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Evaluation of Attitudes and Knowledge of Teachers Regarding the Concept of Radiation

Paşa Yalçın [1], Tuğba Karenoğulları [2], Sema Altun Yalçın [3]

Abstract

The purpose of this study is to try to determine the attitude and knowledge levels of teachers regarding radiation. The sample of the research consists of 274 teachers from various branches working in primary and secondary schools in a city with a population of 250 000. Personal data survey and the scale of attitude towards the radiation concept prepared by Torun, Yalçın, and Altun Yalçın (2011) were used in order to collect data. The data obtained were transferred to the SPSS 15 package program and analyzed. Evaluation was done with respect to gender of teachers in the sample, the faculty they graduated from, the institution they work at and the school level they work at and independent t-test was used to compare their opinions obtained. The One-way variance analysis (ANOVA) was used in order to determine whether there are any differences between group variables related to the education branches of teachers in the sample, and the Kruskal-Wallis test was used to determine if there are differences between group variables related to the region of the university of graduation and the educational status of teachers. According to the results of the study, no significant differences were found among teachers in terms of the variables of the level of education, the region of the university of graduation, the faculty of graduation, the institution of employment and the level of education, while significant differences were found in variables the gender of teachers and their education branch.

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[1] Erzincan University, Faculty of Education, Dept. of Mathematics and Science Education, Turkey, pasayalcin@hotmail.com

[2] Erzincan University, Institute of Science and Technology, Dept. of Primary Education, Turkey, aslan_tuba_24@hotmail.com

[3] Erzincan University, Faculty of Education, Dept. of Mathematics and Science Education, Turkey, saltun_11@hotmail.com

Introduction

Radiation can be categorized into ionizing and non-ionizing radiations when considering its effects on matter. Ionizing radiations include cosmic rays, X-rays and the γ-rays emitted by the radioactive decay of radioactive substances, ionized radiation, also in the form of alpha, beta, proton and electron particles. Non-ionizing radiations include ultraviolet, visible light, infrared and microwave, radar, and radiowaves and microwaves. It is possible to define radiation in the most general sense as "energy that travels through space". Within this scope, rapid particles that natural or artificial radioactive nuclei release in order to come into a steady state and their extra energies transferred in the form of electromagnetic wave can also be called "radiation" (Eker, Öden Acar, & Demirkan, 2010). Radiation is the disintegration of radioactive atomic nuclei and its releasing alpha (α), beta (β) and gamma (γ) rays as it turns into a new atomic nucleus (Yılmaz, 1997). The energy, which radiates through energy packages called wave, particle or photon, can also be regarded as a phenomenon that always exists in the nature and we live with.

We live in a world in which radiation naturally exists everywhere. Light and heat emerging from nuclear reactions in the Sun are essential for our existence. Radioactive materials naturally exist in the environment and our body involves radioactive materials. All life on the Earth developed thanks to the existence of radiation (International Atomic Energy Agency [IAEA], 2004; Turkish Atomic Energy Authority [TAEK], 2009). With the discovery of X-rays and radioactivity towards the end of the 19th century, its use in medical and industrial areas has become widespread with an ever increasing rate up till today, which made radiation an inseparable part of our life (Eker et al., 2010). Recently practices of non-ionized radiation have been steadily rising in medicine, communication, industry and daily life. The rapid increase in the use of communication tools boosted the possibility of humans being exposed to radiation. In the wake of these developments the negative effects of devices which create electromagnetic field on human health started to be discussed (Engizek, 1999; Köklü, 2006; Deveci et al., 2007; Düzgün, 2009; Kumaş, 2009).

Radiation use is increasing with the changing technology that continually renews itself and it has penetrated into numerous areas of our daily life. For example, we live close to radiation in mobile phones we use for communication, in microwave ovens we use to warm our food, in hair dryers, in computers and TVs, which are indispensable for us, and in many similar consumer products. Radioactive materials are used for cultivating new and high-quality plant types, increasing agricultural productivity, enhancing the endurance of living creatures, sterilizing medical and pharmaceutical items, diagnosing and treating diseases in medicine, extending the shelf life of foodstuff, measuring thickness and mass in industry, and most importantly as a sustainable energy source. While taking advantage of radiation in every moment of life at such a high degree, we must be aware that it will cause harm if used in excessive amounts. There is some kind of phobia in a large segment of the population about radioactivity, including teachers. Individuals must have adequate knowledge about radiation and the benefits and harms of radiation must be recognized so that these discussions are held in a proper manner (Yalçın & Kılıç, 2005).

