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Full Length Research Paper

Metaphors of primary school students relating to the concept of global warming

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The purpose of this study IS to reveal the metaphors of primary school students (n=362) relating to the concept of global warming. Data collected by completing the expression of "global warming is like…, because…" of the students were analysed by use of qualitative and quantitative data analysis techniques. According to findings of the study, students generated total 148 valid metaphors, and 134 of them were different. As a result of this study, by analysing perceptions relating to the concept of global warming, it was determined that vast majority of the students considered global warming as a damaging concept increasing temperature. In addition to this, while conceptual categories did not differ based on gender of students, they were significantly different from each other in terms of levels of grades.

Key words: Metaphors, global warming, science education.

INTRODUCTION

Analysing the recent education reforms, it is considered that education programs based on constructive learning approach appear instead of teaching-learning models based on behavioural and cognitive learning theories (Lamanauskas, 2010). The reason of this is the differences in the point of view of constructivist approach to learning. The student is the passive receiver and the teacher takes the role of the person conveying information in the traditional education perception based on behavioural theories. Cognitive learning theorists considered learning as an action independent of the individual and described learning concept as working of brain like a computer (Koc and Demirel, 2004).

Knowledge needs to be constructed by the learner by combining with pre-condition learning as knowledge is not independent of the learner and student is the centre; on the contrary to these theories constructivism underlies today's education programs. Active participation of the student is the process by which the learner constructs knowledge subjectively (McAuliffe and Erikson, 1999).

It is an undeniable fact that this approach increases focus on the course by drawing students' attention (Brown, 1996). According to Hanson (1993), the use of metaphors requires active participation. In recent years, metaphors are considered as one of the efficient techniques to ensure active participation required by constructivist approach in the process of learning-teaching (Quale, 2002). Metaphors are one of the education and training tools which show parallelism with the characteristics of constructivist approach. Within this approach, students build knowledge by using metaphors accordingly and they learn conceptions more easily (James, 2002).

Examining the definitions relating to the concept of metaphor in literature, according to Lacoff and Johnson (1980), metaphors are intellectual images that people use to express opinions about the existing ones. Morgan (1998) expresses metaphors as a way of thinking and vision which presents the perception of the world by human. Hoban (2000) considered metaphors as pedagogic materials and emphasized the importance of metaphors in education. Hager (2008, p.679) summarized

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The characteristics of metaphors as follows:

1. Metaphors inform thinking about learning.
2. Metaphors can sometimes mislead thinking.
3. Acquisition and transfer are the most common learning metaphors.
4. Alternative metaphors offer fresh ways to think about learning.

Researchers that try to solve this process of understanding will use language as evidence: "We are concerned primarily with how people understand their experiences. We view language as providing data that can lead to general principles of understanding" (Lakoff and Johnson, 1980, p. 116). Therefore, some of the scholars recommend the use of metaphor analysis as a research tool (De Guerrero and Villamil, 2002). Studies reveal that the way various concepts are perceived via metaphors is very common in international literature (Shaw ans Mahlios, 2008; Inbar, 1996; Bozlk, 2002; Armstrong, 2008; Tobin, 1990; Rundgren et al., 2009; Jacobson and Wickman, 2007; Alger, 2009; Gallas, 1992).

In the study carried out by Shaw and Mahlios (2008) to find out the perceptions relating to concepts of "teaching" and "literacy" by metaphors with 52 prospective classroom teachers, metaphors used for concept of "teaching" were divided in 11 categories to analyse data by content analysis and featuring metaphors were classified in "nurturing" and "guiding". Metaphors used for "literacy" were divided in 14 categories and the categories featuring for this concept were sequence of knowledge and skill, parts that come together as a whole, foundation of life and journey.

Inbar (1996) asked for every educationist and student to develop four metaphors about student, teacher, principal and school concepts and to explain one of these metaphors. As a result of the study he collected 7042 metaphors.

Although there are studies in the literature examining mental images (metaphors) for the concepts of teacher and students such as geography, principal (Cerit, 2008), teacher (Saban, 2004), social sciences (Güven and Güven, 2009), knowledge (Saban, 2008), inspecton (Töremen and Döş, 2009), climate (Coşkun, 2010), earthquake (Kaya, 2010) etc. we do not see studies about the concept of global warming being a very current and important subject. However, considering the results of studies on global warming in education field, it has been found out that awareness levels and knowledge levels of the students about global warming are very low and important misconception are in question about the subject, as well (Groves and Pugh, 1999; Kılınç et al., 2008; Grimo et al., 2010; Daniel et al., 2004; Stanisstreet et al., 2008; Stanisstreet and Boyes, 1992). Starting from the efficiency of metaphors to reveal perceptions relating to complex and abstract concepts such as global warming, this study tries to contribute to the field in question significantly.

