



Research Paper / Makale

**Examination of High School Teachers' Radon Awareness in Terms of
Some Variables**

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Abstract: The aim of the present study is to determine the awareness levels of high school teachers regarding the Radon gas and its environmental effects. Another aim is to compare the results of the current study with those of a previous study carried out by the researchers about the awareness levels of students. Survey design out of quantitative research methods was employed for the study. The sampling of the study consisted of 119 (65 males and 54 females) teachers who were randomly chosen from three different school types in Nevşehir. Radon Awareness Questionnaire developed by the researchers was used as the data collection tool. Since the data collection tool provided discrete data, chi-square test, frequencies and percentages were computed for the analysis of these data. The findings of the study showed that a large number of the participants had fairly low awareness levels toward Radon. Approximately one-third (31.10%) of the teachers participating in the study stated that they had never heard of Radon. A significant difference was found among those who stated that they know radon according to the branch variable. This difference emerged in favor of science teachers according to the branch. There are no statistically significant differences between the score of awareness and the gender, age and years of experience.

Keywords: Radon awareness; science education; environmental education; high school teachers; high school students

**Lise Öğretmenlerinin Radon Gazına Yönelik Farkındalık Düzeyinin Bazı
Değişkenler Açısından İncelenmesi**

Özet: Bu çalışmanın amacı Radon gazı ve onun çevresel etkilerine ilişkin lise öğretmenlerinin farkındalık düzeyinin belirlenmesidir. Çalışmanın bir diğer amacı ise bu çalışmanın sonuçları ile yazarlar tarafından yapılmış olan lise öğrencilerinin Radon farkındalığına ilişkin ilk çalışmanın sonuçlarını karşılaştırmaktır. Çalışmada nicel araştırma yöntemlerinden tarama (survey) yöntemi kullanılmıştır. Çalışmanın örneklemi; Nevşehir il merkezinde bulunan üç farklı okul türünden (Meslek L., Anadolu L. ve Fen L.) rastgele seçilen 119 (65erkek ve 54 kadın) lise öğretmeninden oluşmaktadır. Veri toplama aracı olarak araştırmacılar tarafından oluşturulan Radon Farkındalık Anketi (RFA) kullanılmıştır. Kullanılan veri toplama aracı RFA süresiz türde veriler sağladığından bu verilerin analizinde ki-kare testi, frekans ve yüzde değerleri kullanılmıştır. Örneklemin büyük bir bölümünün Radon farkındalık düzeyi oldukça düşük çıkmıştır. Çalışmaya katılan lise öğretmenlerinin yaklaşık üçte biri (%31,10) Radonu hiç duymadıklarını belirtmişlerdir. Radonu bildiğini ifade edenlerin branş değişkenine göre aralarında anlamlı bir fark bulunmuştur. Bu fark, branş türüne göre Fen Bilimleri branşlarındaki öğretmenler lehine ortaya çıkmıştır. Farklı cinsiyet, yaş ve kıdeme sahip öğretmenlerin farkındalık puanları arasında istatistiksel olarak anlamlı bir fark bulunamamıştır.

Anahtar kelimeler: Radon farkındalığı; fen eğitimi; çevre eğitimi; lise öğretmenleri; lise öğrencileri

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1. Introduction

Protecting nature has always been crucial for the good development of social and economic life. It is possible to list the environmental problems of the modern world as follows: pollution, sustainability of the ecologic balance and rapid consumption of the limited natural sources [1].

Environmental problems are the negative effects of the artificial environment created by people on the natural environment. There is an ecologic balance between the environment and the living things in nature which do not fail thanks to the ordinary processes. Human beings, animals, and plants can maintain their lives as this balance is sustainable without changes. Any failure in this natural balance due to any reason can lead to the fracture in the lifeline between the living organisms, and thus environmental problems come into the question [2]. Environmental pollution is broadly defined as the deposits in the environment which occur as a result of the wastes that are not biodegradable. Moreover, the effects of the pollution may vary according to the quality of the accumulating deposits or deposit groups. In other words, the main reason behind the environmental pollution is that it is not always possible for the nature by itself to dissolve the wastes that arise out of the human effects [3]. Within this context, according to the increasingly prevalent and widespread views in the related literature, environmental pollution cannot be overcome just with an understanding of environment that center the people. In this new perception, development comes to the forefront as a concept that needs to be indispensable anticipated and dealt with the sustainability phenomenon [4].