The clinical study of Deveci et al. (2007) examined the frequency with which students use devices that create electromagnetic field, such as mobile phones, computers, televisions. It was found out in this study that the frequency of using aforementioned electronic devices was high among students studying in primary schools in the city center of Elazığ. Certain relations that do not depend on the experiment and the reason of which is unknown were discovered between the use of some devices that are thought to create electromagnetic wave field and the disorders reported by students (40.2% upper respiratory tract infection, 10.7% lung infection, 26.7% condition in the body in the form of rash or itching).

In a study conducted in Germany among primary school 4th grade students, the rate of mobile phone possession was found to be 34.7%. 6.2% of the children reported that they used mobile phones at least once a day (Bohler & Schuz, 2004).

In the study by Torun (2012), the attitude and knowledge of undergraduate students about the concept of radiation was investigated. At the end of the study, it was determined that factors such as the department of students, the grade, the area of residence and income status show a significant difference. These studies conducted in various segments of the society, health workers and students show that a positive or negative attitude has not been established about the radiation concept as a result of education. It is also seen from these studies that the reason why a positive or negative attitude has not been established about radiation is the lack of knowledge on the concept of radiation.

A great responsibility falls on education given in schools and on teachers, who are inseparable pieces of schools, to enable that the society follows the developments in the process of interaction with technology and it avoids negative situations that arise with those developments. This is because education is the process of preparing the young members of the society for the existing culture in the society by those members who grew with this culture and creating desired changes in an individual's behaviors through his/her own life (Ertürk, 1982, p. 12). Teachers, who play an active role in establishing the structure of society, have a significant place in this process. Teachers need to follow technological developments closely and develop conscious usage habits in individuals in order to raise conscious generations. We live in a sea full of radiation, some of which are natural, some of which are produced by humans. Sometimes the radiation we use to relieve our misery has a prescription that can also cause our life to end when unconscious and uninformed. The main reason why work is important; It is to determine how the teachers, who are basically the architects of the societies, know the concept of radiation and how they have developed attitudes towards this concept. Although not included as an achievement in primary education programs, these teachers are the architects of the initial attitudes about the benefits and harms of radiation, especially as the individuals in the era of primary education are in every respect. For this reason, primary school teachers were selected as target groups. Although there are studies on sensitivity, awareness, perception and various consciousness raising about the effects of radiation (Miller, 1968; Eijkelhof, Klaassen, & Millar, 1990; Togay, 2002; Prabhat, Sudhakar, Kumar, & Ramaraju, 2011; Mavi, 2008; Prather, 2005; Bakaç, Kartal Taşoğlu, & Usta, 2012; Bakaç, Kartal Taşoğlu, Çınar, & Dönmez, 2012; Abdellah, Attia, Fouad, & Abdel-Halim, 2015), there are inadequate numbers of such studies in the literature. This work; they aimed to determine the level of knowledge about the radiation concept of primary and secondary school teachers and to determine the current state of their attitudes towards radiation. For this purpose, answering the following questions was sought first:

1. Are there differences in knowledge levels and attitudes towards radiation in relation to the concept of radiation according to the fields in which the teachers train?
2. Is there a difference in knowledge levels and radiation versus radiation concept among the teachers according to the school level they are working?
3. Is there a difference in knowledge levels and radiation versus radiation concept of the teachers according to the institution they are working with?
4. Is there a difference in knowledge level and radiation versus radiation concept of the concept of radiation according to the characteristics of teachers' graduates?
5. Is there any difference in knowledge levels and attitudes towards radiation about the concept of relative radiation in the universities where teachers are graduated?
6. Is there any difference in knowledge levels and attitudes towards radiation according to the level of education of teachers according to the concept of radiation?
7. Is there any difference in the level of knowledge about the concept of radiation according to the gender of teachers and their attitude towards radiation?

Method

The survey research method, one of the quantitative research methods, was used in this study. Survey research is a study in which the viewpoints or interests, skills, abilities and attitudes etc. of participants regarding a topic or event are determined and which are usually conducted in larger samples than other studies (Büyüköztürk, Çakmak, Akgün, Karadeniz, & Demirel, 2011).