The purpose of this study is to introduce the perceptions of students of primary school, grades 4th, 5th, 6th, 7th, and 8th about the concept of global warming by means of metaphors. Answers to the following questions were sought within the framework of this general purpose.

What are the mental images (metaphors) of the students of primary school, grades 4th, 5th, 6th, 7th, and 8th about the concept of global warming? Which conceptual categories can be used for these metaphors in terms of their common characteristic?

Do these conceptual categories differ based on gender of students? Do these conceptual categories differ based on grade levels of students?

METHOD

Research model

Research is of survey model. Qualitative and quantitative research methods were used together in the research. The research was conducted within the framework of concept analysis method with qualitative research methods, descriptive method for status determination. The main objective of qualitative researches is to examine subjects through description, to explain data collected in a systematic way and to interpret the perspectives of individuals involved in the research (Yıldırım and Simsek, 2006).

Participants

Participants of the research are 362 students (189 girls and 173 boys attending 4th, 5th, 6th, 7th and 8th, grades during first term of school academic year of 2010-2011 at Ahmet Bileydi Primary school in Antalya, Turkey). The distribution of students based on the grades is as follows: 63 fourth grade students, 86 fifth grade students, 76 sixth grade students, 74 seventh grade students, 64 eighth grade students. The students are between 10-16 (Table 1).

Data collection tool

Each primary school student participating in the research was asked to complete the sentence of "Global warming is like…., because…" for the purpose of finding out metaphors they had about the concept of global warming. These sentences written by the hand-writing of students were used as the primary data source in this study.

Analysis and interpretation of data

The process of analysing and interpreting metaphors of the participants by content analysis was performed at these five stages:

Table 1. Distribution of frequency and percentage of the students according to grade level and age.

Grade level	Age	Frequency(f)	Percentage (%)
4	10-11	63	17.4
5	11-12	86	23.7
6	12-13	76	20.9
7	13-14	74	20.4
8	14-15	64	17.6
Total	-------	362	100

Listing stage: Metaphors developed by the students were listed individually for each grade at this stage. Forms not including any metaphor image looking whether the students expressed a metaphor clearly or not and six unfilled forms were marked to eliminate at the next stage.

Election stage: At this stage, after taking 6 forms unfilled out from the forms distributed to 362 students, metaphors developed by 356 students were assessed. Forms of 23 girls and 30 boys were not included in the research based on the below three reasons as a result of this assessment.

Forms not including any metaphor image: Students' form added based on this criterion was of the quality of explaining the reason or result of global warming in general. For instance "Global warming is the seasons' losing their characteristics and changing…"(4^{th} grade, girl).

Forms not including reasons related to the metaphor: At this stage, logical grounds of metaphors developed by the students were analysed. Considering the forms eliminated at this stage, it was seen that although source of metaphor was clear in these forms, the reason of developing this source had no relation with the source. For instance, "global warming is like a maths teacher, because it melts ices and warms magma…." (7^{th}.grade, boy). As it is seen in this example although the subject of metaphor (global warming) and source of metaphor (maths teacher) is clear, there is no relation between the metaphor source and explanation.

Forms with more than one metaphor: Based on this criterion, forms that have more than one metaphor were eliminated. Metaphors in these forms were included to more than one category. For instance, "global warming is like bomb and virus, because it explodes immediately when something happens and causes diseases like a virus and affects lives of people…" (8^{th} grade, girl). As it is seen in this example, two metaphors were created about global warming and according to examples which characteristic of global warming is featured by the student is not very clear.

Category development stage: Based on the criterion, after eliminating 53 forms, 148 valid metaphors of total 303 students were obtained as data. 134 of these 148 metaphors are different metaphors. 14 metaphors were generated as they were classified in different categories. The same metaphors were explained by em-phasizing different characteristics of sources of these metaphors. For instance, metaphor was developed based on the infectious characteristic of concept of virus as "virus" metaphor was developed by a student as "global warming is like a virus bec ause virus is infectious. Global warming affects all countries like the virus…" (8^{th} Grade, girl); another student emphasized the damaging characteristic of virus as "global warming is like a virus, because it is harmful for the health of all living-beings and threatens their lives" (8^{th} grade, boy) and developed this concept as metaphor. As it is seen in the examples, although metaphors were not different, they were used as data in this study since different characteristics were based on them. Other metaphors used in this way are the following: sun, fire, flame, volcano, light/light source, candle, bomb, cancer, monster, disaster, school, germ, black cloud.

