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AN INVESTIGATION ON THE ELEMENTARY TEACHERS' KNOWLEDGE ABOUT AIR POLLUTION ISSUES

İLKÖĞRETİM ÖĞRETMENLERİNİN HAVA KİRLİLİĞİ KONUSUNDAKİ BİLGİLERİ İLE İLGİLİ BİR ARAŞTIRMA

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ABSTRACT: The aim of this study was to determine the elementary teachers' knowledge about air pollution. Ozone depletion, global warming, acid rain, and renewable energy were also addressed in this study to get holistic picture about air pollution. A total of 183 teachers from the 91 schools in Ankara participated to the study. The data obtained were analyzed by means of both quantitative statistical and document analyses techniques. Results revealed that majority of the teachers have an idea about the basic air pollutants and the air pollution problem it causes, like CO2, CH4, SO2 and NOX, they do not seem as having an in depth knowledge about the air pollutants and corresponding air pollution problems. Teachers' knowledge about renewable energy was quite satisfactory. It was argued that geographical nature of Turkey (having sunny seasons, being a peninsula, and having spring waters) improved teachers' knowledge about renewable energy sources.

Keywords: environmental education; environmental knowledge; elementary teachers; air pollution; global warming; ozone depletion

ÖZET: Bu çalışmanın amacı ilköğretim öğretmenlerinin hava kirliliği, ozon tabakasının incelmesi, asit yağmurları ve temiz enerji kaynakları hakkında sahip oldukları bilgilerin belirlenmesidir. Hava kirliliği bahsedilen kavramlarla birlikte incelenerek konu hakkında genel bir durum ortaya çıkarılmak istenmiştir. Çalışmaya Ankara'da 91 okulda çalışan 183 öğretmen katılmıştır. Elde edilen veriler nicel istatistik teknikleri ve doküman analizi tekniği ile analiz edilmiştir. Sonuçlara göre öğretmenlerin %50 sinin kava kirliliğinin sebepleri hakkında yeterli bilgileri olmadığı ortaya çıkmıştır. Öğretmenlerin temel hava kirleticileri, CO2, CH4, SO2 ve NOX, hakkında bilgileri olmakla beraber bunların hava kirliliğine nasıl neden olduklarını bilmemektedirler. Temiz enerji kaynakları hakkındaki bilgileri ise oldukça yeterli bulunmuştur, bunun nedeni olarak Türkiye'nin sahip olduğu coğrafik özellikleri (güneşli mevsimlerin olması, yarım ada olması, yeraltı sularının olması) düşünülmüştür.

Anahtar sözcükler: çevre eğitimi; çevre bilgisi; ilköğretim öğretmenleri; küresel ısınma; ozon tabakasında incelme

1. INTRODUCTION

The environmental problems become an area of great concern all over the world. Soil, air, water, forest, and every part of biosphere, in other words, the earth has affected by the environmental problems. Global warming, climate change, ozone depletion, habitat degradation, species extinction, loss of biodiversity, and population growth are some of the environmental problems. These problems are mainly caused by human activities. (WCED, 1987; UNEP, 1992 as cited in Palmer, 1998).

The urgent need for worldwide environmental education has been declared in Tbilisi conference (UNESCO, 1977). The attention on environmental education has resulted to incorporate environmental education in international and national policy and documents. In Turkey, in 1982 environment law was accepted and in 1993 environmental education was included in science curriculum by the Ministry of National Education (Demiröven, 1999). In 2004, new elementary science curriculum gave more emphasis to environment concepts. According to curriculum developers and theorists, the theories and the documents released from all the various meetings and conferences in the world account for very little without commitment and engagement of classroom teachers, who make the environmental education a reality (Hart, 2003). Teachers play central role in attaining the goals of the environmental education. Especially, Tbilisi Intergovernmental Conference (UNESCO, 1977) underline the importance of teachers by maintaining that the future of the environment may depend up on the ability of the teachers to incorporate and practice of an effective environmental

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education curriculum. Wilke (1985) highlighted this point as "The key to successful environmental education is the classroom teacher. If teachers do not have the knowledge, skills and commitment to environmentalize their curriculum, it is unlikely that environmentally literate students will be produced." To be able to effectively incorporate environmental dimension in education and achieve effective environmental education, teachers should have some competencies. These competencies are defined as mainly adequate knowledge, behaviors, attitudes and skills (Sail, 1999; UNESCO, 1977).