The study group consisted of 274 teachers working in primary and secondary schools in a city center with a population of 250 thousand in the inner western Anatolia. 68 teachers in the group worked at primary schools and 206 of them worked at secondary schools. The research group was selected by the convenience sampling method, which is one of the unselected sampling methods. Convenience sampling; Due to the limitations in terms of time, money and labor, the sample is selected from easily accessible units that can be accessed (Büyüköztürk et al., 2011). The information regarding the teachers that constitute the experimental group is given in the tables below.

Table 1. The Distribution of Teachers in the Sample according to their Branches of Education

Their Branch of Education	N	%
Form teacher	56	20,4
Science and Technology	34	12,4
Social Sciences	35	12,8
English	34	12,4
Primary Mathematics	37	13,5
Turkish	33	12,0
Other Branches	45	16,4
Total	274	100

Table 1 gives the distribution of the branches of teachers in the sample. It is important to determine whether the teachers are different in terms of their thoughts, feelings and behaviors related to the concept of radiation due to the education they receive in different branches. If there is a significant difference in attitudes towards radiation due to the training they receive, this will be discussed in the conclusion. As can be seen in the table, the branches include form teachers, science and technology, social sciences, English, primary mathematics, Turkish, and other branches (computer, religious culture, painting, music and physical education). The branch with the largest proportion in the sample is form teachers with 56 members. The percentages of the science and technology, social sciences, English and Turkish branches are close to one another.

Table 2. The Distribution of Teachers in the Sample according to their School Levels

School Levels	N	%
Primary	68	24,8
Secondary	206	75,2
Total	274	100

Table 2 presents the distribution of teachers in the school levels they work at. 68 of the teachers in the sample work at primary school level, while 206 of them work at secondary school level.

Table 3. The Distribution of Teachers in the Sample according to the Institution they Work at

The Institution of Employment	N	%
State school	241	88,0
Private Schools	33	12,0
Total	274	100

The distribution of teachers in the sample according to the institution they work at is given in Table 3. According to this table, 33 of the teachers in the sample work at private schools and 241 of them work at state schools.

Table 4. The Distribution of Teachers in the Sample according to their Faculty of Graduation

Faculty of Graduation	N	%
Faculty of Education	196	71,5
Other Faculties	78	28,5
Total	274	100

In Table 4, 196 of the teachers in the sample are graduates of the faculty of education and 78 are graduates of other faculties (faculty of science and letters, faculty of economics and administrative sciences, etc.).

Table 5. The Distribution of Teachers in the Sample according to the Area of their University of Graduation

The Region of the University of Graduation	N	%
Eastern Anatolia Region	8	2,9
Southeastern Anatolia Region	1	0,4
Aegean Region	114	41,6
Mediterranean Region	12	4,4
Central Anatolia Region	93	33,9
Black Sea Region	23	8,4
Marmara Region	23	8,4
Total	274	100

In Table 5, the numbers of teachers in the sample according to their university of graduation and their percentages are given. According to these data, the region with the biggest number of graduates is the Aegean Region with 41.6%, and the region with the smallest number is the Southeastern Anatolian Region with 0.4%.

Table 6. The Distribution of Teachers in the Sample according to their Level of Education

Level of Education	N	%
Undergraduate	248	90,5
Graduate	24	8,8
Doctorate	2	0,7
Total	274	100

Table 6 gives the distribution of teachers in the sample according to their level of education. The levels are classified as undergraduate, graduate and doctorate. 248 of the teachers in the sample have undergraduate degree, 24 have graduate degree and 2 have doctorate degree.

Table 7. The Distribution of Teachers in the Sample according to their Genders

Gender	N	%
Female	140	51,1
Male	134	48,9
Total	274	100

Table 7 gives the distribution of teachers in the sample according to their genders. The sample consists of 140 female teachers and 134 male teachers.

Data Collection Tools

As the data collection tool, the Attitude and Knowledge Scale towards Radiation, which was developed by Torun et al. (2011), and the personal information survey developed by the researcher were used. "The Attitude and Knowledge Scale towards Radiation" consists of 32 items that involves ideas, emotions and behaviors regarding the concept of radiation. The students who answered this scale which is likert type can get a maximum of 160 points and a minimum score of 32. The Attitude and Knowledge Scale towards Radiation was prepared through the steps below:

a. The phase of factor analysis
b. The reliability calculation phase

The Cronbach Alpha internal consistency coefficient was found 0.88 in the assessment instrument. The consistency coefficient was found as 0.85 in the process of calculation for this research. A Cronbach Alpha coefficient of 0.80 and over is regarded as a good level for reliability; therefore, the reliability of the scale was found high.