These 148 metaphors were divided in 11 conceptual categories in terms of their common characteristics relating to the concept of global warming. For instance, global warming as heat source, global warming as damaging/making life difficult, global warming impacting large area.

Stage of validity and reliability: Reporting data obtained in a qualitative research in details and how the researcher came through are important criteria for the validity (Yıldırım and Simsek, 2006). In this study, for the purpose of ensuring the validity of research results, the analysis method of data collected was explained in details. During this process, especially how these conceptual categories were obtained was emphasized. Then how the metaphors obtained in the research were used by the participants was described in the findings part with direct citation.

Reliability of qualitative researches is to confirm the results expected, reached through research with data collected (Yıldırım and Simsek, 2006). For the purpose of confirming whether the metaphors collected as data represented 11 conceptual categories or not, raw data, coding during analysis stage, findings obtained in the end of analysis and results were presented to an expert. The expert assessed whether findings of the research and results were confirmed or not.

Stage of quantitative data analysis: Following determination of total 148 valid metaphors and grouping them in 11 categories, percentage and frequencies of the students representing 148 metaphors and 11 categories were calculated. Finally, to find out whether 11 conceptual categories differed based on gender and grade levels of the students or not, Pearson chi square test was conducted twice and results were analysed and interpreted.

FINDINGS

Metaphors of the students participating in the study relating to concept of global warming were shown in tables. Then to which categories these metaphors be-longed were shown in tables with grade levels and cate-gories were explained by supporting with the data

Table 2. Metaphors of fourth grade students relating to global warming.

Metaphor order	Metaphor name	f	%	Metaphor order	Metaphor name	f	%
1	Sun	12	22.6	15	Doomsday	1	1.8
2	Drought	7	13.2	16	Hail	1	1.8
3	Aridity	5	9.4	17	Lie	1	1.8
4	Light /light source	4	7.5	18	Monster	1	1.8
5	Flame	2	3.7	19	Heater	1	1.8
6	Fire	1	1.8	20	Desert	1	1.8
7	Stove	1	1.8	21	Revolution	1	1.8
8	Season	1	1.8	22	Obese man	1	1.8
9	Candle	1	1.8	23	Misbehaviour	1	1.8
10	Sunset	1	1.8	24	Black hole	1	1.8
11	Drill	1	1.8	25	Dead tree	1	1.8
12	Disease	1	1.8	26	Death ring	1	1.8
13	Scarcity	1	1.8	27	Devastating	1	1.8
14	Disaster	1	1.8	28	Extravagance	1	1.8
					Total	53	100

f: frequency; %: percent.

collected. Finally these conceptual categories were compared based on gender and grade levels of students.

Metaphors of the student relating to the concept of global warming by grade levels

Metaphors generated at each grade level were shown in tables by frequency and percentage values in this part.

It is seen that 28 different metaphors relating to the concept of global warming were generated by 4th grade students in Table 2. The top three of these metaphors are: sun (f= 12, %22.6), drought (f=7, %13.2), aridity (f=5, %9.4).

It is seen that students generated 39 different metaphors and dominant metaphors are sun (f= 21, 26.5%), flame (f=9, 11.3%) and fire (f=4, 59%) in Table 3 showing the metaphors generated by fifth grade students.

It is seen that sixth grade students generated 35 different metaphors for the concept of global warming in Table 4. Dominant metaphors generated by the students are as follows: flame (f=12, %19.3), sun (f=5, %8.0), candle (f=4, %6.4).

It is seen that seventh grade students generated 43 different metaphors for the concept of global warming in Table 5. Dominant metaphors generated by the students are as follows: flame (f=5, %7.9) and sun (f=4, %6.3).

It is seen that eighth grade students generated 30 different metaphors for the concept of global warming in Table 6. Dominant metaphor generated by the students is virus (f=7, 15.2%). Metaphors of flame and school were generated by each three student (%6.5).

Conceptual categories constituted by the metaphors used by the students for the concept of global warming

Metaphors used by the students constituted 11 categories in terms of common characteristics. These categories and frequencies and percentages are shown in chart. In this part, each category was shown in tables with grade levels and data obtained by categories were supported by examples. As of this part of study, while sentences of metaphors were stated, the grade level of the student generating metaphor and the sex were shown in parenthesis in the end of metaphor sentence. Figures of 4, 5, 6, 7, 8 were used to specify the grade levels and letters of F and M were used for sexes.

Category 1: Global warming as a concept rising the temperature

This category is represented by 111 students and 16 different metaphors generated by them (Table 7). 36.6% of participants consider global warming as a concept rising the temperature. The most frequent used of the metaphors in this category are sun (39) flame (30) and stove (10).

