

Knowledge Level of Prospective Science Teachers Regarding Formation and Effects of Acid Rains on the Environment and Organisms

Filiz Kara

Ondokuz Mayıs University
Faculty of Education
Department of Elementary Education
Samsun, Turkey

Abstract

The purpose of this research is to measure knowledge level of prospective science teachers about acid rains. The research involved 54 prospective teachers who attended 3rd year of the program of science education at primary school level in a Turkish university located in the Black Sea region. The research made use of "single group post-test model". A scale consisting of two open-end questions regarding formation and effects of acid rains was utilized. The question regarding the formation was analyzed using evaluation criteria including 5 comprehension categories. The question impacts of acid rain on the environment and organisms are resolved through content analysis. At the end of the research it has been seen that majority of the prospective teachers have answered the formation question within the category of complete comprehension. Moreover, it has been noted that answers by the prospective teachers to the impact question were divided into four categories and most emphasis was on that they damage human skin.

Keywords: Acid rains, environmental pollution, environmental problems, environmental education, prospective science teacher

1. Introduction

Today advances in science and technology cause many things to change and even disappear in the environment while making lives easier. Many daily activities cause environmental pollution. As far as the pollution goes on in the current pace it will not be possible to leave upcoming generations an environment to live in. The responsibility of solving environmental problems and protecting the environment befalls onto individuals as well as to states. Recognition and fulfillment of those responsibilities is only possible through environmental education. Especially children need to receive fundamental environmental education in order to grow up sensitive to environmental issues (Campell, Waliczek & Zajicek, 1999). Acid rains, which are regarded as a kind of environmental pollution, are formed as rain, snow and hail including sulfuric acid, nitric acid and sulfurous acid resulting from reaction of the vapor in the atmosphere with oxides of sulfur and nitrogen. The source for sulfur and nitrogen oxides is fossil fuels. Anions as sulfate or nitrate that are carried to the earth's surface through meteorological events cause direct or indirect harm to many organisms and inanimate things (Eflatun, 1994; Bağ & Sürücü, 2011).

Sulfates that hang in the atmosphere cause a lot of harm by getting into human bodies through respiration. Among the effects of those are inflammations, weakening of immune system, respiratory disorders as bronchitis and damaging of lungs. Furthermore, sulfates cause decrease in visibility range by producing foggy weather (Bağ & Sürücü, 2011). Acid rains also cause diminishing of minerals in the soil and the consequent decrease in the agricultural productivity by carrying minerals in the soil to further depths. Acid rains have pH values lower than 3 and they cause damage on forests. Acid rains mix into the soil and inhibit acquisition of minerals by plants since they break down those minerals. As aluminum in the soil gets activated only in an acidic medium, it cause malnutrition, slowing and even stopping of growth in trees in areas with heavy acid rains (Bağ & Sürücü, 2011).

Acid rains that descend to bottom of the soil or lakes have reactions with poisonous matters as mercury, cadmium and aluminum and indirectly harm living things as well. Matters formed in such a way in turn harm plants, animals and humans through food chain or drinking of the water (Bağ & Sürücü, 2011) Acid rains cause corrosion on surfaces of historical and cultural buildings, motor vehicles, certain metallic or plastic surfaces and sculptures made of marble or limestone (Arslan, Boybay & Elatun, 1992).

Enlightenment of children and youngsters regarding environmental issues and their growing up as individuals with environmental sensitivities are conditional to their receiving a proper science education including environmental matters. Only then individuals exhibit positive behavioral improvements and become environmentally sensitive individuals. Therefore it is a vital issue that prospective science teachers, who would teach those matters to upcoming generations, have a good grasp of environmental subjects. Hence, this research has been conducted to determine knowledge level of prospective science teachers regarding formation and environmental impact of acid rains.

2. Method

The research employed the “single group post-test model”. The single group post-test model involves application of the independent variable to a single randomly selected group and measuring effect of the independent variable on the dependent variable (Karasar, 2003). The research involved 54 prospective teachers who attended 3rd year of the program of science education at primary school level in a Turkish university located in the Black Sea region.