Environmental educators often maintain that primary school education should endeavor to improve and protect the environment through producing an environmentally informed, committed and active citizenry, but research show that the implementation of environmental education in primary schools is problematic and has had limited success (Cutter, 2002; Michail, Stamou, & Stamou, 2007). The teachers have a crucial role on education and environmental education. However, the knowledge on teachers' subject matter is not clear enough. In Turkey and other countries, there have been a few studies examining teachers' knowledge on environmental issues and these were generally preservice teachers and limited studies concentrated on specific environmental problems like ozone depletion, global worming etc. (Aydemir, 2007; Dove, 1996; Gayford, 2000; Özdemir ve Çobanoğlu, 2008; Summers, Kruger, Childs & Mant, 2000). For example, Michail et al. (2007) investigated Greek primary school teachers' understanding of three current environmental issues (acid rain, the ozone layer depletion, and the greenhouse effect). One hundred fifty-five practicing primary school teachers from the urban area of Thessaloniki participated in the study. Researcher stated that Greek teachers have more environmental knowledge gaps than their colleagues in other countries. The teachers generally indicated that human activities are the main causes of the ozone layer depletion, greenhouse effect, and acid rain. The teachers had misconceptions about association of the ozone layer depletion with greenhouse affect. The location of ozone layer was confused and natural green house effect was not known by the teachers. They knew harmful effects of acid rain on vegetation and did not know the name of the gases involved in the ozone layer depletions.

In another study Cutter (2002) conducted a mixed qualitative and quantitative research approaches to investigate Australian elementary teachers' knowledge about environmental concepts. An ethnographic approach was conducted to document the 'knowledge and beliefs systems' of 26 primary school teachers. Results revealed that the teachers displayed little or simple understanding of environmental education. Some of the teachers had confusion about green house affect and ozone layer depletion and they had misconception on these issues. With the green house effect t and ozone layer depletion, the teachers had concerns about pollution and biodiversity. Similarly, Summers et al. (2000) explored the understanding of a non-random sample of 12 English practicing primary school teachers in four areas: biodiversity, the carbon cycle, ozone and global warming. Common misconceptions of the teachers were found as that, the 'holes' were caused by global warming and ozone-destroying chemicals come from car exhausts. Related to global warming, almost all of the teachers were aware of the global warming and the possible climatic consequences of the problem. Most of the teachers knew the mechanism by which a real greenhouse 'traps' the sun's energy, but few of them were fully aware of how the Earth's atmosphere mimics this process. The complete awareness of the uncertainty about causes of global warming and of the precautionary principle was shown by a few teachers but most of the teachers only partially understood the phenomenon. Teachers had little knowledge of man's enhancement of the natural greenhouse effect (or indeed the existence of a natural effect), or awareness of the Earth as a system which both receives and radiates the Sun's energy. Moreover, Mansaray, Ajiboye, and Audu (1998) studied on 360 secondary school teachers from 29 schools in Nigerian. Results showed that teachers generally had a low level of environmental knowledge. Science and social science teachers found to be more knowledgeable than the art teachers, science and social science teacher knowledge did not significantly different from each other. Around two third of the teachers claimed that hey have never heard of environmental education. Researchers underline that teachers, although sciences and social sciences relatively related to environmental education concepts, may not be cognitively well equipped to teach environmental education within the current revision in the school curriculum.

As a result, one can inferred by the above mentioned studies that, there are several points lacking about elementary school teachers' knowledge on environmental issues. The results of this research better inform the policy makers, curriculum developers, and school principals about of such research are promising to improve environmental education in these countries. Similarly the current study is also promising to improve the quality of the environmental education in Turkey, by pointing out the current status about the teacher's knowledge on environmental issues. Thus, in this study researchers aimed to investigate the elementary teachers' knowledge about air pollution issues with a special emphasis on ozone depletion, global warming, acid rain, and renewable energy issues.

2. METHOD

2.1 Sample

Among 221 schools in total in Çankaya and Yenimahalle districts of Ankara (Turkey), teachers from 91 schools were participated to this research, which constituted 43% of the main clustered schools. The ratio of these schools in Çankaya district was 55 out of 129 schools and that for Yenimahalle was 36 out of 83 schools. Public schools (85%) constituted a great part of the all schools in both districts. A total of 183 teachers teaching in 4th to 8th grades participated to the study. Of these teachers 75 of them were science teachers in 6th through 8th grades and 108 of them were teachers in 4th and 5th grades.

2.2 Instrument

To investigate teachers' knowledge about environmental concepts covered in 4th- to-8th grades Turkish curriculum, an Environmental Knowledge Test (EKT) was developed by researchers (Aydemir, 2007). While developing the test and establishing its validity, the pursued steps were as follows: As a first step, literature review was conducted to find related instruments that were used to investigate environmental knowledge of teachers (Cutter, 2002; Mansarat, Ajiboye, & Audu, 1998; Lane, Jennie, Wilke & Richard, 1994; Ko & Lee, 2003; Marco, 1997). These instruments provided an insight into the questions to be included in EKT. Then the Turkish elementary science curriculum and science textbooks were analyzed by the researchers. The analyses were based on the following assumptions: i. The elementary education in Turkey has a centralized character and all of the public and private elementary schools are conformed to the guidelines set up by the Ministry of National Education. ii. All the elementary teachers are required to teach the same curricula. iii. Teachers are aware of the science curricula and science textbooks including the environmental concepts they are expected to teach in their classrooms.

In the third step, a pool of 55 questions was prepared by considering the results of the analyses of 4-8th grades science and technology curriculum and textbooks. Furthermore, the questions in selected tests and scales gathered through literature review and adapted to the study.