We can give the following examples about how the metaphors constituting this category are used by the students:

Table 3. Metaphors of fifth grade students about global warming.

Metaphor order	Metaphor name	f	%	Metaphor order	Metaphor name	f	%
1	Sun	21	26.5	21	Disorder	1	1.2
2	Flame	9	11.3	22	Aridity	1	1.2
3	Fire	4	5.0	23	Tea kettle	1	1.2
4	Candle	3	3.7	24	Volcano	1	1.2
5	Stove	2	2.5	25	Erosion	1	1.2
6	Environmental pollution	2	2.5	26	Balance layer	1	1.2
7	Drought	2	2.5	27	Lake	1	1.2
8	Soil	2	2.5	28	Tomato	1	1.2
9	Caustic ball	1	1.2	29	Days	1	1.2
10	Smoking	1	1.2	30	Glass	1	1.2
11	Excessive calorie	1	1.2	31	Ice	1	1.2
12	Destruction	1	1.2	32	Eye	1	1.2
13	Aerolite	1	1.2	33	Water	1	1.2
14	Disaster	1	1.2	34	Ice-cream	1	1.2
15	Earthquake	1	1.2	35	Death ring	1	1.2
16	Killer	1	1.2	36	Gun	1	1.2
17	Natural disaster	1	1.2	37	Cursed perfume	1	1.2
18	Powder drum	1	1.2	38	Artificial disaster	1	1.2
19	Doomsday	1	1.2	39	Light/light source	1	1.2
20	Evil	1	1.2	Total		79	100

f: frequency; %: percent.

Table 4. Metaphors of sixth grade students relating to the concept of global warming.

Metaphorder	Metaphor Name	f	%	Metaphorder		f	%	Metaphorder	Name	f	%
1	Flame	12	19.3	13	Flu	1	1.6	25	Life	1	1.6
2	Sun	5	8.0	14	Coal	1	1.6	26	Fountain	1	1.6
3	Candle	4	6.4	15	Caustic ball	1	1.6	27	Technology	1	1.6
4	Monster	3	4.8	16	Volcano	1	1.6	28	Oven	1	1.6
5	Stove	2	3.2	17	Telephone	1	1.6	29	Pen	1	1.6
6	Losing	2	3.2	18	Ill-hearted robot	1	1.6	30	Snow	1	1.6
7	Fire	2	3.2	19	Torn umbrella	1	1.6	31	Nature	1	1.6
8	Disaster	2	3.2	20	Bad friend	1	1.6	32	Ice-cream	1	1.6
9	Desert	2	3.2	21	Air pollution	1	1.6	33	Rubbish bin	1	1.6
10	Aerolite	1	1.6	22	Pipe	1	1.6	34	Human	1	1.6
11	Cancer	1	1.6	23	Tap	1	1.6	35	Death ring	1	1.6
12	Darkness	1	1.6	24	Vortex	1	1.6		Total	62	100

f: frequency; %: percent.

"Global warming is like the sun, because sun is hot. Global warming increases temperature. If global warming is experienced, the world will become very hot…" (4, F)

"Global warming is like a volcano; if volcano erupts,

Table 5. Metaphors of seventh grade students relating to the concept of global warming.

Metaphor order	Metaphor name	f	%	Metaphor order	Metaphor name	f	%
1	Flame	5	7.9	23	Teacher	1	1.5
2	Sun	4	6.3	24	Epidemic	1	1.5
3	Stove	3	4.7	25	Turnout	1	1.5
4	Monster	3	4.7	26	Pointed pencil	1	1.5
5	Disaster	3	4.7	27	Poison	1	1.5
6	Flame	2	3.1	28	Exam marks	1	1.5
7	Atom bomb	2	3.1	29	Cancer sufferer	1	1.5
8	Desert	2	3.1	30	Central heating	1	1.5
9	Lesson marks	2	3.1	31	Clock	1	1.5
10	Ice-cream	2	3.1	32	Pencil case	1	1.5
11	Smoking	2	3.1	33	Rubbish	1	1.5
12	Black hole	2	3.1	34	Human body	1	1.5
13	Vacuum cleaner	1	1.5	35	Earth	1	1.5
14	Witch	1	1.5	36	House	1	1.5
15	Lazy student	1	1.5	37	Cancer	1	1.5
16	Volcano	1	1.5	38	Black cloud	1	1.5
17	Bad person	1	1.5	39	Non-existence	1	1.5
18	carbon dioxide	1	1.5	40	Death	1	1.5
19	Unsmiling face	1	1.5	41	Twilight	1	1.5
20	Minister of national education	1	1.5	42	Eraser	1	1.5
21	Guilty	1	1.5	43	Airlessness	1	1.5
22	Hair dryer	1	1.5	Total		63	100

f: frequency; %: percent.