For the sustainable development, a new understanding that enhances the environmental awareness is required [5]. The importance of creating environmental awareness is often emphasized in the new ecologic paradigm. With this aim, many studies in the field propose that it is a necessity to focus on the environmental education to contribute to the sustainable development of the countries [6,7,8,9].

It is a well-known fact that the main effective factor to protect the nature and prevent the pollution is human beings as they do in the environmental pollution and the deterioration of the ecologic balance. It is clear that individuals with a certain level of education, awareness, and sensitivity regarding the environmental problems, their reasons and solution methods take more active roles in protecting the nature [10]. Providing an effective environmental education for the individuals to raise environment conscious societies is of capital importance [11].

Environmental education is a continuous learning process that provides knowledge, skills, experience and value to solve environmental problems in order to leave a clean and healthy environment for the next generation [12,13]. The studies in the relevant literature indicate that awareness regarding the current environmental problems has a key role in eliminating these problems. Recent environmental problems, such as air pollution, water pollution, soil pollution and radioactive pollution can be listed as the major problems for the human life and future. Radon gas is one of the important contaminants that is closely related to all these pollution types.

Nearly 50% of the natural radiation that permanently exists around us arises from the Radon gas and its short life products. As people spend about 90% of their time in the buildings, it is crucial to determine the radon gas activity in the buildings, to calculate the dose that is taken or to determine the awareness about the existence of this gas and its properties in terms of the precautions that can be taken against its harms [14]. Because the awareness level that is one of the factors influencing the relation of attitudes and behaviors regarding the environment orientates people toward the proper attitudes and behaviors in due course. The studies conducted in the field reveal that a high level of awareness reinforces the attitude-behavior relation [15].

It is quite important to identify the prior knowledge, awareness, and attitudes of individuals about the environment to provide them with an effective environmental education and consciousness [16]. As teachers raise the future generations, guiding them with a well-planned and purposeful environmental education is crucial in terms of preventing and eliminating the environmental problems [17,18]. In this regard, it is considered that identifying and improving the awareness levels toward Radon, that can emerge as a result of the geological structure of the cities people live in, have a great place in forming positive attitudes and behaviors regarding the environment. Therefore, the current study basically aims at determining the awareness levels of high school teachers regarding Radon and its environmental effects. Moreover, the results of the current study will be compared with those of a previous study [19] that was conducted about the Radon awareness by the researchers on the 9th and 12th -grade high school students attending the high schools that the participating teachers of the current study work at. In the related literature, there were no studies on the relationship between teachers' radon awareness and the type of education they have.

The problems of study are;

1. Do the radon awareness scores of the sample differ according to the field?
2. Do the radon awareness scores of the sample differ by gender?
3. Do the radon awareness scores of the sample differ according to the seniority?
4. Do the radon awareness scores of the sample differ by ages?

2. Method

Survey design out of quantitative research methods was used for the current study. Survey studies can be described as the research that determines the characteristics of the participants such as opinions, interests, skills, attitudes etc. on an issue or an event generally with a larger sampling than the other research [20].

Data Collection Tool of The Study and Data Analysis

Necessary permissions to gather data were obtained from the Directorate of the National Education as the first step. Although 125 high school teachers were reached in the study, 119 of the questionnaires were evaluated. The sampling of the study comprised 119 (65 males and 54 females) randomly chosen high school teachers from three different types of high schools (Vocational High School – Anatolian High School – Science High School) in Nevşehir. The participating teachers were examined according to their fields in the three groups. While Science branch included the fields such as physics, chemistry or biology, social studies branch involved the teachers of geography, literature, history etc. Vocational field of study included teachers that teach a specific professional group. These branches were furniture, machines, graphics, electronics, handicrafts, textile etc.