In the fourth step, the question pool was examined by two experts who are expert on environmental education, Turkish elementary school, 4-8th grades science and technology curricula and textbooks, and elementary teacher education in Turkey. Questions were examined by the experts with respect to adequacy and appropriateness for elementary teachers. As a result, several modifications were done according to the recommendations of the experts. Following the establishment of the content and face validity of Knowledge Test, instrument were prepared for pilot study in the fifth step. In the sixth step, the instrument was piloted with six teachers: two serving in 4th and two serving in 5th grades and two science teachers serving 6-8th grades. The teachers were requested to answer each of the questions in the test. During the pilot study, the researcher took notes about pitfalls of the items in each part and issues related to administration of the overall instrument such as timing. Moreover, the teachers were asked to provide their comments and suggestions on revising unclear or ambiguous questions. Once the pilot study was finished, teachers' comments were gathered, and they were carefully examined. Based upon their comments and responses, necessary changes were done for the final version of instrument in the seventh step. Final version of EKT included 14 multiple choice, 9 true false, 5 matching, and 11 essay questions. To determine internal

consistency of the Knowledge Test, Kuder-Richerdson approach was utilized (Fraenkel & Wallen, 2006). The results of KR21 was found as .91 indicating high internal consistency. Among these questions, one multiple choice, two matching, and one essay questions were examined in this study because these questions addressed the issues related to air pollution. All of the 4 questions and purposes of asking these questions were given in Table 1.

Table 1. Test Questions and their Types and Purposes

Type	Purpose	Test Questions
Multiple Choice	To understand teachers' knowledge about major characteristic of the greenhouse gases that make them cause global warming.	Which characteristic of the green house gases make them cause global warming? a. Being poisonous b. They are found in the upper layers of the atmosphere relative to the other gases. c. They absorb the sunlight emitted from the Earth surface They react with other gases.
Matching 1	To get in depth understanding about teachers knowledge about air pollutants.	"You are given several elements/compounds and air pollution issues. Please write the appropriate word next to each element/compound by using below information. Effective in the formation of Acid Rain (**AR)** Effective in the formation of Global Warming (**GW)** Effective in the destruction of Ozone Layer (**OL)** No effect (**NE)** Carbon — Sulphur dioxide Nitrogen — Nitrogen Dioxide Hydrogen — Carbon Dioxide Ozone — Chloro Floro Carbon Helium — Spray and Deodorant Water — Refrigerator and Air Vapor — Conditioner Gases Methane
Matching 2	To understand teachers' knowledge about the ways for sustainable use of the natural sources.	"You are given several energy sources. Please put "A" to the ones that you think is a renewable energy source. Bor — Biodiesel Petroleum — Geothermal Coal — Natural Gas Wind — Sunlight Rivers — Wave Biogas — Radioactive Elements Hydrogen
Essay	To investigate teachers' general knowledge about sources of air pollution	Which human activities contributed to air pollution? Please explain in terms of role individual, role of community, and role of industry.

For all questions a rubric was prepared according to the knowledge included in 4-8th grades science and technology course textbooks, as requiring no judgment on the part of the scorer (Fraenkel & Wallen, 2006). The rubric was reviewed by three experts to determine the criteria for the true answers. As a result, grading was realized by three scorers' expert on science curricula and textbooks and 90% scoring agreement was reached. According to this rubric each participants had a score on each question and for the total test questions. These scores were used in calculating reliability value.

2.3. Data Collection

Every attempt was done to reach all 4th -8th grades science teachers in the invited schools. The instrument was given to 332 teachers and they were asked to complete and return it back to researcher. Third author of this study visited all the data collection sites for data collection. In some schools teachers used their free time in schools to complete the answers. For these schools the researcher waited at schools and took the administered instruments. In some schools teachers took the instrument at home. The researcher made second or sometimes third visit to these schools to get the filled instruments. The return rate was fairly high (55%). Total 183 teachers were completed the instruments and they were considered as the sample of the study.

2.4. Data Analyses

Multiple choice question and matching questions were analyzed by taking percentages of the participants' responses. Document analysis strategy was used for open ended questions. For this purpose each participants' responses to particular question was coded. Codes that are related to specific environmental concept were counted. Then, participants' understandings and misconceptions if exist about that content were interpreted by giving the percentages.

2. RESULTS

The results of this study will be presented in three stages as;

1. Detecting elementary teachers' general knowledge about air pollution sources;

2. Detecting elementary teachers' nature of knowledge with an emphasis on ozone depletion, global warming and acid rain.

3. Detecting elementary teachers' knowledge about renewable energy

Stage 1: An open ended question, "*Which human activities contributed to air pollution*?" was asked to teachers in order to investigate their general knowledge about sources of air pollution. The answers for this question were categorized based on different types of contribution stated by the participants as, individual, societal, and industrial contribution As far as the results about individual contribution to air pollution activities is concerned, approximately 24% of the responses of teachers revealed that exhaust gases are the main cause of the air pollution (Figure 1).

