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HIGH SCHOOL STUDENTS' AND TRAINEE SCIENCE TEACHERS' PERCEPTIONS OF OZONE LAYER DEPLETION

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Abstract. *The focus of this study was to identify and describe misconceptions held by pre-service science teachers and high school students regarding the ozone layer depletion. The views of the participants were investigated using a closed-form questionnaire. The analysis of the survey data indicates that many high school students and pre-service science teachers possess an array of erroneous ideas about the ozone layer damage, its causes and consequences. For a better teaching of environmental issues, this study provides some implications for both teachers and researchers of science education.*
Key words: *high school students, pre-service teachers, misconceptions, ozone layer.*

Introduction

In the last few years, an increasing interest in environmental education has run parallel to the growing degradation of ecosystems and a growth of information about environmental affairs. Environmental problems are no longer unique to one zone of the planet or, for that matter, one particular nation. Thus environmental education is becoming an integral part of the education of any country's youth (Manzanal, et al., 1999). Besides United States and Europe, in Turkey, the general public has developed an increasing awareness of world environmental problems, and some of the most acknowledged concerns are the ozone layer and its depletion.

Unfortunately, anxiety about global environmental issues, including ozone layer damage, is not always well informed (Boyes & Stanisstreet, 1992; 1994; 1997; Boyes et a1., 1993; 1999) and so real understanding and the possibility for action to reduce the problem are limited.

Formal, school-based environmental education is often seen as an effective way of informing children, and hence future generations, of the importance of environmental issues. Unfortunately, the ozone layer is an invisible and effectively abstract problem with many complex concepts associated with it. Experiential learning and simulations are difficult, so teaching is normally via secondary sources and more flexible learning strategies (Boyes et al., 1995).

What Do Students Think About the Ozone Layer?

For science instruction, misconceptions held by both teachers and students have been a critical problem (Boyes et al., 1993; Dove, 1996; Groves & Pugh, 1998, 1999 and 2002). Driver et al. (1985) reported students' misconceptions in different disciplines of science. However, little research has been done so far as compared to science in order to reveal students' misconceptions regarding environmental issues. The researchers found that students of various educational levels hold a variety of misconceptions about the environmental issues.

Previous studies in different countries have indicated that students' ideas about global environmental issues are extremely confused. From the previous studies, data have revealed that students bear many misconceptions relating to environmental issues and especially ozone layer depletion. Boyes & Stanisstreet (1992) asked 218 first year undergraduates taking degrees in a variety of biological subjects to respond to 36 statements about the causes and effects of global warming. Their research revealed a widespread misconception that ozone depletion was encouraging global warming. Similar findings were revealed in the study of 861 students between 11-16 years

old, from 10 secondary schools in England (Boyes & Stanisstreet, 1993; 1994). In another study Boyes et al., (1995) investigated undergraduate understanding of the ozone layer and causes of its depletion. In this study, 435 BA(Ed) degree students were asked to respond to 36 statements about ozone layer, and they found that a majority of the students knew that the layer was gaseous and that is naturally occurring. A majority of the students knew that the ozone layer protected the earth from ultraviolet (UV) radiation and that it was being depleted by CFCs. On the other hand a range of other environmental pollutants were also considered to be responsible for the depletion. But a large number of the students were not aware that volcanic eruptions could cause the depletion of the ozone layer. Most of the students also thought that ozone layer depletion would exacerbate the greenhouse effect. How well university students understand both the greenhouse effect and the depletion of the ozone layer has been studied by Dove (1996). Sixty students specializing in the humanities were given paper-and-pen tasks to solve. In most cases, it was a matter of agreeing or not with a series of statements, but some open-ended questions were also included. The study verifies results obtained earlier. Rye et al., (1997) interviewed students aged 11-13 years. It was shown, among other things, that half of the students were of the opinion that depletion of the ozone layer is the main reasons for global warming. Groves & Pugh (1999) asked high school students, undergraduate elementary education seniors, and graduate students in an advanced elementary science methods course about the results, causes and ways to alleviate of ozone depletion and found that high school and college students conflate cause and effect relationships of this problem with that of other environmental problems, just as they do with the ozone depletion problem. Meadows and Wiesenmayer (1999) found that students commonly believe that the ozone "hole" allows more sunlight to penetrate the atmosphere and heat the earth. Groves & Pugh (1999) noted that some students conflate cause and effect relationships of environmental in general. As an example, over 30% thought that cleaning up refuse from beaches helps reduce of global warming, while 20-40% thought that reducing the world's nuclear weapon stockpile would also lower the risk of global warming. It was also found that, such misconceptions are held by elementary teachers as well as elementary, junior high, and high school students. In another study conducted by Khalid (2003), twenty-seven senior-level secondary science education majors enrolled in a high school science teaching method course participated. Consisting of 30 statements focused on the causes, effects, and interactions greenhouse effect, ozone depletion and acid rain. The analysis of the survey data indicates that the many pre-service high school teachers possess an array of misconceptions about the causes and effects of the greenhouse effect, ozone depletion and acid rain.