The prospective teachers took the class titled “Special Subjects in Chemistry” during the semester in question and the class included acid rains as a part of environmental matters and problems. The prospective teachers were applied a scale consisting of two open ended questions at the end of the semester. The first question was related to formation and the second was regarding the impacts of acid rains on the environment and organisms. The first question was evaluated using the scoring criteria consisting of 5 categories as used by Abraham, Williamson & Westbrook (1994). Answers which were vague, incoherent, consisting of repetition of the question, not related to the question or ambiguous were considered within the “non-comprehension” category. Answers that were provided as answers to the question but wrong scientifically were regarded in the category of “a certain misconception”. Answers reflecting an understanding of the question and yet involving misconceptions were considered within the “partial comprehension with a certain misconceptions” category. Answers that included some of the scientific notions were regarded within the “partial comprehension” category and answers including all of the scientific notions were regarded within the “complete comprehension” category. The second question was analyzed through content analysis. The fundamental purpose of content analysis is to reach at notions and relations that could explain the data. Hence, similar data are gathered around certain concepts and categories to interpret them in a fashion that is understandable by the reader (Yıldırım & Şimşek, 2006). Answers by all prospective teachers were examined within the context of research questions and common concepts and categories were determined by comparison of each answer by one another (Miles & Huberman, 1994; Yıldırım & Şimşek, 2005). Furthermore, direct quotes from answers by prospective teachers that are related to those categories and concepts are included.

3. Findings and Discussion

Table 1 shows frequency and percentage distributions of categories reflecting knowledge level of the prospective teachers regarding formation of acid rains.

Table 1: Categories Reflecting Knowledge Level of the Prospective Teachers Regarding Formation of Acid Rains

Category	f	%
Non-comprehension	2	3.7
A certain misconception	4	7.4
Partial comprehension with a certain misconception	7	13.0
Partial comprehension	13	24.1
Complete comprehension	28	51.8

The prospective teachers answered the formation question with the following percentages: 3.7 % Non-comprehension, 7.4 % a certain misconception, 13.0 % partial comprehension with a certain misconception, 24.1 % partial comprehension and 51.8 % complete comprehension. The research concluded that a majority of the prospective teachers know how acid rains are formed. Direct quotations from answers of prospective teachers belonging to the categories are given below.

“Acid rains are formed by the chemicals formed the water in the air” (a certain misconception category).

The prospective teacher's answer has been spotted in a certain misconception category because of the teacher's mistake on the acid rains are formed by the chemicals formation water. A study done by Khalid (2003) revealed that many prospective teachers have various misconceptions regarding acid rains.

"It is a combination of the sulphur and the nitrogen oxides in the rain with acid by forming the sulfuric acid and the nitric acid and returning back to earth as rain" (partial comprehension with a certain misconception).

It is seen that the prospective teacher has knowledge about the sulphur and the nitrogen oxides form the acid rains and returns to the earth as rain but misinformation about the sulphur and the nitrogen acid shows a reaction when meets acids and forms the sulphuric acid and the nitric acid. So the answer of prospective teacher has been evaluated in the partial comprehension with a certain misconception category.

"It is a conversion of the nitrogen oxides and the sulphur oxides to the sulphuric acid and nitric acid and returning to the earth as snow, hail or rain" (partial comprehension).

The prospective teacher's answer has been spotted in the partial comprehension category because it had been seen that the prospective teacher has knowledge about the conversion of the nitrogen oxides and the sulphur oxides to the sulfuric acid and nitric acid and return to the earth as snow, hail or rain but has not knowledge about the reaction of the nitrogen and sulphur oxide in the rain when meet the water vapor and forms the nitric acid and the sulfuric acid.

"Acid rains are formed by combining the nitrogen oxides and the sulphur oxides with the humidity in the air and forming the sulphuric acid, sulfurous acid and nitric acid and returning to the earth as rain, snow or hail" (complete comprehension).

The answer of prospective teacher has taken place in the complete comprehension category because the answer is so close to expected answer.

Table 2 shows frequency values regarding to the categories and concepts in those categories in the answers of the prospective teachers to the environmental impact question.

Table 2: Answers by the Prospective Teachers to the Environmental Impact Question

Category	Concept within the category	Frequency	Total Frequency
Human	Skin	25	60
	Indirect impact (through food chain, fish, drinking water, plants)	14	
	Respiratory ways	12	
	Visibility	4	
	Immune system	4	
Animal	Indirect impact (through food chain, drinking water, plants)	4	8
	Directly fish	4	
Plant	Productivity	10	30
	Death	8	
	Photosynthesis	8	
	Forest	4	
Inanimate objects	Building	18	85
	Soil productivity	16	
	Historical structure	15	
	Soil mineral	14	
	Sculpture	9	
	Water source	5	
	pH of soil	4	
	Motor vehicle	4	
Total	19	183	183

Answers of the prospective teachers were divided into four categories as human, plants, animals and inanimate objects by the analysis of the gathered data. It has been seen that answers to the environmental impact question were dense around categories of inanimate objects (85) and then humans (60).