Table 6. Metaphors of eighth grade students relating to the concept of global warming.

Metaphor order		f	%	Metaphororder		f	%
1	Virus	7	15.2	16	Sun	1	2.1
2	Flame	3	6.5	17	Black cloud	1	2.1
3	School	3	6.5	18	Killer	1	2.1
4	Bomb	2	4.3	19	Animal haunting	1	2.1
5	Summer	2	4.3	20	Water monster	1	2.1
6	Stove	2	4.3	21	Mother	1	2.1
7	Natural disaster	2	4.3	22	Epidemic	1	2.1
8	Smoking	2	4.3	23	Hide and seek	1	2.1
9	Germ	2	4.3	24	Burning tree	1	2.1
10	Grill	1	2.1	25	Cancer	1	2.1
11	Hair dryer	1	2.1	26	Clock	1	2.1
12	Enemy	1	2.1	27	Bacteria	1	2.1
13	Monster	1	2.1	28	Terminal illness	1	2.1
14	Central-heating	1	2.1	29	Cheetah	1	2.1
15	Bad friend	1	2.1	30	Baby	1	2.1
					Total	46	100

f: frequency; %: percent.

Table 7. The categories of the metaphors that students produced about "global warming" concept.

Categories	Metaphor	f	%	Metaphor no
Global warming as a concept rising the temperature	Heater, sun, fire, stove, candle, light, summer, flame, volcano, caustic ball, desert, central heating, hair dryer, grill	111	36.6	15
Global warming as a concept damaging /making life difficult	Sunset, hail, drill, disease, scarcity, disaster, lie, doomsday, monster, smoking, excessive calorie, destruction, aerolite, earthquake, killer, natural disaster, gun drum, flame, evil, chaos, cancer, darkness, flu, coal, telephone, ill-hearted robot, torn umbrella, bad friend, air pollution, Lazy student, poison, airlessness, atom bomb, witch, guilty, vacuum cleaner, volcano, bad person, carbon dioxide, minister of national education, unsmiling face, Enemy, virus, germ, black cloud, bomb, school, animal haunting	72	23.7	48
Global warming as the reason of drought	Aridity, drought, desert, teapot, soil, erosion, pipe, fountain, vortex, Water monster	24	7.9	10
Global warming as an absolute "end"	Black hole, dead tree, devastating, death ring/trap , Non-existence, Cancer, black cloud, disaster, monster, losing, twilight, eraser, Smoking, virus	23	7.5	14
Global warming as a concept progressing continuously	Obese man, misbehaviour, fire, tomato, Technology, oven, pencil, Cancer sufferer, ice-cream, flame, rubbish, Germ, bacteria, clock	16	5.3	14
Global warming as synonymous to the concept of "earth"	glass, ice, eye, water, ice-cream, Snow, desert, nature, ice-cream, rubbish bin, man, human body, earth, house, Baby	16	5.3	15
Global warming as a concept requiring to be prevented	Revolution, lake, disaster, tap, Turnout, pointed pencil, lesson marks, test marks, Bomb, hide and seek, terminal illness, burning tree, cancer	14	4.6	13
Global warming as a positive/beneficial concept	light/ light source, Balance layer, sun, candle, life, mother	11	3.6	6
Global warming as a concept of having large impact area	Fire, teacher, epidemic, virus	6	2	4
Global warming as a concept of man-made	Extravagence, Environmental pollution, gun, cursed perfumes, artificial disaster	6	2	5
Global warming as a concept progress of which is unavoidable	days, light/light source, school, cheetah	4	1.3	4
Toplam		303	100	148

f: frequency; %: percent.

everywhere will warm and melt." (5, M)
"Global warming is like a hair-dryer, because it gives heat to everything around it …" (7, F)

Category 2: global warming as a concept damaging/making life difficult

This category is represented by 72 students and 48 different metaphors generated by them as shown in Table 6. 23.7% of participants generated metaphors expressing that they considered global warming as a concept damaging/making life difficult. The most frequent used of the metaphors in this category are monster (7), disaster (5) and virus (4).