To raise public awareness through the use of teaching materials and teaching techniques, therefore, we wished to find out what students and pre-service science teachers knew in this area. This study sets out to determine what ideas the participants have about the ozone layer, and how these relate to *present* scientific understanding, what can be done for a better teaching of these environmental isuues.

Research methodology

In order to determine the ideas of Turkish high school students and university pre-service science teachers have about the ozone layer, students from two different high schools and trainee science teachers from an education faculty were asked to complete a questionnaire. The sample consists of 178 science students between the ages of 16 and 18 from suburban (n=115) and urban (n=63) high schools, and 69 final year trainee secondary science (n=35) and biology teachers (n=34) from an education faculty in Turkey. Questionnaires were conducted over the 2002-2003 academic year, with a total of 247 participants. The overall sample contained 65% boys and 35% girls. The survey instrument used for this study was a minor modified version of the one used by Groves and Pugh, (2002). The questionnaire was consisted of 37 items pertaining to the ozone layer and 2 additional items regarding demographic information. In order to make the questionnaire more

understandable for participants we changed some of the terms and descriptions. For example, qualitative answer choices were made clearer such as, for the size of the ozone "holes", "the size of dish", "the size of a football field", "the size of your city", "the size of the district of East Anatolian" or "the size of Europe".

The first part of the questionnaire is composed of Likert type statements with choices ranging from " I am sure this is right", "I think this is right", "I don't know about this", "I think this is wrong" to "I am sure this is wrong". Similar to Groves and Pugh, (2002); our pilot test revealed that many participants chose the "I think this is correct/incorrect" position, rather than the more affirmative "I am sure this is correct/incorrect" set of choices, and this resulted almost no significant differences when only the definite answer choices were used to score the results. However, when the first two sets of choices ("I am sure" and "I think") were clumped together, several sets of significant differences appeared. So, the first 30 statements were statistically analyzed using the clumped answer choices.

The 30 Likert-type statements were arranged in three subsets of 10. The first subset focused on results of ozone depletion, the second subset dealt with causal relationships, and the third targeted means to alleviate the problems presented by this problem. The second set of seven questions, which focused on factual knowledge, was analyzed for correctness, and also to determine the percentage of students choosing each possible answer. The last question asked participant if they believed the ozone problem to be a real problem, or if they thought that it was a politically manufactured one.

Research results

ANOVA analysis showed that there was a statistically significant difference between the mean scores of the four groups of participants ($p < .001$). Using LSD-ANOVA analysis, it was determined that there was a statistically significant difference between the mean scores of urban and suburban high school students ($p < .001$), and also between the mean scores of the trainee secondary science teachers and trainee biology teachers ($p < .05$). Statistical LSD test results also revealed that urban high school students ($M = 2.94$) were more successful than the suburban high school students ($M = 2.69$), and secondary science pre-service teachers ($M = 2.86$) was more successful than the biology pre-service teachers ($M = 2.74$). However, statistically no significant differences were found between the mean scores of the trainee teachers and high school students.