For the collection of data, Radon Awareness Questionnaire (RAQ) that was developed by the researchers to be used for a previous study was employed. To ensure the construct validity of the RAQ, experts in the field were consulted, and test-retest method was used for the reliability of the instrument [19].

RAQ includes three parts. The first part inquiries about the variables such as gender, field of study, years of experience and age; the second part examines the information about the variables such as color, smell, taste, form, source of Radon; and the last part seeks to investigate the variables

regarding the effect of Radon on human health. Minimum and maximum scores that can be taken in RAQ is respectively zero and eight points. As the data collection instrument, RAQ gathers discrete data, chi-square test, frequencies and percentages were used for the data analysis [21].

3. Findings

In this part, firstly, demographic information about the participants is presented and the findings by taking the aims of the study into consideration are given;

The findings related to the participants' gender, the field of study, years of experience and age are shown in Table 1 and Table 2.

Table 1. The distribution of the participants according to the variables of gender, field of study and age

Gender		Age			Total
		22-32	33-43	>44	
Female (54)	Vocational	2	-	2	4
	Social Studies	7	18	6	31
	Science	2	11	6	19
Male (65)	Vocational	1	4	15	20
	Social Studies	-	17	14	31
	Science	-	5	9	14
Total		12	55	52	119

As shown in Table 1, the number of the male teachers is slightly more than the females. Also, the age variable indicates that most of the participants are above the age of 33. According to their field of study, it can be said that the majority of the teachers (N=62) are from the social studies branch. This is followed by science teachers (N=33) and vocational teachers (N=24).

Table 2. The distribution of the participants according to gender, field of study and years of experience

Gender		Years of experience			Total
		1-10	11-20	>21	
Male (54)	Vocational	2	1	1	4
	Social Studies	11	15	5	31
	Science	5	11	3	19
Female (65)	Vocational	-	13	7	20
	Social Studies	5	19	7	31
	Science	1	7	6	14
Total		24	66	29	119

Table 2 illustrates that most of the teachers (N=66) have teaching experience between the years of eleven and twenty. The number of the teachers who have mostly eleven years of experience is 24. The number of the teachers having the highest years of experience in the profession is 29.

The Findings Related to The Radon Awareness of The Participants

The first two items in the RAQ are yes/no questions that examine whether the participants have heard of or know about the Radon. Some important findings regarding the Radon awareness of the participants are given in Table 3.

Table 3. The Distribution of Answers related to Hearing and Knowing about Radon in terms of Gender Variable

Gender			Knowing about Radon		Total
			Yes	No	
Female	Hearing about Radon	Yes	27	8	35
		No	-	19	19
Male	about Radon	Yes	36	11	47
		No	-	18	18
Total			63	56	119

As in Table 3, the number of the teachers who expressed that they had never heard of Radon is 37 (31.10%). This number nearly equals to the one-third of the total participants. On the other hand, 82 (68.90%) of the participating teachers stated that they had heard of Radon, yet only 63 (52.95%) of these teachers knew about Radon. Moreover, none of the participants imported that they knew about Radon although they did not hear about Radon. This finding can be evaluated as an important result for the internal consistency of the research. The numbers of the male and female teachers regarding the situations of knowing and hearing about the Radon is approximately the same in terms of the gender variable.

The findings of whether there is a statistically significant difference between the study fields of teachers and the number of the participants expressing they know about Radon are presented in Table 4.