This result can be accepted as not surprising, when it is remembered that the study area is Ankara and the number of cars in the city has been increasing and traffic is getting more and more challenging everyday. Use of sprays and deodorants was considered as the second main individual source of air pollution by the participants. The analyses of 4th to 8th grades' textbooks revealed that this issue was included in only in the 4th and 7th grades' textbooks with very little information. However, our results indicated that participants' awareness on this issue was quite high. We believed that media has an effect in developing teacher' knowledge on this issue. Use of coal at home for heating was declared as the third most important individual source of air pollution by the teachers of this study. Again the reason for this issue appearing as one of the main sources of air pollution is that, both media and textbooks address this issue with enough detail. Besides coal, the teachers seemed to have knowledge about importance of improper use of other energy sources. Moreover, as far as the individual perspective was concerned, cigarette, forest fires, education, and trash are other important sources of air pollution declared by the teachers.

When the participants were asked about the contribution of community to air pollution, they stated exhaust gases as the main source. Again, we believe that heavy traffic in Ankara increased the participants' awareness toward this issue. Unconscious use of energy especially at homes was also considered as one of the main sources of air pollution in the societal perspective. Forest fires, on the other hand, were seen as the third major source of air pollution by the teachers. In addition, awareness toward environmental pollution, trash, and industrial emissions were also considered as the sources of the air pollution by the participants of this study (Figure 2).

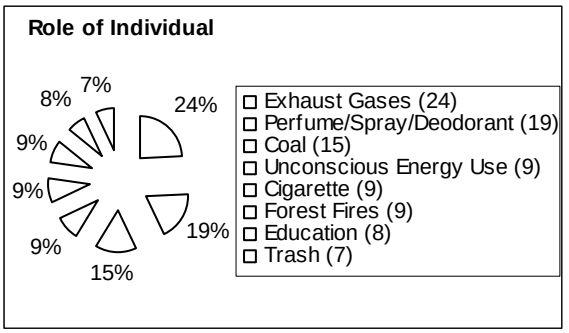

Figure 1: Sources of Air Pollution Caused by Individual Activities

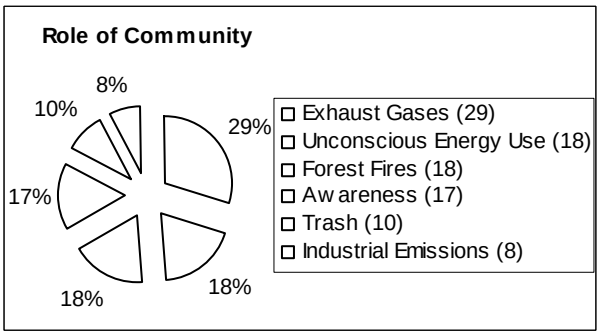

Figure 2: Sources of Air Pollution Caused by Societal Activities

From industrial perspective, more then 70% of responses of the teachers revealed that industrial emissions were the main contributor to air pollution. They also indicated that lack of control mechanism is an important aspect for air pollution. According to the teachers of this study, emissions from solid waste disposal areas also cause air pollution (Figure 3).

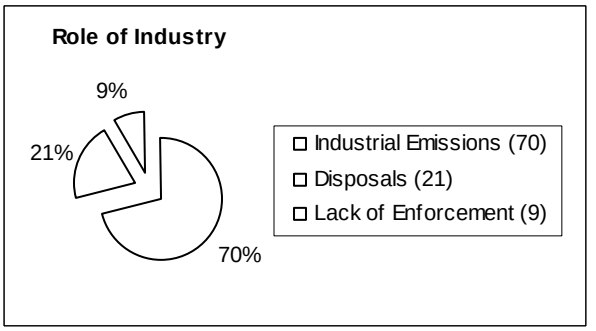

Figure 3: Sources of Air Pollution Caused by Industrial Activities

Stage 2: Participants' answers to open ended question revealed that they have a considerable knowledge about the reasons of air pollution. However, it was not possible to get an idea about nature of their knowledge with this question. For example, they stated exhaust gases as the main source for the air pollution. But it is not possible to infer from this result if participants were talking about carbon monoxide (CO) or nitrogen oxides (NO_X) or another pollutant by stating exhaust gas. Therefore, to get in depth understanding about this issue the first matching question (Table 1) was asked to the participants.

The answers were tabulated according to issues in below Table 2. As was represented by the table, the teachers of this study declared that global warming was caused mainly by carbon dioxide (CO_2) (44.3%), methane (CH_4) (28.4 %), chloroflorocarbons (CFCs)(19.7 %) and ozone (10.4 %). But at the same time, 34.9 % of them declared CO as one of the gases causes global warming, while 18.1 % declared SO_2 as so. Teachers declared CFCs (31.7%), spray deodorants (61.7%) and air conditioners and refrigerators (38 %) as the pollutants for the ozone layer depletion problem. The interesting result at this point is that, although about 32 % of them indicated CFCs as a reason for the ozone layer depletion, spray deodorants were indicated by 62 %. This may be because teachers are more familiar with the term rather than the chemical formula. This in tern may be attributed to the effect of media. Because, ozone layer depletion has always coincided with the use of spray deodorants in media; especially by the phrase "ozone friendly" in the deodorant advertisements. Moreover, sulphur and nitrogen compounds were stated as the pollutants for acid rain problem by relatively higher percentages of the teachers. Here the problem is that, besides sulfur dioxide (SO_2) and nitrogen oxides (NO_X), they also stated CO as one of the source for acid rain. As a result we can infer from Table 2 that, although teachers have an idea about the basic air pollutants and the air pollution