The personal information survey was prepared by the researcher in order to obtain the personal information of teachers. The questions in the survey were prepared so that they include the gender of teachers, the name of their university of graduation, their faculty of graduation, their branches of education, their status of education, their institution of employment and the school level they work at.

Collection of Data

The data in this study were acquired through the attitude and knowledge scale towards radiation and the personal information survey. The necessary permissions were obtained from the Provincial Directorate for National Education by official correspondence so that the surveys could be implemented. The researcher held face-to-face interviews with the teachers who were willing to take part in the survey at primary and secondary schools in the city center. 312 teachers participated in the surveys. 38 of those surveys were eliminated by the researcher because they were filled mistakenly or deficiently and a total of 274 surveys were evaluated. The surveys were implemented in the free hours of teachers or during breaks so as not to interrupt the education at schools. The surveys, particularly the attitude and knowledge scale towards radiation, were implemented successively. The surveys were completed in 30 minutes in average. The researcher was with the teachers while they completed the surveys. After they were completed, the questions that teachers asked about radiation were answered by the researcher. Especially those teachers who were parents demanded that they were given information about the harmful effects of technological devices that emit radiation.

The Analysis of Data

Each item in the attitude and knowledge scale towards radiation and the personal information survey implemented on teachers were read and analyzed one by one. Those scales that were not completed properly were not evaluated. The attitude and knowledge scale towards radiation and the personal information survey were dealt with together and the teachers in the sample were classified into groups separately with regard to gender, faculty of graduation, institution of employment, school

level, branch, the region of the university of graduation and the status of education. The data obtained from the attitude and knowledge scale towards radiation were entered via the SPSS 15 package program. The frequency and percentages of the sample distributions were calculated using the SPSS 15 package program. Assessment was performed according to the gender status, the faculty of graduation, the institution of employment and the school level of the teachers in the sample and independent t-test was used for comparison of their opinions obtained. One-way variance analysis (ANOVA) was used in order to determine whether there are any differences between group variables in homogeneous distributions. In nonhomogeneous distributions, on the other hand, Kruskal-Wallis test was used. The LSD test was carried out in order to see in whose favor the difference was. With regard to the source of difference, first of all it is looked into whether the variances show a homogeneous distribution or not. If they show a homogeneous distribution, the Scheffe, LSD and Tukey tests, and if they do not show, the Dunnet's C test is implemented (Sow, 2014). Analysis was performed taking the total attitude scores of each individual into consideration. The analysis about the gender, faculty of graduation, institution of employment, and school level was performed according to the results of the independent t-test; the analysis about the branches of teachers in the sample was performed according to the results of the One-way variance analysis (ANOVA); and the analyses about the region of the university of graduation and the educational status of teachers in the sample was performed according to the results of the Kruskal-Wallis test.

Results

The data obtained in the study were analyzed using various methods and techniques. The findings of the analyses were presented in line with the problem statements of the study.

The Attitudes of Teachers towards the Concept of Radiation Based on the Gender Variable

Table 8. Findings Regarding the Attitudes of Reachers towards the Concept of Radiation Based on the Gender Variable

Gender Status	N	$\bar{X}$	S.s.	T	p*
Male	134	115,13	12,265	-2,337	0,020
Female	140	118,24	9,596		

p*<0,05

When Table 8 is investigated, it is seen that the arithmetic mean of male teachers is $\bar{x}$=115.13 while that of female teachers is $\bar{x}$=118.24. According to this result, it can be seen that the attitudes of teachers towards the radiation concept constitute a significant difference at p<0.05 level. This difference of opinion is in favor of female teachers. Based on this finding, it can be said that female teachers are more sensitive and create a more positive attitude towards the radiation concept compared to male teachers.

The Attitudes of Teachers towards the Concept of Radiation Based on the Branch Variable

Table 9. The Attitudes of Teachers towards the Concept of Radiation Based on the Branch Variable

Branch	N	$\bar{X}$	S.s.	F	p*
Form teacher	56	117,6	11,4	7,5	0,001
Science and Technology	34	123,2	7,8		
Social Sciences	35	111,8	10,9		
English	34	114,2	8,4		
Primary Mathematics	37	122,2	13,0		
Turkish	33	110,8	10,9		
Other	45	116,0	8,1		

p*<0,05

It is seen that there is a significant difference at p<0.05 level between their opinions regarding their attitudes towards the radiation concept based on the education branch variable. According to this picture, it can be expressed that the teachers' opinions on their attitudes towards radiation are affected by their branch of education. Moreover, the intergroup and intragroup interaction in expressing the significance is given in Table 10.