Table 4. Chi-Square Test Results regarding the Variables of Knowing about Radon and Teachers' study field

		Teachers' Study Field			Total
		Vocational	Social Studies	Science	
Knowing about Radon	Yes	12	24	27	63
	No	12	38	6	56
Total		24	62	33	119

($\chi^2 = 16.169$, df: 2, $p < .05$)

Table 4 indicates that there is a statistically significant difference between the number of the teachers who stated they knew about Radon and their fields of study. According to the table, the highest number (N=27) of teachers expressing their knowledge about Radon is from the Science field. This is followed with the teachers from the Social Studies field (N=24) and vocational teachers (N=12). When the total number of the participants (N=119) is taken into account, it is clear that the number of the participants who state they know about Radon is nearly half of the total participants.

The findings related to whether there is a statistically significant difference between the number of teachers expressing their knowledge about Radon in the RAQ and their genders are shown in Table 5.

Table 5. Chi-Square Test Results for the Variables of Knowing Radon and the Gender

		Gender		Total
		Female	Male	
Knowing about Radon	Yes	27	36	63
	No	27	29	56
Total		54	65	119

($X^2=0.34$, df: 1, $p>.05$)

As seen in Table 5, there is no statistically significant difference between the number of the teachers who stated they knew about Radon and their genders. The number of the male and female teachers who imported that they knew or did not know about Radon is close to each other.

The findings regarding whether there is a statistically significant difference between the number of the teachers expressing their knowledge about Radon in the RAQ and their ages are given in Table 6.

Table 6. Chi-Square Test Results for the Variables of Knowing about Radon and Their Ages

		Age			Total
		22-32	33-43	>44	
Knowing about	Yes	6	28	29	63
Radon	No	6	27	23	56
Total		12	55	52	119

($X^2=0.30$, df: 2, $p>.05$)

According to the Table 6, no statistically significant difference has been found between the number of the teachers expressing their knowledge about Radon and their ages.

The findings for whether there is a statistically significant difference between the number of the participants knowing about Radon and their years of experience are shown in Table 7.

Table 7. Chi-Square Test Results for the Variables of Knowing about Radon and Years of Experience

		Years of Experience			Total
		1-10	11-20	>21	
Knowing about	Yes	12	36	15	63
Radon	No	12	30	14	56
Total		24	66	29	119

($X^2=0.17$, df: 2, $p>.05$)

As it is clear in Table 7, there is no statistically significant difference between the number of the teachers knowing about Radon and their years of experience.

The distribution of the responses given to the 8 questions in the RAQ about the Radon awareness is given in Table 8.

Table 8. The Distribution of Awareness Scores

Awareness Score	Number of Teachers		According to Table 8, the number of the teachers with 0
	f	%	
0	35	29.4	
1	8	6.7	
2	15	12.6	
3	13	10.9	
4	11	9.2	
5	11	9.2	
6	10	8.4	
7	3	2.5	
8	13	10.9	

awareness score is 35 (29.4%). This number is consistent with the number (N=37) of the teachers expressing “I have never heard of Radon” as shown in Table 3.

Radon awareness scores of sampling were analyzed by dividing into three categories. These categories are evaluated as 0- 2 points low level, 3-5 points medium level, 6-8 points high levels of awareness.

The findings regarding whether there is a statistically significant difference between the awareness scores of the RAQ and teachers’ fields of study are presented in Table 9.

Table 9. Chi-Square Test Results for the Variables of Awareness Scores and Fields of Study

Awareness Score	Teachers’ Field of Study			Total
	Vocational	Social Studies	Science	
0-2	14	36	8	58
3-5	6	20	9	35
6-8	4	6	16	26
Total	24	62	33	119

($X^2= 21.22$, df: 4, $p<.05$)

Table 9 shows that there is a statistically significant difference between the awareness scores of the participants and their fields of the study. According to their fields of study, the range of the teachers’ awareness scores which are 6 and above is respectively 16 (13.45%) for Science teachers, 6 (5.04%) for Social studies field and 4 (3.36%) for Vocational teachers.

Table 10 presents the findings of whether there is a statistically significant difference between the awareness scores of the RAQ and the gender variable.