problem it causes, like CO_2, CH_4, SO_2 and NO_X, they do not seem as having an in depth knowledge about the air pollutants and corresponding air pollution problems. This is obvious when they stated CO and SO_2 as gases causing GW or CO_2 as causing acid rain, etc. That is to say, teachers' knowledge about global warming, ozone layer and acid rain can not go beyond just defining the concepts. But obviously they have lack of understanding about the causes of the GW gases. The information stated in below quotation clearly present the scientifically accepted explanation for GW gases (Houghton et al., 2001): "The major greenhouse gases are water vapor carbon dioxide (CO_2), methane (CH_4), and ozone. Molecule for molecule, methane is a more effective greenhouse gas than carbon dioxide, but its concentration is much smaller so that its total radioactive forcing is only about a fourth of that from carbon dioxide. Some other naturally occurring gases contribute very small fractions of the greenhouse effect; one of these, nitrous oxide (N_2O), is increasing in concentration owing to human activity such as agriculture. The atmospheric concentrations of CO_2 and CH_4 have increased by 31% and 149% respectively since the beginning of the industrial revolutions in the mid-1700s. These levels are considerably higher than at any time during the last 650,000 years, the period for which reliable data has been extracted from ice cores… Use of chlorofluorocarbons (CFCs) in refrigeration systems, and use of CFCs and halons in fire suppression systems and manufacturing processes are other major sources of man made greenhouse gases. Moreover, agricultural activities, including the use of fertilizers lead to higher nitrous oxide concentrations."

Table 2. Teachers' Knowledge about Air Pollutants

Air Pollution Issues	% of teacher responses	Air Pollution Issues	% of teacher responses
Global warming		**Ozone Layer Depletion**	
Carbon dioxide (CO_2) *	44.3	Chlorofluorocarbons (CFCs)*	31.7
Carbon monoxide (CO)	34.9	Spray & deodorants*	61.7
Methane (CH_4)*	28.4	Air conditioner & refrigerators*	38.0
Nitrogen dioxide ($NO_{2)}$	20.2	Ozone	10.4
Chlorofluorocarbons (CFCs)*	19.7	**Acid Rain**	
Air conditioner & refrigerators	18	Sulfur compounds – SO_2*	44.3
Nitrogen ($N_{2)}$	10.9	Nitrogen compounds – NOx*	28.4
Ozone*	10.4	Carbon monoxide (CO)	23.0
Carbon (C)	18	Carbon dioxide (CO_2)	14.8
Sulfur dioxide (SO_2)	18.1	Carbon (C)	11.5
Spray & deodorants	11.5	Nitrogen (N_2)	9.8

* refers to the correct answers.

Misconceptions of the teachers of the current study about global warming and ozone layer were also obvious by the answers they gave for one of the multiple choice questions of the test (Table 1). Although 61% of the teachers answered this question correctly, as they absorb *the sunlight emitted from the Earth surface,* 15 % of them answered as they are *found in the upper layers of the atmosphere relative to other gases.* This is related to a common misconception observed in the literature. As was declared by Michail, Stamou and Stamou (2007), Cutter (2002) and Summers, Kruger, and Childs (2000), for example, teachers had confusion about green house affect and ozone layer depletion and they had misconception on these issues. In general terms, the location of ozone layer was confused with that of the greenhouse gases and stratospheric ozone with tropospheric ozone. In other words, the knowledge of teachers of this study is far from distinguishing *good and bad ozone.*

Stage 3: As a last step teachers' practical knowledge about solutions for air pollution has been tested by means of an energy question with matching 2 (Table 1). It was assumed that teachers need to teach renewable energy sources to allow their students to show appropriate actions to prevent air pollution. Just having knowledge about causes of the air pollution will not help us prevent air pollution. We can prevent air pollution if we know the ways for sustainable use of the sources.

As a result of answers given to this question, we can say that, more than majority of the teachers knew that wind, sun light, wave, and geothermal are renewable energy sources. Some of the teachers also indicated that biogas, hydrogen, and biodiesel can be used as the renewable energy sources. None of the teachers indicated petroleum or coal as renewable energy source.