Demographic Data. Independent T- Test analysis for gender effect revealed that male participants (Mean = 2.86) scored significantly higher than their female counterparts (Mean = 2.66) in general ($p < .001$). Similarly, male trainee teachers and male high school students scored significantly higher than their female counterparts (Table 1).

For the high school students, the three subscales showed wide variation in overall scores, with subscale 3 (means to alleviate the problems) having the highest mean, 2.944, while subscale 1 (results of ozone depletion) was lowest, with a mean of 2.626. However, variation in overall scores of the trainee teachers, with subscale 2 (causes of ozone depletion) having the highest mean, 2.971, while subscale 1 (results of ozone depletion) was lowest, with a mean of 2.461 (Table 2).

Table 1. Gender analysis (Independent T- Test) results.

Groups	Male (Mean)	Female (Mean)	Sig. (2-tailed)
All Participants	2.86	2.66	$p < .001$
High School Students	2.85	2.64	$p < .001$
Trainee Teachers	2.88	2.69	$p < .05$

Table 2. Subscale Scores for Items #1-#30.

	High School Students	Trainee Teachers

	Suburban $\overline{X}$	Urban $\overline{X}$	Secondary Science $\overline{X}$	Biology $\overline{X}$
Subscale 1	2.610	2.642	2.509	2.413
Subscale 2	2.690	3.079	3.024	2.919
Subscale 3	2.782	3.107	3.049	2.889
Total	8.082	8.828	8.582	8.221

Survey results for the three subscales were quite low, with less than 30% of the pre-service teachers responding correctly to 13 of the 30 statements. The highest number of the correct responses, 100% was for #5 and 97% for #10. Also, three statements (#1, 7and 8) received no correct responses at all (Table 3).

Results for pre-service teachers show that many believe that increases in atmospheric CO_2, is a major factor (#12), along with the idea that too much light is reaching the earth's surface (#11), and the related idea that failure of sunlight energy to escape the earth (#19) will lead to further ozone depletion. These results parallel the problem found by Meadows and Wiesenmayer (1999), that students tend to lump global warming and ozone depletion together casually. Indeed, responses to #12 and #27 (ozone depletion can be lessened by producing less carbon dioxide and methane) indicate that the pre-service teachers confuse global warming with ozone depletion. The role of CFCs in ozone depletion was also a problem for pre-service teachers (#13 and #24): only 91% understood that CFCs are a major causal agent, but 88% understood that controlling the amount of these gases will alleviate the problem. The cause/effect relationship of UV radiation to ozone depletion was another problematic area (#10 and #14): 97% knew that a result of ozone depletion is more UV radiation reaching the ground but only 82% believed that ozone depletion is caused by too much UV radiation reaching the ground. Thus, they believed that UV radiation is both a cause and effect of ozone depletion. Similarly global warming and ozone depletion are confused: more than 70% of the pre-service teachers believed that too much sunlight is a cause of the ozone problem (#11), while 78% believed that the problem is caused by sunlight's inability to escape from the earth's surface (#19).

Another example of difficulty with cause-effect relationships is illustrated by the role of methyl bromide. Eighty-four percent of the pre-service teachers understood that pesticides such as methyl bromide are a cause of ozone depletion (#20), whereas only 76% recognized that reducing the amount of such pesticides can alleviate the problem (#30). Thus there was not enough carryover between understanding a cause, and how this information can be used to identify a means of alleviating the problem.

