about evaporation and condensation, since sublimation is not a common phenomenon in daily life. Students encounter the phenomena of evaporation and condensation almost every day in the winter when they are in vehicles, in the classroom or at home. Such frequently-encountered phenomena are expected to be more closely associated with daily life. The results might indicate the lack of teaching of these concepts in an in-depth way in the classroom environment, as well as the lack of proper explanations provided by the people around the students.

The sixth question was about the concept of deposition. The ratio of responses included in the full understanding category was 23%, which is almost the same as the ratio of the responses to the fifth question. Since sublimation and deposition are opposite concepts, it is not surprising if a student who did not understand one concept, also failed to understand the other. The low ratio might have resulted from the fact that deposition is not a common phenomenon that can be observed everywhere. Another reason might be that the students do not investigate the reasons for the phenomena they encounter in daily life.

The last question was about the concept of freezing, and the ratio of responses included in the full understanding category was 24%. Although freezing is the most frequently encountered daily-life phenomenon, the ratio is found to be low, which might indicate that the concept was taught only by giving its definition. Yılmaz (2008) reported that the freezing of water was the chemistry topic that seventh-grade students had most difficulty in associating with daily life. Thus, the reason for the failure of both fifth- and seventh-grade students to sufficiently associate the concept with daily life might be that they do not dwell on the concept too much, as it is already familiar. The study by Kırbulut and Betth (2013) examined high-school students' understanding of melting, freezing, condensation and evaporation and found that the students showed inconsistencies when associating theoretical principles related to these concepts with everyday phenomena. Therefore, the concepts must be taught from the beginning in all grades and examples must be provided in detail.

In conclusion, given the importance of associating existing knowledge with daily life, we can say that students are required to achieve maximum success at associating what they have learned in the courses with daily life (Coştu, Ünal & Ayas, 2007). Yılmaz (2008) reported that changing states of matter was the chemistry topic that sixth-, seventh- and eighth-grade students most frequently failed to associate with daily life. The findings of this study also reveal the importance of teaching this fundamental science concept, which is first taught in the third grade, by associating it more with daily-life events. On the other hand, the concept of heat must also be given due weight while teaching the changing states of matter. These are the only ways to ensure permanent learning of the concepts.

### Suggestions

Based on the findings of this study, the following suggestions can be offered:

1. Since changing states of matter is a fundamental science topic, it must be taught by giving examples from daily life, starting from the elementary school.
2. Students must be provided with the opportunity to carry out homework and projects that will allow them to explain daily-life events using their existing knowledge.
3. Context-based and case-based learning approaches should be applied when teaching concepts related to changes of state.
4. Course planning must be performed in such a way as to give emphasis to daily-life events.
5. Student-centred approaches must be adopted to reveal the responses that are not considered to be scientifically valid. The students themselves must learn why their responses are not valid.

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