Table 10. Chi-Square Test Results for the Variables of Awareness Scores and Gender

Awareness Score	Gender		Total
	Female	Male	
0-2	27	31	58
3-5	12	23	35
6-8	15	11	26
Total	54	65	119

($X^2= 3.36$, df: 2, $p>.05$)

As can be seen in Table 10, there is no statistically significant difference between the awareness scores of the participants and their ages. The finding of no statistically significant difference according to the gender is consistent with the findings of the chi-square test results (table 5) for the variables of knowing about Radon and the gender.

Table 11 illustrates the findings of whether there is a statistically significant difference between the awareness scores in the RAQ and the age variable.

Table 11. Chi-Square Test Results for the Variable of Awareness Scores and Age

Awareness Score	Age			Total
	22-32	33-43	>44	
0-2	9	26	23	58
3-5	1	17	17	35
6-8	2	12	12	26
Total	12	55	52	119

($\chi^2 = 4.17$, df: 4, $p > .05$)

According to Table 11, no statistically significant differences have been found between the awareness scores of the participants and their ages.

The findings for whether there is a statistically significant difference between the awareness scores of the RAQ and teachers' years of experience are shown in Table 12.

Table 12. Chi-Square Test Results for the Variables of Awareness Scores and Years of Experience

Awareness Score	Years of Experience			Total
	1-10	11-20	>21	
0-2	13	32	13	58
3-5	5	21	9	35
6-8	6	13	7	26
Total	24	66	29	119

($\chi^2 = 1.32$, df: 4, $p > .05$)

Table 12 indicates that there is no statistically significant difference between the awareness scores of the participants and their years of experience on the profession.

4. Results and Discussion

The results elicited through the aforementioned findings have been presented according to the aims of the study which investigates the awareness levels of high school teachers toward Radon in terms of some variables.

It can be stated that the awareness levels of a large number of the participants (48,7%) is quite low. Nearly one-third (31,10%) of the participating teachers expressed that they had never heard of Radon. Only 63 (52,95%) of the participants stating they had heard of Radon imported that they knew about Radon. The number of the participants expressing their knowledge about Radon with the awareness scores of 6 and above is 26 (21,84%).

There has been found a significant difference between the number of the participants stating that they know about Radon and their fields of study (table 4). This difference is in favor of the field of Science teachers (chemistry, physics, biology etc.). However, there is no statistically significant difference between the number of the participants expressing their knowledge about Radon and their gender, ages and years of experience (tables 5-6-7).

Ford et al. [22], and Wang et al. [23], asserted in their studies about Radon awareness that the

awareness appears to be high for the people who have had a science education. A similar finding has been found in the current study conducted with the teachers on the field of Science (chemistry, physics, biology etc.). This can be interpreted as an expected situation since teachers of these branches differ from the teachers of other branches as a result of the courses, seminars, and programs they attend throughout their pre-service and in-service experiences. When their syllabuses of the courses they give at schools especially following their pre-service education are examined, objectives related to the subjects such as Radon seem to continue during class grades [19].

According to the distribution of teachers' Radon awareness scores, the number of the teachers getting 0 score is 35 (table 8). This score is consistent with the number of the teachers (N=37) who expressed that "I have never heard of Radon" as given in Table 3. There has been detected a statistically significant difference between the Radon awareness scores of teachers and their fields of study (table 9). This difference is in the favor of the teachers of Science field. However, there is no statistically significant difference between the Radon awareness scores of the participants and their genders, ages and years of experience (table 10-11-12).

The related literature on Radon awareness indicates that previous studies share the similar results with those of the present study. For instance, in the studies of S. Rahman [24] and Alaamer [25], it is emphasized that the awareness levels of the participants are low and this level is affected by the type of the education participants undergo. Furthermore, these two studies indicate that gender variable has no effect on the awareness levels. There are also some other research studies [26] which show that, even low in number, males have higher levels of awareness than females, and people in rural areas have higher levels of awareness than those in urban areas.