Item-by-item analysis revealed the same general misconceptions and trouble with cause-effect relationships as was found for the high school students. Performance on 11 items had higher scores than the pre-service teachers'. But performance for pre-service teachers on 19 items had higher scores than the high school students' (see Table 3). The eleven anomalous results are likely connected. Item #1 matches with #3, #7, #8: all deal with the role of CO_2 (global warming); item #11 matches with #19: both deal with the role of carbon dioxide but for item #11 we can also say that they confuse cause and effect relationship of ozone depletion; #2 matches with #4: pre-service teacher may be confused with flooding after global warming; item #9, #23 matches with #26: deal with the environmental pollution, and here we should state that during their faculty education students take ecology and environmental health lessons that may effect and force students to think excessive environmentalist and also confused the cause-results effects of ozone depletion with other environmental problems'. Because when we examined these lesson books and notes, we find almost

Table 3. Percentages of the correct answers of every statement[a].

		High S. Students		Trainee Teachers		Groves &
No	**Statements**	Suburban	Urban	S.Science	Biology	Pugh

If the ozone layer problem becomes worse						
1	Our weather will get hotter	9.6	1.6	0	0	2.5
2	Some of our tap water will be unsafe to drink	14.8	15.9	8.6	0	18
3	There will be more flooding	40	28.6	17.1	17.6	44.5
4	There will be more water pollution	12.1	23.8	17.1	8.8	25.5
5	More people will get skin cancer	87.9	95.2	100	100	45
6	There will be more insect pests	26.9	38.1	54.3	17.7	25.5
7	There will be changes in the world's weather	4.3	3.2	0	0	2.5
8	The world's ice caps will shrink in size	6.1	4.8	0	0	9.0
9	There will be more air pollution for us to breathe	6.9	14.3	14.3	2.9	15.5
10	More ultraviolet rays will reach the earth's surface	84.3	93.7	100	94.1	42.5
The ozone layer problem is made worse						
11	By too much sunlight reaching the earth's surface	26.1	54	40	17.7	50.0
12	Because too much CO_2 is entering the atmosphere	13.9	36.5	34.3	29.4	47.0
13	By man-made CFC gases entering the atmosphere.	66.1	84.1	94.3	88.3	44.0
14	By too much UV reaching the earth's surface	10.4	30.1	17.2	20.5	35.5
15	By gases from rotting wastes	4.4	19.0	20.0	17.6	29.0
16	By radioactive waste from nuclear power	3.4	6.4	22.9	8.8	6.5
17	By acid rain	15.7	20.6	48.5	20.7	29.5
18	By gas from artificial fertilizers	53.1	66.7	85.7	67.7	16.5
19	Sunlight reflected … cannot escape into space	26.9	46.0	22.8	20.7	42.5
20	By the use of certain pesticides	74.7	84.1	74.3	94.2	37.5
The ozone layer problem can be lessened by						
21	Using nuclear instead of coal power stations	31.3	60.3	51.4	55.9	39.5
22	Keeping trash picked up	13.9	28.6	48.5	14.7	38.5
23	Using unleaded gas	8.7	12.7	8.6	2.9	11.5
24	Stopping the use of CFC gases	66.1	79.3	94.3	82.4	47.5
25	Planting more trees	8.7	23.8	22.8	8.8	2.5
26	Recycling household trash	15.6	25.4	20.0	14.7	6.5
27	Producing less carbon dioxide and methane	10.4	14.2	14.3	11.8	46.5
28	Protecting rare plants and animals	32.2	55.5	48.5	55.9	33.0
29	Launching fewer rockets and missiles through it	53.9	60.4	71.4	55.8	56.0
30	Stopping the use of certain pesticides	64.4	81.0	65.7	88.2	46.5
Factual Knowledge Questions.						
31	The location of the ozone layer …	32.2	77.8	60.0	67.6	48.5
32	The thickness of the ozone layer …	25.2	49.2	31.4	29.4	32.0
33	The size of the ozone holes …	11.3	14.3	22.9	5.9	21.5
34	The composition of the ozone layer is …	32.2	46.0	57.1	41.2	40.0
35	The number of the ozone holes …	8.7	12.7	14.3	5.9	5.0
36	The ozone layer problem is getting better / worse…	9.6	14.3	14.3	2.9	19.5
37	The ozone layer problem is genuine / politic …	92.2	92.1	100	100	100

[a]Groves and Pugh, (2002) data included for comparison.

nothing about ozone depletion but little about global warming. Most of these anomalous are in conformity with Groves and Pugh, (2002) and they state that the problem of applying a "one size fits all" approach to explaining causal relationships and connections between these and other environmental issues. These anomalous also support the arguments in the literature that people tend to cling to simplistic mental models when faced with complex data.