Within the inanimate objects category main focus was on buildings (18), soil productivity (16), historical structures (15), soil minerals (14) and within the human category it was on skin (25) and indirect impact (15). When all categories are taken into consideration it was seen that the prospective teachers mentioned that acid rains might harm human skin and cause cancer (25). Among 54 prospective teachers only 12 mentioned respiratory ways while there were 4 mentions of immune system and 4 of visibility. This suggests that other prospective teachers do not have sufficient knowledge regarding those matters. Within the category of animals, there were only 4 mentions of fish directly and 4 of indirect impact such as food chain reveal that those matters are not well known by the prospective teachers either. Within the plants category, as only 10 prospective teachers mentioned productivity, 8 mentioned plant death, 8 mentioned photosynthesis and 4 mentioned forests shows that the other prospective teachers did not have sufficient knowledge regarding those matters. Within the inanimate objects category the fact that only 9 prospective teachers mentioned sculptures while there were 5 mentions of water sources, 4 mentions of soil pH and 4 mentions of motor vehicles reflect that the other prospective teachers have insufficient knowledge regarding those matters. There are 2 prospective teachers' direct quotations from their answers to the question about the effects of the acid rains on the environment below.

“Acid rains reduce the minerals by mixing in the soil. The plants growing slows down or even stops when can't take the necessary minerals. Acid rains destroy the forest. They also affect not only the live life but also the cars, the buildings and even the historical monuments. For example the colors of the cars can be ruined”.

“Acid rains can affect people indirectly: transferred to the animals by plants. The fish we eat can derange our health. It reduce the photosynthesis of the plants and causes deaths. It destroys and ruins the building”.

4. Conclusion and Suggestions

It has been concluded that majority of the prospective teachers have the knowledge that acid rains form as a result of the reaction of vapor in the air with sulfur and nitrate that are produced by human activities and returning of products of the said reaction as sulfuric acid, nitric acid and sulfurous acid by weather events. It has been concluded that majority of the prospective teachers have the knowledge that acid rains harm human skin, they also cause harm on humans indirectly by harming animals and plants, entering the food chain, they cause corrosion on building surfaces, damage cultural structures, reduce soil productivity and diminish soil minerals. However, it has been concluded that majority of the prospective teachers do not have sufficient knowledge as to acid rains cause various inflammations, heart conditions, damage on respiratory system, cause immune deficiency in humans, poor visibility by causing foggy air, direct and indirect effects on animals by effecting the plants animals feed on and contaminating water sources they drink, diminished agricultural productivity, damage on forests, effects on aquatic animals by accumulating in water bodies, reduced soil productivity by effecting its pH value, corrosion on motor vehicles and various metallic and plastic surfaces. It is suggested that knowledge level of prospective teachers on the matter must be improved and their curricula must include such matters more intensively when it is considered that individuals will have tendencies to reduce activities that cause accumulation of sulfur and nitrogen oxides once they are enlightened as to formation and environmental impact of acid rains.

References

- Abraham, M. R., Williamson, V. M. & Westbrook, S. L. (1994). A cross-ages study of the understanding of five chemistry concepts, *Journal of Research in Science Teaching*, 31 (2), 147-165.
- Arslan, M., Boybay, M. & Elatun, A. (1992). Tarihi ve Kültürel Eserlerde Korozyon, Çevre 92 Uluslararası Çevre Kongresi, Bildiriler Kitabı, 141-145, İstanbul.
- Bağ, H. & Sürücü, A. (2011). Kimyada Özel Konular. Ankara: Pegem Yayıncılık. Second Edition, 224 p.
- Campbell, J., Waliczek, T. M. & Zajicek, J. M. (1999). Relationship between environmental knowledge and environmental attitude of high school students, *Journal of Environmental Education*, 30(3), 17-21.
- Eflatun, A. (1994). Tarihi Eserler Üzerine Asit Yağmurlarının Etkisi, Yüksek Lisans Tezi, Fırat Üniversitesi, Elazığ.
- Karasar, N. (2003). Bilimsel Araştırma Yöntemi. Ankara: Nobel Yayın Dağıtım. Twelfth Edition.
- Khalid, T. (2003). Pre-service high school teachers' perceptions of three environmental phenomena, *Environmental Education Research*, 9(1), 35-50.
- Miles, M. B. & Huberman, A. M. (1994). *Qualitative Data Analysis: An Expanded Sourcebook*. London: Sage Publications. Second Edition, 337 p.
- Yıldırım, A. & Şimşek, H. (2011). *Sosyal Bilimlerde Nitel Araştırma Yöntemleri*. Ankara: Seçkin Yayıncılık. Eighth Edition, 366 s.