We can give the following examples about how the metaphors constituting this category are used by the students:

"Global warming is like a drill, because it drills the outside of earth and causes harmful beams. These beams are very dangerous for plants, animals and humans in other words, all living-beings." (4, F)
"Global warming is like a hail in an apple size, because it damages our environment.
It makes our life difficult. Prevents our lives …" (4, F)
"Global warming is like excessive calorie because excessive sun beams damage to the earth and use due to global warming." (5, M)

Category 3: Global warming as the reason of drought

This category is represented by 24 students and 10 different metaphors as shown in Table 6. 7.9% of students generated metaphors expressing global warming as a concept of reason of drought. The most common used of metaphors in this category are drought (8), aridity (7) and soil (2).

We can give the following examples about how the metaphors constituting this category are used by the students:

"Global warming is like a teapot, because just like the water inside the teapot evaporates and disappears, global warming wipes away all waters." (5, F)
"Global warming is like soil, because soil absorbs water, water flowing to the soil disappears in the end. Global warming is just like this." (5, M)
"Global warming is like a pipe; however, just like a pipe all waters are withdrawn from seas and rivers" (6, M).

Category 4: Global warming as an absolute "end"

This category is represented by 23 students and 14 different metaphors as shown in Table 6. 7.5% of students generated metaphors expressing global warming as an absolute end. The most common used of metaphors in this category are death ring/death trap (4) as dominant metaphor, black hole, non-existence and disaster metaphors were generated by each three students.

We can give the following examples about how the metaphors constituting this category are used by the students:
"Global warming is like a monster, because it erases everything just like a monster." (7, F)
"Global warming is like a cancer, because cancer makes people die slowly and slowly, giving pain. Global warming is erasing the earth slowly, inflicting pain." (7, M)
"Global warming is like smoking; because smoking kills us slowly… global warming kills the earth." (8, M)

Category 5: Global warming as a concept progressing continuously

This category is represented by 16 students and 14 different metaphors as shown in Table 6. 5.3% of students generated metaphors expressing global warming as a concept progressing continuously. It is seen that dominant metaphor is clock (2). Other metaphors were used by one each student.

We can give following examples about how the metaphors constituting this category are used by the students:

"Global warming is like a small tomato, because small tomatoes grow and become big tomatoes. Effects of global warming are growing more and more." (5, M)
"Global warming is like technology, because it progresses, advances like the technology…" (6, F)
"Global warming is like rubbish, if we do not dispose rubbish regularly, it increases, becomes just like a mountain. Global warming is increasing more and more." (7, F)

Category 6: Global warming as synonymous to the concept of "earth"

This category is represented by 16 students and 15 different metaphors as shown in Table 6. 5.3% of students generated metaphors expressing global warming as synonymous to the concept of earth. It is seen that dominant metaphor is ice-cream in terms of frequency distribution (3). Other metaphors were used by one each student.

We can give the following examples about how the metaphors constituting this category are used by the students:

"Global warming is like ice-cream, because the earth melts and disappears with the effect of sun. Just like putting ice-cream in the refrigerator for not to melt, we should put the earth in the refrigerator, too…" (5, F)

"Global warming is like ice, because as the weather becomes warmer, earth melts like ice and disappears. (5, F)

"Global warming is like new-born baby, because if we take care of the baby, it will be happy. If we take care of global warming, namely the earth, we can get rid of warming of earth"(8, F)

Category 7: Global warming as a concept requiring to be prevented

This category is represented by 14 students and 13 different metaphors as shown in Table 6. 4.6% of students generated metaphors expressing global warming as a concept requiring to be prevented. It is seen that dominant metaphor is lesson marks (2) in terms of frequency distribution. Other metaphors were used by one each student.

We can give the following examples about how the metaphors constituting this category are used by the students:

"Global warming is like a revolution; because everything changes just like a revolution due to global warming, but no one can do anything for it… people should try to prevent global warming." (4, M)

"Global warming is like our lesson marks, because, if we try to get higher marks, it will be good… we will achieve good results as much as we try to prevent global warming.. if we do not, we will be condemned to live in a very terrible world." (7, F)

"Global warming is like hide and seek, because if we cannot hide ourselves well, we are caught and lose. For this reason, we should find global warming and protect our world against it.

Category 8: Global warming as a positive/beneficial concept

This category is represented by 11 students and 6 different metaphors as shown in Table 6. 3.6% of students generated metaphors expressing global warming as a positive/beneficial concept. It is seen that dominant metaphors are sun (4) and light source/life light (3) in terms of frequency distribution. Other metaphors were used by one each student.

We can give following examples about how the metaphors constituting this category are used by the students:

"Global warming is like light source, because if there was not global warming, the earth would not receive light, warm, we would frost. There would be no life on earth." (4, M)

"Global warming is like sun, because we warm owing to it just like the sun." (5, M)

"Global warming is like my mother, because it is warm as my mother, warms up the earth. If there was not global warming, we would be cold and would not live." (8, M)

Category 9: Global warming as a concept having large impact area

This category is represented by 6 students and 4 different metaphors as shown in Table 6. 2% of students generated metaphors expressing global warming as a concept having large impact area. It is seen that metaphors of epidemic and virus were generated by two students, other metaphors were generated by one each student.