Overall, the amount of correct responses to the three subscale statements was not good. Most of the responses reveal considerable misunderstandings. For example, while all of the pre-service teachers failed to know that global warming is not a result of ozone depletion (#1, #7 and #8), only 17% knew that the problem is unconnected with flooding. Nearly two-thirds of the pre-service teachers believed that increase in insect pests is a result of ozone depletion (#6). 69% for item #12 and 87% # 27 failed to know that the role of CO_2 and methane is not a cause or result of the ozone

depletion. About the sunlight reaching the earth's surface (#11), more than 70% failed to know that this is a result of ozone depletion but not the cause of ozone depletion; because sunlight reflected from the earth's surface cannot escape into space (#19), nearly 80% confused the causes for the ozone depletion with the results of global warming. About the UV rays nearly all of the pre-service teachers knew that if the problem becomes worse more UV rays will reach the earth's surface (#10); but on the contrary, more than 80% failed to know that too much UV light reaching the earth's surface is a result of ozone depletion but not the cause for ozone depletion (#14). For items #15, #22 and #26 it can be said that students more than two-thirds of the pre-service teachers confused cautions for environmental pollution with the ozone depletion. While 84% believed that radioactive waste from nuclear power is an ozone depletion factor (#16), 47% thought ozone depletion can be lessened by using nuclear instead of coal power stations (#21) (see Table 3). Further, 45% of the pre-service biology teachers believed that the problem can be lessened by protecting rare plants and animals (#28), although 52% of the pre-service secondary science teachers believed this item. These results suggest that the students conflate cause-effect relationships across a broad range of environmental issues, and not just global warming and ozone depletion.

A second set of questions dealt with basic factual understanding of the ozone problem. Question 31 asked where the ozone holes are located, and both sets of students showed differences in their knowledge of this, while nearly two-third of the pre-service teachers chose the correct answer, only 48% of the high school students knew correctly. Understanding of the thickness of the stratospheric layer (#32), nearly 60% of the students and also pre-service teachers chose 10 or 1 mile alternatives. Understanding of the size of the holes (#33), while more than half of the pre-service teachers thought between football fields and a typical parish or county, most of the high school students thought between pie plates or table tops and football fields. About the composition of the ozone layer (#34), while 49% of the pre-service teachers, only 37% of the high school students knew correctly. And most of the participants thought that there are more than hundreds or thousands of ozone holes (#35). Even though, about 90% of the all participants didn't understand that there are only two holes after hearing from the media or reading from the books etc. this disparity in response results indicate that the students did not develop a sound factual understanding of the ozone layer. They did not know how many holes there are, and this is parallel to their misunderstandings about how large the holes are. When asked about the composition of the ozone layer, total correct answer was not more than the half of the all participants. Upon reflection, the authors believe that general description of the atmosphere, "air", involved in ozone depletion caused the participants to choose "air" besides the "oxygen molecules" as the answer. It is obvious that the targeted answer choice is too simplistic; thus the problem probably lies more with the design of the question, rather than with the students' knowledge.

The past two questions (#36 and #37) focused on the students' opinions. 69 and 79% of the high school and pre-service teachers, respectively, believed that the ozone problem is becoming worse. The participants were also asked if they believe that this problem is genuine, while 92% of the high school students, all of the pre-service teachers said yes.