4. DISCUSSION

Overall 7 to 50 % participants were responded to issues raised in the first question in stage 1. Similar percentage range was observed for the questions asked in the second stage. In here we concluded that majority of the participants do not have enough knowledge about sources of air pollution. Moreover, in stage 2 we observed that, teachers do not have true understanding

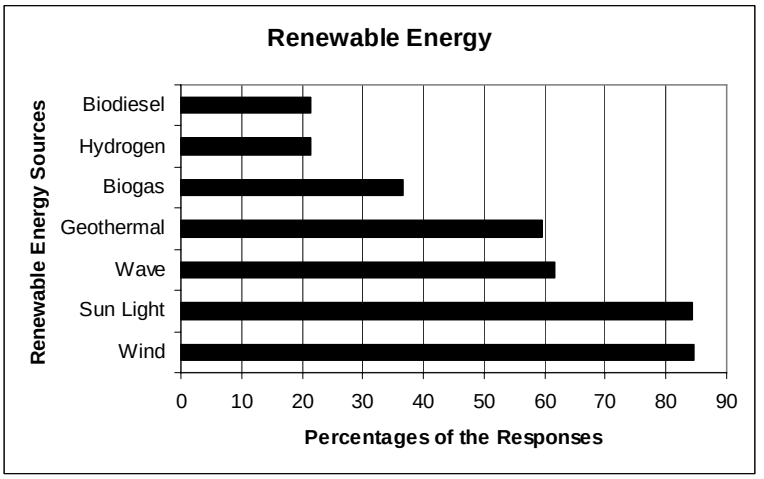

Figure 4. Teachers' Knowledge about Renewable Energy Sources

about chemicals that cause the air pollution. Follow up multiple choice question revealed that they also have major misconception about lower and upper level of the ozone layers. Previous research conducted with Greek, Australian, and English teachers had also revealed that they did not had enough understanding about air pollutants, green house gases and ozone layer (Cutter, 2002; Michail, Stamou, & Stamou, 2007; Summers et al., 2000). In this study, while developing the rubric for the answers of the questions we used the environmental knowledge presented in the textbooks. It was assumed that teachers should at least know the knowledge given in the students' textbooks. What we assumed was true. The teachers' knowledge was similar to the environmental knowledge presented in the textbooks. However, we also observed that for some of the environmental concepts the knowledge given in the textbooks was not enough for teachers to understand the concept appropriately. We do believe that teachers' knowledge about environmental concepts should be enhanced while providing those teachers different opportunities to learn these concepts.

Tremendous increase in the human population makes the role of conservation important for our planet. Conservationists have concentrated their efforts on technological and biological solutions to the environmental problems. However, conservationist efforts alone cannot solve the environmental problems. Public participation on environmental issues is inevitable to attain an efficient solution on problems. The public participation on environmental activities is closely related to their awareness and perceptions, which can be understood by their behaviors. In other words sensitivity to environmental problems is closely related to public awareness and perception of environmental problems. Education has an important role to increase public sensitivity toward environmental problems (Chawla, 1998). Interestingly in our study 15% of the elementary school teachers indicated the importance of the public awareness and education to solve problems related to air pollution. We expected from our teachers to give high percentage to the importance of EE. Previous studies on EE clearly established the importance of EE on increasing both students' and public awareness and attitudes toward environmental problems. Tanner (1980, p.20) indicated the goal of the environmental education (EE)

as "the maintenance of a varied, beautiful, and resource rich planet for future generations." Effective education can increase the students' interest in learning about the environment; attitudes take care of it, and actively involving in conserving it (Chawla, 1998). So, education enables the students to become responsible citizens in the future concerning environmental issues. Education is also powerful way to inform current public about the environmental problems. Hungerford and Volk (1980) argued that public behavior can be changed with the help of informal educational agencies and local and regional educational resources. Besides informing the students and public, education can also change their behavior and knowledge. Research carried out last two decades indicated that formal education has influenced the students' attitudes positively by increasing their knowledge (Chawla, 1998; Hungerford & Volk, 1990; Tanner, 1980). Teachers' awareness toward the importance of EE in increasing students' knowledge and behaviors about environmental issues should be increased by stakeholders and policy makers while providing them to study in EE projects and to attend inservice training programs.

Participants' answers to the renewable energy question revealed that teachers are aware of the available natural resources of Turkey very well. Having sunny weathers, being a peninsula, and having spring waters, were acknowledged by the teachers as they are renewable sources of energy. We believe that teachers can use such characteristics of Turkey to improve their students' attitudes, behaviors, and concerns toward natural and environmental issues. For this purpose they need to do outdoor activities with their students. Earlier studies revealed that outdoors experiences increased the students' understanding about the environmental problems because the interaction with natural, rural and other pristine environments shows reality to the students without imagination (Chawla, 1998; Hungerford & Volk, 1990; Tanner, 1980). Those studies also indicated that the older people state that childhood experiences in school, attending to natural organizations, and work increased their awareness about environmental problems. Consequently, learning events related to environment in actual settings increased both the students' and publics' knowledge and changed their attitudes.

As a result of all, we can infer that there are several points lacking about elementary school teachers' knowledge on environmental issues. The results of this research may be accepted as a clue for policy makers, curriculum developers, and school principals to seek for the ways to improve teachers' knowledge about environmental issues for growing environmentally literate citizens and for a sustainable future. Teacher education programs for the candidate teachers, for example, may be reorganized accordingly for making them environmentally literate and in-service education programs for the teachers already teaching in the elementary level may be organized to include subjects related to environmental issues. Moreover, integrating environmental issues into the textbooks, without any training attempts for teachers is not an efficient way to raise environmentally literate citizens. The key factors for environmentally literate citizens are teachers; therefore, teacher education programs in Turkey are also required to include environmental subjects into possible currently offered courses or include environmental education courses for future teachers.