We can give the following examples about how the metaphors constituting this category are used by the students:

"Global warming is like epidemic, because it affects the entire world like an epidemic." (7, F)

"Global warming is like a teacher, because just like the student affects the whole class during a lesson, global warming affects the world." (7, M)

"Global warming is like an infectious virus, because it infects the world …" (8,F)

Category 10: Global warming as a concept of man-made

This category is represented by 6 students and 5 different metaphors as shown in Table 6. 2% of students gene-rated metaphors expressing global warming as a concept of man-made. It is seen that dominant metaphor is environmental pollution (2) in terms of frequency distribution and other metaphors were used by one each student.

We can give the following examples about how the metaphors constituting this category are used by the students:

"Global warming is like artificial disaster, because men make it …" (5, M)

"Global warming is like environmental pollution, because people pollute the environment. People cause global warming, too …" (5, F)

"Global warming is like a gun, because man makes the

gun dangerous for man, man creates the global warming, too …" (5, F).

Category 11: Global warming as a concept progress of which is unavoidable

This category is represented by 4 students and 4 different metaphors as shown in Table 6. 1.3% of students generated metaphors expressing global warming as a concept progress of which is unavoidable. It is seen that each metaphor was generated by one each student in terms of frequency distribution.

We can give the following examples about how the metaphors constituting this category are used by the students:

"Global warming is like days, because we cannot stop the progress of days. We cannot stop progress of global warming." (5, M)

"Global warming is like school, because no matter what we do we cannot escape from school…" (8, M)

"Global warming is like a cheetah, because when cheetah starts to run, no one can stop it. As global warming proceeds, no one can stop it". (8, F).

Variations for conceptual categories according to grade level of student

When metaphors generated by the students about global warming are compared by grade levels , they show significant variations. (According to Pearson chi-square independence test; X^2 calculation=80.34 > X^2 critical =55.76, significant variation is in question.) We can summarize these variations as follows:

Fourth, fifth and sixth grade students generated more metaphor images representing the categories of global warming as a concept that increases temperature (37.7, 47, 42% respectively) and global warming as a positive/ beneficial concept (5.6, 5, 4.8 respectively) than seventh and eighth grade students.

Sixth, seventh and eighth grade students generated more metaphor images representing the category of global warming as a concept damaging/making life difficulty (24.1, 28.5 respectively) than fourth and fifth grade students.

Fourth grade students generated category of global warming as a reason of drought (24.5) more than fifth, sixth and eighth grades. Seventh grades did not generate any metaphor images representing this category.

Seventh grade students generated more metaphor images representing the categories of global warming as an absolute end (17.4) and global warming as a concept progressing continuously than other grades.

Sixth grade students generated metaphor images representing the category of global warming as a concept synonymous to the earth (9.6) more than fifth, seventh and eighth grades. Fourth grades did not generate any metaphor image representing this category.

Seventh and eighth grades generated metaphor images representing the category of global warming as a concept requiring to be prevented (8, 10.8 respectively) than other grades.

Eight grades generated metaphor images representing the category of global warming as a concept having large impact area (6.5) than seventh and fifth grades. Fourth and sixth grades did not generate any metaphor images representing this category.

Fifth grades generated metaphor images representing the category of global warming as a concept of man-made (6.3) than fourth grades. Sixth, seventh and eighth grades did not generate any metaphor image representing this category.

While fifth and eighth grades generated metaphor images representing the category of global warming as a concept progress of which is unavoidable (2.5, 4.3 respectively) in similar rates, fourth, sixth and seventh grades did not generate any metaphor image.

Variations by genders of students for conceptual categories

Metaphors representing conceptual categories were generated by female and male in similar rates. (According to Pearson chi-square independence test; X^2 calculation=10.99 < X^2 critical =18.307, no significant variation is in question.)