Discussion

Compared with previous studies, our findings provide a more comprehensive picture of student and teacher understanding of ozone layer. From the results of the present study, it appears that Turkish students and pre-service teachers have a good understanding of the position and purpose of the ozone layer in terms of protection from harmful ultraviolet rays, but some also think that it helps keep the world warm or protects it from acid rains. Participants seem aware that the ozone layer in danger and they believe that many varied forms of pollution are the cause. It also seems well known that further depletion might cause an increase in skin cancers, however, participants assumed

strong, erroneous, links with the greenhouse effect and other forms of local pollution, using pesticides and artificial fertilizers.

When compared to the previous literature, results of this study parallel that of other studies dealing with global climate issues (Boyes et al., 1993; 1995; Dove, 1996; Groves and Pugh, 1999; Meadows and Wiesenmayer, 1999; Khalid, 2003). In addition, when compared to the results of Groves & Pugh, (2002) Turkish participants have a higher mean (36.53) than the American participants (31.43). However there was no statistically significant difference ($p>.05$)

When Table 3 examined as a whole it has seen that the proportions of the students holding erroneous ideas (confusing global environmental issues) were similar to those of pre-service teachers. This situation is in conformity with Boyes et al., (1995) and suggests that misconceptions persist to the adult population.

After examining the responses given to the survey items; water pollution (#4), air pollution (#9), acid rain (#17), the effect of missiles (#29), and the factual question of where ozone layer is located (#31), one may ask: What are the causes under these anomalous? This anomalous support the arguments in the literature that people tend to cling to simplistic mental models when faced with complex data. Here, we can also see the problem of applying a "one size fits all" approach to explaining causal relationships and connections between these and other environmental issues. Consequently these results are in conformity with the previous studies.

When answers of the statement groups such as 11, 19 or 2, 4 or 1, 3, 7, 8 examined there can be seen that both high school students and pre-service teachers conflate cause and effect relationships of this problem with that of other environmental problems, just as they do with the ozone depletion problem. As it was stated by Groves and Pugh, (1999) and Boyes et al., (1993), such results for two different environmental issues indicate that such confusion over cause/effect relationships, and measures needed to alleviate these problems, is widespread. Students have a general awareness of environmental issues, but they have little specific knowledge of them, and, as it was stated by Adler, (1992), information gained through print and television media often simplistic and misleading. Thus, Groves and Pugh, (1998) reports that they mistakenly assume relationships between the various environmental problems that do not have sufficient exposure to information to be able to develop sound understandings of such complex issues. Thus the real problem in this is lack of information, rather than incorrect concepts.

Results of this study also approves a thesis put forwarded by Boyes et al., (1995) that in the realm of global environmental problems at least, all forms of anthropogenic 'pollution' are seen as exacerbating all environmental problems and, conversely, all 'environmentally friendly' actions are seen as benefiting all aspects of the environment.

Our study also reveals the general lack of knowledge of the pre-service science and biology teachers besides in addition to the high school students. For this reason, it is possible to say that if teachers hold incorrect views, then they are more likely to teach their students these misconceptions, as it was noted by Groves & Pugh (1999).

As it is suggested by Boyes et al., (1995) once trained, teachers may influence the knowledge and attitudes of students for many years. Therefore, the role of teachers and especially biology teachers in the high school is of crucial importance.

Turkey is a country that is on the eve of the integration into European Union. Because human being live on the same world the view-points of Turkish students' and teachers' about global environmental issues such as ozone layer depletion can not be *unimportant* for European Union and also other countries of the world. This perspective shows the importance of this study. Some other scientifically new and important points of this study may be:

1. This study is the first and comprehensive study to reveal the perceptions of Turkish high school students' and pre-service teachers' about global environmental issues and especially the ozone layer depletion.

2. This study contributes to the scientific evidence database of the environmental and science education through its findings.

3. Findings of this study can be a base and an important data source for teachers, science and environmental education researchers of the future and studies.