Table 10. The Results of One-Way Variance Analysis (ANOVA) Carried Out to Test Whether there Are Differences between the Attitudes of Teachers at Primary and Secondary Schools towards the Radiation Concept Based on the Branch Variable

Variance Source	Sum of Squares	Sd	Mean of Squares	F	p
Intergroup	4852,0	6	808,6	7,5	0,001
Intragroup	28613,3	267	107,1		
Total	33465,3	273			

p*<0,05

The analyses show that there is a statistically significant difference between the success levels of groups. The ANOVA table shows whether there is a significant difference between groups, but does not show from which group that difference arises. Post Hoc tests are used to see which group the difference between groups arises from. Based on the findings of our study, the groups from which the difference arises are revealed in Table 11 as a result of the Post Hoc tests.

Table 11. The Results of One-Way Variance Analysis (ANOVA) Carried Out to Test Whether there are Differences between the Attitudes of Teachers at Primary and Secondary Schools towards the Radiation Concept Based on the Branch Variable

		Mean Difference	P
Science and Technology Teacher (STT).	FT	5,687	0,384
	SST	11,494(*)	0,002
	PST	9,029(*)	0,048
	PMT	1,024	1,000
	TT	12,415(*)	0,001
	Other	7,250	0,152
Social Sciences Teacher (SST)	F.T.	-5,807	0,345
	STT	-11,494(*)	0,002
	PST	-2,465	0,986
	PMT	-10,470(*)	0,006
	TT	,921	1,000
	Other	-4,244	0,769
Primary Mathematics Teacher (PMT)	F.T.	4,663	0,607
	STT	-1,024	1,000
	SST	10,470(*)	0,006
	PST	8,006	0,106
	TT	11,391(*)	0,002
	Other	6,226	0,294

Table 11. Continued

		Mean Difference	P
Turkish Teacher (TT)	F.T.	-6,728	0,191
	STT	-12,415(*)	0,001
	SST	-,921	1,000
	PST	-3,386	0,937
	PMT	-11,391(*)	0,002
	Other	-5,166	0,578

P<0,05*

In determining whether there was a meaningful difference between the attitudes of the teachers in the sampling group related to the concept of radiation, as a result of the " Post Hoc" Scheffe analysis to observe the difference in their branches, it was seen that there was no significant differences between the science and technology teachers, primary school teachers (p>0,05) and secondary school mathematics teachers (p>0,05). However, a significant difference was found between science and technology teachers and social sciences teachers (p<0.05), English teachers (p<0.05) and Turkish teachers (p<0.05).

There is not a significant difference between social sciences teachers and form teachers (p>0.05), English teachers (p>0.05), Turkish teachers (p>0.05) and teachers from other branches (p>0.05). There is no significant difference between Turkish teachers and social sciences teachers (p>0.05), social sciences teachers (p>0.05), English teachers (p>0.05) and teachers from other branches (p>0.05) in terms of their attitudes towards radiation.

However, a significant difference was found between social sciences teachers and science and technology teachers (p<0.05) and primary mathematics teachers (p<0.05).

There is no significant difference between primary mathematics teachers and form teachers (p>0.05), science and technology teachers (p>0.05), English teachers (p>0.05) and teachers from other branches (p>0.05). However, a significant difference was found between primary mathematics teachers and social sciences teachers (p<0.05) and Turkish teachers (p<0.05).

There is no significant difference between Turkish teachers and social sciences teachers (p>0.05), social sciences teachers (p>0.05), English teachers (p>0.05) and teachers from other branches (p>0.05). However, a significant difference was found between Turkish teachers and science and technology teachers (p<0.05) and primary mathematics teachers (p<0.05). According to our conclusion from these data, there is a significant difference with some form teachers, while no such difference was found for others. It can be said that these findings are the result of the variety of programmes the teachers studied at.

The Attitudes of Teachers towards the Concept of Radiation Based on the School Levels they Work At

Table 12. Findings Regarding the Attitudes of Teachers towards the Radiation Concept Based on the School Levels they Work At

School Level	N	$\bar{X}$	S.s.	F	p*
Primary	68	117,9	11,2	0,104	0,747
Secondary	206	116,3	11,3		

p*<0,05

It is seen in Table 12 that there is no significant difference between the attitudes of teachers whose opinions were gathered as to the radiation concept based on the school levels they work at (p>0,05). According to these data, it can be commented that the school levels of teachers do not influence their attitudes towards radiation. The attitudes of teachers working at primary schools and those working at secondary schools towards radiation have similar characteristics.