5. RECOMMENDATIONS FOR THE FUTURE WORK

The content of the current study is comprised of the knowledge of elementary school teachers' about environmental issues with emphases on the air pollution, global warming and ozone depletion. As was explained in the former sections, the reason for emphasizing those issues was that there are several studies pointing out the misconceptions related to them. Moreover, the participants of the current study are composed of elementary school teachers of 4th-to-8th grades. In Turkish educational system, on the other hand, 4th and 5th grades are distinguished from those of 6th—8th graders, as 1st stage elementary and 2nd stage of elementary respectively. Therefore, the background of teachers may differ according to this categorization since 2nd stage teachers are educated as for special subjects, like science, social sciences, mathematics etc. In line with the purpose of the current study, we did not make a comparison with this distinguished feature of the teachers; instead we made a general conclusion about the elementary school teachers' knowledge about environmental issues. Separate analyses of these teachers would require in depth examination while considering their educational

background, the concepts that they thought in their grade level, etc. Including these analyses into this paper would be resulted in a lengthy paper. We strongly suggest determining the level of knowledge of 1st and 2nd stage elementary school teachers to make further evaluations related to in service training and/or textbooks, etc.

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GENİŞLETİLMİŞ ÖZET

Çevre problemleri tüm dünyada ilgi çeken önemli bir alanı oluşturmaktadır. Dünyamız çevre problemlerinden oldukça fazla etkilenmeye başlamıştır. Küresel ısınma, iklim değişikliği, ozon tabakasının incelmesi, doğal alanların hızla kaybedilmesi, türlerin ve çeşitliliğin yok olması ve popülasyon artışı önemli çevresel problemler olarak kabul edilmektedir. Bu problemler genelde insan aktiviteleri sonucunda oluşmaktadır (United Nation the World Commission on Environment ve Development (WCED), 1987; United Nations of Environment Program (UN-UNEP), 1992 aktaran Palmer, 1998). Acil çevre eğitimine ihtiyaç olduğu Tbilisi konferansında açıkça belirtilmiştir (1977). Çevre eğitiminin gerekliliğinden dolayı çevre eğitimi uluslararası ve ulusal stratejiler olarak değişik ülkelerde var olan eğitime entegre edilmeye başlanmıştır. 1998 yılında Türkiye'de çevre kanunları kabul edilmiş ve 1993 yılında çevre eğitimi fen müfredatına Milli Eğitim Bakanlığı tarafından entegre edilmiştir (Demiröven, 1999). 2004 yılında kabul edilen yeni fen ve teknoloji programı çevre kavramlarına daha fazla önem vermiştir. Tbilisi de farklı ülkelerin resmi devlet kurumlarının katıldığı konferanata (UNESCO, 1977) öğretmenlerin çevre eğitimindeki önemine vurgu yapılmıştır. Bu konferansa göre öğretmenlerin çevre konularını müfredata yerleştirme yeteneklerinin ve bu konuda sahip olacakları pratik bilgi ve deneyimlerinin çevre eğitiminin etkili bir şekilde verilebilmesinde önemli olduğu vurgulanmıştır. Çevresel boyutun müfredata iyi bir şekilde entegre edilebilmesi ve etkili bir çevre eğitimin verilebilmesi için öğretmenlerin bazı yeterliliklere sahip olması gerekmektedir. Bu yeterlilikler genel olarak yeterli alan bilgisi, davranış, tutum ve yetenekler olarak belirtilmektedir (Sail, 1999; UNESCO, 1977). Yapılan çalışmalar ilköğretim öğretmenlerinin çevre konularına yönelik bilgilerinde eksiklik olduğunu ortaya koymuştur. Öğretmenlerin çevre konularında sahip oldukları bilgi eksikliğine yönelik çalışmalar, eğitim politikasını üretenler, eğitim müfredatlarını geliştirenler ve okul müdürleri için iyi bir kaynak olmaktadır. Bu kişiler buradan gelen geri dönütler sayesinde daha etkili çalışmalar yapabilmektedir. Bu bakış açısıyla bu çalışma Türkiye'deki bu tür çalışmalara destek vermesi açısından önem taşımaktadır. Bu çalışmada araştırmacılar ilköğretim öğretmenlerinin hava kirliliği ile ilgili konularda özellikle ozon tabakasının incelmesi, küresel ısınma, asit yağmurları ve yenilenebilir enerji konusunda sahip oldukları bilgi düzeyini belirlemeyi amaçlamıştır. Bu çalışmaya Türkiye'nin Ankara ilinin iki farklı yerleşim bölgesinde 4, 5. 6. 7. ve 8. sınıflarda derslere giren 183 öğretmen katılmıştır. Her iki yerleşim bölgesinden katılan okullar arasında devlet okulları en çok katılım oranına (85%) sahip olmuştur. Öğretmenlerin çevre konuları ile ilgili bilgilerini ölçebilmek için Çevre Bilgi Testi araştırmacılar tarafından geliştirilmiştir. Testin güvenirlik değeri Kuder-Richardson 21 (KR21) yöntemi kullanılarak hesaplanmıştır (Fraenkel ve Wallen, 2006). KR21 değeri .91 olarak oldukça yüksek bir değer bulunmuştur. Bu çalışma bu testin 4 adet hava kirliliği ile ilgili olan soruları alınarak öğretmenlerin ozon tabakasının incelmesi, küresel ısınma, asit yağmurları ve yenilenebilir enerji konusunda bilgilerinin tespiti yapılmıştır. Dört sorudan bir tanesi çoktan seçmeli, iki tanesi eşleştirme ve bir tanesi de klasik soru türündedir.