4. This study suggests important implications for a better environmental education and sustainable life on our unique earth.

Implications for teaching

The presence of misconceptions regarding these environmental issues among the subjects raises several concerns because these students will be teaching in their classrooms very soon. The question is whether these pre-service teachers are fully prepared to discuss these abstract concepts in their classrooms. As these environmental issues are very closely related to science, students' misconceptions about these issues reveal their lack of a full understanding of these science-related issues. As it was stated by Khalid, (2003) science educators need to think about the current situation and how to improve it.

It is clearly important that teachers themselves do not, unwittingly, perpetuate erroneous ideas and it might be argued that major large-scale environmental issues should be addressed during the training of teachers. As the literatures have shown, such environmental issues also provide examples of the potential importance of children's preconceptions, perhaps constructed from out-of-school sources, in the learning process. Global environmental problems might provide a further dimension, namely abstract issues about which information has been received from the media and other informal sources. Thus, by including this as an element of "children's learning", it should be possible to emphasize the difference in the causes and consequences of different global problems without a specific addition to curriculum load (Boyes et al., 1995), for example, a foreign language education class can explore ozone layer depletion and the means to alleviate this problem on a student's daily life. From the results of this study, it is obvious that global environmental problems should be more formally embedded in to the curricula of both trainee teachers and their students.

Therefore, in order to avoid misconceptions, as it was suggested by Littledyke, (1996) the science education researchers have recommended that various environmental issues and problems be discussed in various science classes. In these science classes the instructors should use student-centered methodologies (such as classroom discussions) rather than teacher-centered methodologies.

For in-service teachers, workshops and refresher courses should be held for the teachers in each school district during the school year and during the summer.

As a matter of fact, the knowledge level of teachers should be determined in order for the presence of misconceptions regarding every contemporary environmental issue to be discovered if we want to achieve the goal of environmental literacy among our future citizens.

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Резюме

ПРЕДСТАВЛЕНИЯ УЧАЩИХСЯ СРЕДНИХ ШКОЛ И СТУДЕНТОВ – БУДУЩИХ УЧИТЕЛЕЙ ЕСТЕСТВЕННЫХ НАУК ОБ ИЗМЕНЕНИЯХ ОЗОНОВОГО СЛОЯ

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Настоящее исследование посвящено обнаружению и описанию научно неверных представлений студентов – будущих учителей естественных наук, а также учащихся средних школ в отношении явлений изменения озонового слоя Земной атмосферы. Взгляды участников были исследованы путём применения вопросника закрытой формы. Анализ полученных данных указывает, что многие учащиеся и студенты - будущие учителя естественных наук имеют ряд научно неверных представлений о нарушениях озонового слоя, причинами и последсвтвиями этого явления. В этом аспекте, связанным с усовершенствованием изучения окружающей нас среды, данное исследование представляет интерес как для учителей, так и для исследователей естественнонаучного образования.

Представляется ясным, что сами учителя не хотят укоренить научно неверные представления, поэтому требуется значительное усовершенствование научно-педагогической работы во время подготовки учителей.

Литературные данные показывают, что подобные проблемы встречаются также в учебном процессе детей, когда необходимо учесть многие научно неверные предубеждения, созданные и создаваемые разными внешкольными источниками информации. Наконец, это касается также трезвого понимания глобальных проблем окружающей нас среды в целом, когда научно неверная информация поступает от средств массовой информации.

Для решения вышеуказанных проблем во всех региональных центрах образования как в течении учебного года, так и во время летнего периода для учителей должны проводится творческие семинары, курсы повышения квалификации и тому подобные мероприятия.

Если мы хотим достичь грамотность в понимании окружающей среды наших будущих граждан, необходимый уровень знаний учителей должен быть определён с учётом имеющихся ряда научно неверных представлений о явлениях в окружающей нас среде.

Ключевые слова: озоновый слой, средняя школа, окружающая среда, естественнонаучное образование.

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