The Attitudes of Teachers towards the Concept of Radiation Based on the Institution of Employment Variable

Table 13. Findings Regarding the Attitudes of Teachers towards the Concept of Radiation Based on the Institution of Employment Variable

Institution of Employment	N	$\bar{X}$	S.s.	F	p*
Private School	33	114,4	8,7	2,7	0,098
State School	241	117,0	11,3		

p*<0,05

It is seen in Table 13 that there is no significant difference between the attitudes of teachers, whose opinions were obtained regarding the radiation concept based on the institution of employment variable (p>0.05). According to these data, it can be concluded that the institutions the teachers work at do not influence their attitudes towards the radiation concept. The attitudes of teachers working at private schools and those working at state schools towards radiation show similarities.

The Attitudes of Teachers towards the Concept of Radiation Based on the Faculty of Graduation Variable

Table 14. Findings Regarding the Attitudes of Teachers towards the Concept of Radiation Based on the Faculty of Graduation Variable

Faculty of Graduation	N	$\bar{X}$	S.s.	F	p*
Faculty of Education	196	116,6	11,3	1,2	0,261
Other Faculties	78	117,0	10,4		

p*<0,05

At the end of the analysis performed, it is seen in Table 14 that there is no significant difference between the attitudes of teachers, whose opinions were obtained regarding the radiation concept based on the faculty of graduation variable (p>0.05). According to these data, it can be said that teachers' faculty of graduation does not influence their attitudes towards the radiation concept. The attitudes of teachers who graduated from various faculties and those from the faculty of education towards radiation bear similar characteristics.

The Attitudes of Teachers towards the Concept of Radiation Based on the Educational Status Variable

Table 15. Findings Regarding the Attitudes of Teachers towards the Concept of Radiation Based on the Educational Status Variable

	Educational Status	N	Mean Rank	Chi-Square	p*
Attitude	Undergraduate	248	137,93	0,177	0.916
	Graduate	24	134,77		
	Doctorate	2	116,50		

p*<0,05

Kruskal-Wallis test was performed to analyze the attitudes regarding the radiation concept based on the educational status variable. It is seen that there is no significant difference between the attitudes of teachers in the sample towards radiation based on their educational status (p>0.05). As a result of this analysis, it can be commented that teachers' educational status does not influence the attitudes they develop towards radiation. The attitudes of teachers who have undergraduate, graduate and doctorate degrees show similarities.

The Attitudes of Teachers towards the Concept of Radiation Based on the Region of the University of Graduation

Table 16. Findings Regarding the Attitudes of Teachers towards the Concept of Radiation Based on the Region of the University of Graduation Variable

	The Region of the University of Graduation	**N**	**Mean Rank**	**Chi-Square**	**p***
Attitude	Eastern Anatolian Region	8	141,81	2,192	0,901
	SE Anatolian Region	1	62,00		
	Aegean Region	114	134,80		
	Mediterranean Region	12	121,63		
	Central Anatolia Region	93	138,77		
	Black Sea Region	23	145,61		
	Marmara Region	23	147,67		

p*<0,05

It is seen in Table 14 that there is no significant difference between the attitudes of teachers, whose opinions were obtained regarding the radiation concept based on the university of graduation variable (p>0.05). According to these data, it can be said that teachers' opinions on their attitudes towards the radiation concept are not influenced by the region of their university of graduation. The attitudes of teachers who studied in different regions towards radiation have similar characteristics.

Conclusion and Suggestions

This part of the study includes the methodology of the study, the data acquired within the study scope, the results obtained by examining the comments, and recommendations for leading prospective research studies in the future by linking the results with the research findings and for making suggestions.

Conclusion

With the developing technology, radiation appears in almost all areas of education. Smart board systems in the classes, tablet computers given to students, Internet network systems in the schools etc. are among the objects that emit radiation. While objects that emit radiation are used so frequently in the education sector, unawareness of the radiation concept and unconscious usage will be a great deficit. It is an unavoidable fact that education must be given on radiation at university level, particularly in undergraduate programs that train teachers (Türkkan, Çerezci, Kartal, Pala, & Türkkan, 2012).