DISCUSSION AND CONCLUSION

The results of the attention data of this study carried out for the purpose of revealing mental images of primary school 4^{th} , 5^{th} , 6^{th} , 7^{th} , and 8^{th} grade students about the concept of global warming were analysed:

Each metaphor collected as data and used in this study revealed different perceptions about global warming. Majority of students constituting more than one third of students characterize global warming as a concept of that increases temperature (n=111, 36.7%), about thirteenth of them characterize them as a concept of reason of drought (n=24, 7.9%) and about one fourth of students generated metaphor about global warming as a concept damaging/making life difficult (n=72, 23.7%). Students developed metaphors which are mostly included in these three category. Similar results were reached in many of

the studies which were made relating to global warming (Assaraf, 2009; Demirbaş and Pektaş, 2009; Kahraman et al., 2008; Kılınç et al., 2008; Lee et al., 2007; Shepardson et al., 2009). In a study performed with 100 students about global warming by Kılınc et al. (2008) 92% of students described global warming as temperature rising, 64% of them described it as reduction of water. Other than these, other perceptions about global warming are as follows: about thirteenth generated metaphors characterizing global warming as an absolute "end" (n=23, 7.6%), nineteenth of them generated metaphors characterizing as a concept progressing continuously (n=16, 5.3%), one second of them generated metaphors characterizing as a concept requiring to be prevented (n=14, 4.6%), metaphors characterizing global warming as a concept having large impact area (n=6, 2%) , *man-made* (n=6, 2%) and progress of which is unavoidable *(n=4, 1.3%)* were generated by the students in similar rates. As we can see, different perceptions which are in the literature about global warming in the level of metaphors, have come forward.

Daniel et al. (2004) encountered some misconceptions about global warming in the study which they conducted with 90 students. One significant misconception was that students think if we reduced the use of nuclear power we could help prevent the global warming. However nuclear energy could be useful filling the gap between carbon-based and renewable energy sources. This study also showed that even the oldest students have some misconceptions about global warming. For instance the 50% of the students thought that if we used unleaded petrol it would be helpful in reducing the global warming.

Stanisstret et al. (2008) conducted a study with approximately 700 Chinese high school students (aged 11 to 16) from the city of Shanghai and Zhejiang Province to find out the ideas of these students about reducing the global warming. According to the study most of the older students thought that decreasing sea pollution would help reduce the global warming. These studies showed that students had misconceptions about the prevention of global warming. In our study, whilst 7.5% of the students considered global warming as an absolute end, 1.3% of them considered as a concept that has an inevitable progression. Students thought that global warming is an inevitable phenomenon. This is also a misconception about global warming. Besides, 3.6% of the students presented some metaphors which show global warming as a positive concept. And 5.6% of the students correlated global warming concept to the earth and developed metaphors stating that students consider global warming as warming of the world. This fact shows the level of misconceptions that students have about global warming.

This shows that knowledge of students about the said concept can be learnt. If the knowledge revealed via metaphors is true, it will be used for preliminary learning that subsequent learning will be built on and mis-conceptions of the students will be determined and eliminated. According to Semerci (2007) metaphors warn teachers about previous knowledge of students and reveal misconceptions arising from previous learning.

In order to build up effective environmental programs, environmental education researchers have been looking for the demographic factors that can influence the environmental knowledge and attitudes (Ocal et al., 2011). According to Loughland et al. (2003), the gender difference is one of the important demographic factors that influence students' conceptions of the environment and environmental problems. Therefore the metaphors developed by the students have been analysed in terms of gender variable. There are studies in which the metaphors developed by the students have been analysed in terms of gender in the literature section (Stanisstreet and Boyes, 1992; Daniel et al., 2004; Stanisstreet et al., 2008; Ocal and diğerleri, 2011). These studies showed that there is a significant difference between students' global warming conceptions and their genders. In contrast to these studies, there are not any difference between the metaphors developed by the students relating the global warming and students' genders in our study. As we can see, the studies in the literature have different result. It is thought that this situation has arisen as a result of different data collection method.

It was found out that there was a quite significant relation between grade levels of students and formation of conceptual categories on the contrary to gender variable. It was seen that significant variations were present between grade levels and conceptual categories in many studies where opinions were determined by means of metaphors. In literature the similar studies in which the concepts relating global warming show difference according to grade level, are found (Groves and Pugh, 1996; Meydan and Doğu, 2008; Stanisstreet et al., 2008). According to Saban (2008) as long as the students' grade levels increase their proportion of use of abstract con-cepts increases, therefore the metaphors used by the students show difference according to their grade levels.

As a conclusion, important knowledge that metaphors can be used as a strong tool to reveal and explain mental images of students relating to concepts is presented in this study. Findings of the study show perception of students about significant and current subjects such as global warming. In addition to this, misconception about global warming was found in this study. From this perspective, it is seen clearly that metaphors can be used as an education tool to provide information to the teachers about preliminary knowledge and potential

perception errors of students. In this context, it can be recommended that metaphors should be made use of more to reveal perceptions about different concepts and subjects; more research should be performed and metaphors should be used as education tool for teaching complex and abstract concepts such as global warming in lessons.

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