In a study of Daştan [10] conducted with high school teachers, it is aimed to find out the interests, knowledge, and sensitivity of the participants regarding the environmental problems. According to the results of this study, there are differences in the interests and sensitivity levels of participating teachers toward the environmental problems in terms of their years of experience. It is stated that teachers who are younger and have fewer years of experience are more sensitive and interested in the environmental problems. However, when the results of the study are examined in details, participating teachers who are older and have much more years of experience are more sensitive and interested in the issues they see, feel and face (noise pollution, waste problem etc.). Therefore, it can be asserted acceptable that the awareness levels of the participants emerge independently from the variables of age and years of experience in this study which is conducted about Radon gas that is a pollution factor difficult to be seen and felt. Because people's attitudes and awareness towards concrete events and phenomena may appear more clearly [31].

The other aim of the current study is to compare the results of this study with those of a previous one [19] carried out by the researchers on the Radon awareness of high school students. The Radon awareness levels of the participants were mostly low in the first study which was conducted with 554 9th grade and 12th grade students of various high schools in Nevşehir. Nearly half of the participants (55%) stated that they had never heard of Radon. The number of those expressing their knowledge about Radon with the awareness scores of 5 and above is 131 (23,7%) [19]. Similar findings have been found in the present study carried out with teachers. Although the number of teachers stating that they have never heard of Radon is fewer than the number of students, it cannot be regarded as few when teachers' years of experience, initial education and general requirements of the teaching profession are taken into account. In a study conducted by the Ministry of National Education [27], it is apparent that a continuous development and update are emphasized in both the general competencies of the teaching profession and the special competencies of branch teachers in terms of profession knowledge and general culture.

In the earlier study conducted by the researchers on high school students, a statistically significant difference was found between the Radon awareness scores of the students and the school type and class grades. This difference is in the favor of the 12th grades in terms of class grades and science high school in terms of the school type [19]. According to these findings, it is possible to assert that the awareness of the students toward the environmental problems can increase the knowledge levels of the students, the quality of the courses taken (more courses that may be related to the environment at science high schools) and their experiences in the educational environment increase. Another factor which is as important as the knowledge level of an effective environmental education is undoubtedly the need for a role model. Therefore, it is necessary for teachers to raise their awareness levels on these issues as they have crucial contributions by both being a sensitive role model and using appropriate and valid teaching methods [28].

24 teachers from different study fields took part in another study [28] which was carried out to determine to what extent the opinions of teachers about nature and environmental education are influenced by an ecology-based environmental education. One of the results of the study is related to the reasons for participation in the ecology-based education. A large number of the teachers stated that they attended this education with the aim of increasing their awareness levels toward the environment and teaching/transferring their knowledge and skills gained in this process to their students. Another finding is about teachers' allocating time on the environmental issues in their courses. According to this finding, the study fields of the teachers affect their time allocation to the environmental issues in their courses. For instance, while a teacher of biology or geography states that he/she can often give examples of the subjects related to the environment and its problems in his/her courses, it is not much possible to observe the same situation for a preschool teacher [28]. Especially vocational high school students who participated in the first study conducted by the researchers of the current study on Radon awareness [19] and vocational teachers participating in the present study had lower awareness levels (table 9) than the others.

After all, when the findings discussed above are considered, it is claimed that determining the awareness levels toward an issue in terms of different variables for planning the training on the environment and its problems will be useful for creating more rational and effective programs. The related literature has some research studies [29] which prove that the individuals will not have positive perceptions about how they can carry out various actions-activities for their environment when they cannot fully understand their environmental problems (possible sources of the problem, variables that lead to the problem, whether the problem is at global or local level etc.). Moreover, making use of contemporary learning theories and practices in teaching environment by taking the related objectives of the existing curriculum into account is thought to be useful for raising environmentally sensitive individuals. Louv also supports direct experiences in nature as a way to build appreciation for the natural world, cautioning that too much time with technology may prevent children from developing this awareness. Louv suggests young people spend some time playing outside away from their computers and video games; perhaps adults should also heed this advice (as cited in [30], p.570).

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