Conceptional, informational and usage objectives must be included starting from primary school years to the last phases of education programs in order to convey awareness of radiation in lives of individuals. An awareness of radiation must be given in childhood. Teachers must be equipped and informed about radiation so that this awareness is acquired. The fact that teachers are sensitive about the advantages and disadvantages of radiation and have adequate knowledge on them mean that they can help develop an awareness about radiation all the segments of society. However, conceptional knowledge about radiation is not included adequately in university curriculums. It is covered in merely graduate education in research centers of universities under specific topics. It is seen that it is given as an elective course in the related departments of health sciences faculties and in some units of certain

universities. Moreover, it is observed that the positive and negative aspects of radiation are not included among the objectives of science and technology lessons in primary and secondary schools, and the precautions that must be taken in order to minimize the harms of radiation are not addressed.

Results Regarding Teachers' Attitudes towards the Radiation Concept Based on the Gender Variable

A significant difference was found in the attitudes of teachers towards the concept of radiation in terms of gender. This difference is in favor of female teachers. It can be said that female teachers develop a more positive attitude towards the radiation concept than male teachers, thus they behave in a more sensitive way. The main reason for such an outcome is maternal sentiment and may be a warning to women for health facilities.

Results Regarding Teachers' Attitudes towards the Radiation Concept Based on the Branch Variable

A significant difference was found between the attitudes of teachers towards the concept of radiation in terms of the branch variable. According to the data in Table 9, the results of the attitudes towards radiation were in favor of science and technology teachers and primary mathematics teachers. This might arise from the fact that the curriculums of the departments from which teachers graduated vary. The attitude towards radiation education was positive among science and technology teachers and primary mathematics teachers. This might result from the fact that the students who studied at science classes at high school took chemistry and physics lessons. Furthermore, the positive results in favor of science and technology teachers might arise from special topics in physics and chemistry in the curriculum of science and technology teaching and theoretical radioactivity topics in general chemistry lessons. Technological materials needed for their branches of education might also result in awareness of radiation.

Results Regarding Teachers' Attitudes towards the Radiation Concept Based on the School Level Variable

No significant difference was found between the attitudes of teachers towards the concept of radiation in terms of the school levels. The attitudes of teachers working at primary schools and those working at secondary schools towards radiation show similarities. This may be because there are no or not adequate courses and objectives in the curriculum of primary and secondary school teachers at university which will help them develop a positive attitude towards the concept of radiation.

Results Regarding Teachers' Attitudes towards the Radiation Concept Based on the Institution Of Employment Variable

No significant difference was found between the attitudes of teachers towards the concept of radiation in terms of the institution of employment. No difference was observed between teachers working at private schools and those working state schools in terms of developing an attitude towards the concept of radiation. Thus, it can be said that during in-service trainings and seminars given in state and private schools, no education that will help teachers demonstrate a positive attitude towards the concept of radiation is given.

Results Regarding Teachers' Attitudes towards the Radiation Concept Based on the Faculty of Graduation Variable

No significant difference appeared between the attitudes of teachers towards the concept of radiation in terms of the faculties of graduation. When the faculty of graduation is analyzed, the teachers were considered as those who graduated from education faculties and those who did not. At the end of the analysis, no difference was found between teachers who are education faculty graduates and those who graduated from other faculties (other than education faculties) in terms of attitudes towards the concept of radiation.

Results Regarding Teachers' Attitudes towards the Radiation Concept Based on the Education Variable

No significant difference appeared between the attitudes of teachers towards the concept of radiation in terms of the education status. The attitudes of teachers who have undergraduate, graduate and doctorate degrees bear similarities. Those teachers who completed graduate and doctorate education did not develop a positive attitude towards radiation unlike those with undergraduate degree. Depending on this information, it can be concluded that training is not given on radiation in graduate and doctorate education.

Results Regarding Teachers' Attitudes towards the Radiation Concept Based on the Region of the University of Graduation Variable

No significant difference was found between the attitudes of teachers towards the concept of radiation in terms of the region of the university of graduation. This study was conducted in a city with a population of roughly 250 thousand in the western part of the Central Anatolia. Since it was performed with teachers who were in this city, the majority of teachers were from this particular city or from nearby cities. Therefore, depending on the region of the university of graduation, there was no significant difference among attitudes of teachers towards radiation. This sub-problem was arranged considering that the attitudes among the teachers, studying nearby the boundary province areas where had more radioactive spread as Chernobyl nuclear power plant, were more different. However, as there was significant possibility that most of the teachers in the place of study area may have graduated from the universities located in the central Anatolia, the expected effect might not have been observed. Similar studies can be planned considering his point may be taken into.