Çalışmanın sonuçlarına göre katılımcıların çoğu hava kirliliğini oluşturan etmenler hakkında yeterli bilgiye sahip değillerdir. Bunun yanı sıra hava kirliliğine neden olan kimyasallar hakkında da doğru bilgiler ortaya koyamamışlardır. Çalışmada ayrıca öğretmenlerin üst düzey ve alt düzey ozon tabakası hakkında kavram yanılgılarının olduğu da tespit edilmiştir. Bazı araştırmacılarda bizim bulgularımıza benzer bulgular ortaya koymuşlardır. Örneğin, Yunanistan'da, Avustralya'da ve İngiltere'de yapılan çalışmalarda bu ülkelerdeki öğretmenlerin hava kirliliği, sera gazları ve ozon tabakası hakkında yeterli bilgiye sahip olmadıkları ortaya çıkarılmıştır (Cutter, 2002; Michail, Stamou, ve Stamou, 2007; Summers ve diğerleri, 2000). Bu çalışmanın bir başka ilginç bulgusu da çalışmanın başında yapılan bir varsayıma yöneliktir. Bu çalışmada ilköğretim öğretmenlerinin çevre ile ilgili konularda en azından ilköğretim öğrencilerine okutulan ders kitaplarında yer alan çevreye yönelik kavramları bildiği varsayılmıştır. Bu varsayıma dayanılarak çalışmada kullanılan testin cevap anahtarı oluşturulurken bu kitaplarda yer alan çevre bilgileri kullanılmıştır. Çalışmanın bulguları analiz edildiğinde bu varsayımın doğru olduğu tespit edilmiştir. Çalışmaya katılan ilköğretim öğretmenlerinin çevre konularına yönelik bilgileri ders kitaplarında verilen bilgilere paralel olarak bulunmuştur. Çevre konularına yönelik kitaplarda verilen bilgiler öğretmenlerin bazı konuları anlamlı öğrenmesi açısından yeterli olmamıştır. Bu bulguya dayanılarak bu çalışmanın araştırmacıları iki öneri

ortaya koymuştur. Bunlardan birincisi öğretmenlerin derslerinde okuttukları kitaplarda çevre konularına yönelik bilgilerin daha iyi hale getirilmesinin gerekliliğine yöneliktir. İkincisi ise öğretmenleri bu konuda daha iyi yetiştirebilecek öğretmen yetiştirme programlarının oluşturulmasının önemine yöneliktir.

Eğitimciler olarak gelecek kuşaklara daha iyi bir çevre bırakmada çevre eğitimin önemini algılamış olmamız gerekmektedir. Maalesef bu çalışmada katılımcılardan sadece % 15 hava kirliliği ile ilgili problemlerin çözülebilmesinde halkın sahip olduğu duyarlılığın ve eğitimin önemine değinmiştir. Bizim beklentimiz ise bu durumun en yüksek yüzde ile katılımcılarımız tarafından desteklenmesiydi. Daha önceki çalışmalar çevre eğitiminin çevre problemlerine yönelik öğrencilerin ve halkın bilincinin ve tutumunun artırılmasında önemli olduğunu vurgulamıştır.

Son olarak ilköğretim öğretmenlerinin yenilenebilir enerji kaynakları konusunda yeterli bilgiye sahip oldukları bulunmuştur. Türkiye'de var olan doğal kaynaklar ve Türkiye'nin coğrafik yapısının öğretmenlerinin bilgilerinin gelişmesinde etkili olduğu düşünülmektedir. Türkiye'nin güneşli havaların yaşandığı bir yer olması, yarım ada olması ve yeraltı su kaynaklarına sahip olması öğretmenlerin yenilenebilir enerji kaynakları konusunda yeterince bilgiye sahip olmasında etkili olduğu varsayılmaktadır. Bu kaynakların derslerde de etkili bir şekilde kullanılmasıyla öğretmenlerin öğrencilerinde bu konularda yeterli bilgiye, davranışa, tutuma ve ilgiye sahip olmalarını sağlamalarında etkili olabileceği araştırmacılar tarafından savunulmaktadır.