It is seen that the study area will contribute significantly to attitudes, knowledge and awareness studies against the concept of radiation which has been done in a very few times. With the developing technology, we live together with radiation sources at home, school, and work. Now that we live such close to radiation sources, it will be inevitable that we acquire sufficient knowledge about the concept of radiation and develop sensitivity to radiation. In this study, the behaviors of teachers are deemed significant in terms of developing attitudes among students especially in school age towards radiation. Thus, this study is aimed at drawing attention to topics that require social sensitivity about the concept of radiation. For instance, in the study conducted with the Norwegian high school students at the age of 16 "High School Students' Understanding of Radiation and the Environment: Can Museums Play a Role?" it was referred in terms of the radiation, teachers, teaching methods and techniques and the concept of scientific education had significant role in education (Henrıksen & Jorde, 2001). Similarly, in a study with the students in the faculty of dentistry on the protection of radiation on their knowledge, attitude and conception, it was stressed to the importance of the continuous education in order to specifically protection of the radiation and provides maximum safety (Prabhat et al., 2011). Emphasis is put on being aware of the fact that radiation is in every sphere of life of today's human beings, creating a conscious society and having adequate knowledge on radiation. According to the results of the researches on radiation, it is seen that all the workers have the need for education on radiation. It was referred by O'Sullivan et al. (2010) that short period and repeated educations have positive effects in raising the awareness. Instead of describing radiation only as "harmful", the need of handling radiation in every respect and living consciously with radiation is stressed. It is addressed in which conditions radiation will be harmful and how it is possible to minimize this harm. Moreover, it is denoted that the objects that might be sources of radiation in our living space must be used only in the required amounts.

Suggestions

Considering this study, the attitudes towards the concept of radiation in each segment of the society can be measured and individuals in each age group can be informed about the concept in line

with the findings obtained. Such studies are much needed so that we can understand how necessary and important it is to gain knowledge about the radiation concept in the society. Materials that can develop attitudes about radiation are needed in education, schools, course books, and social media. By taking into consideration the findings of this study, the related recommendations can be stated as below:

- ✓ Human beings meet radiation in the womb and they benefit from numerous advantages of radiation while they are not aware of its many harmful effects. It is seen that insufficient knowledge is given in programs of education faculties of universities. It is only given in education faculties of certain universities as elective courses. Information must be given about the beneficial usage areas and harmful effects of radiation in appropriate departments of almost every program of the education faculties. Thus, education on radiation that will be given to teachers in the curriculum of education faculties might help reshape the society and grow a more conscious posterity.
- ✓ When the old and new curriculums of primary, secondary and high schools are examined, it is seen that no information is given about the concept of radiation in the curriculums. A study similar to this one can be implemented with primary, secondary and high school students and their attitudes towards radiation can be determined. The objectives "takes advantage of technological products and is aware that they emit radiation", "knows the benefits and harms of radiation", "knows methods to minimize the harms of radiation", "is aware that radiation entered into every part of our lives with technology", and "learns how to live with radiation and develops sensitivity towards radiation" can be placed in the primary, secondary and high school curriculums according to the education level. An awareness of radiation can be developed among students by taking into consideration technology and radiation together.
- ✓ This study only covers a city with a population of 250 thousand in the west of the Central Anatolia. Considering the conditions of each city, this study can be implemented in teachers in other cities and the findings to be obtained can be compared to the findings of previous studies.
- ✓ A radiation attitude scale can be prepared according to the level of students studying at primary and secondary school and their knowledge and attitudes can be measured. Seminars or different activities can be organized that can inform students according to the results and they can be assisted in developing sensitivity towards radiation.
- ✓ This study measured the attitudes of teachers towards radiation. But, in the study by Şaşkın (2009), the results obtained despite warnings "ATTENTION! RADIATOON AREA" and "PREGNANT WOMEN AND WOMEN EXPECTING TO BE PREGNANT SHOULD NOT ENTER" and the results of this study support each other and show us that studies as to radiation can be implemented multiple times in every segment of the society. Studies similar to this which measures knowledge and attitude of radiation can be carried out in other occupational groups that constitute the society, because it will only be possible for the society to be sensitive towards radiation in this way.

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