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Electromagnetic Pollution Awareness Scale

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ABSTRACT In this study, it is aimed to develop a valid and reliable instrument to measure electromagnetic pollution awareness of pre-service teachers. At the test construction process, the related literature was reviewed, expert opinions were taken, and items developed for the scale: Electromagnetic Pollution Awareness Scale[1]. This scale was administered to 476 second and third grade pre-service teachers from a university at west region of the Anatolia. Factor analyses results showed that the Electromagnetic Pollution Awareness Scale has four factors that explain 50.13% of the variance. Moreover, Cronbach's alpha coefficient was found to be .92.

1. INTRODUCTION

Parallel with the technological developments that increase rapidly and continuously, electronic devices has an important place in every moment of our life. These devices, mainly mobile phones and computers, have become indispensable objects that people need at home, office, schools, etc. The rising generation uses these devices actively and effectively, therefore we have them in our life inevitably. However, in addition to all of the advantages that make things to be done easily, there are some negative sides of the use of these devices. The devices radiating electromagnetic waves may have side effects such as deforming the tissues. There are several researches that investigate the possible effects of electromagnetic waves. When we look into these researches, it cannot be said that the electromagnetic field has direct effects on biological systems especially on human health; however, it is also impossible to say that it is harmless (Sorgucu et al. 2011).

Every creature in the earth produces an electromagnetic field. Similarly, heart, brain, veins, and all the other organs of the human beings produce electromagnetic fields. These organs have harmony with themselves and their environments. However, this harmony can be disrupted with external factors. Electromagnetic field is one of these external factors. Parallel with the technological developments, the electronic devices that human beings invented create electromagnetic pollution. The electromagnetic fields radiated by the electronic devices can harm the magnetic balance of the organisms (Sarigoz et al. 2012; Sarmasik et al. 2012).

Power lines, mobile phone base stations, radio-TV transmitters, computers, and other sources of electromagnetic waves produce an environment that is not good for health (Bold et al. 2003), and these type of devices cause electromagnetic pollution (Cansiz and Kurt 2012). As the research studies are carried out to determine electromagnetic pollution, mobile phone base stations are becoming to be the focal point. However, interaction of the electromagnetic wave and organisms are still a controversial issue, therefore, the debate on this issue are seem to be continue for a long time (Sevgi 2004).

Electromagnetic pollution exists in human's life inevitably. Exposure to this electromagnetic pollution is beyond to self-control. According to many research studies since 1960s, people who live near the power lines causes suffer from diseases such as lung cancer (Cerezci 2010). American Science Academy accepted that children who live near power lines takes the more risk of having leukemia than the children living at other areas (Seyhan 1999). In 1994 and 1998, at the research studies conducted in USA and Finland, it was concluded that the people exposed to the electromagnetic waves at their works (radio operators, industry workers, data processing device repairmen, telecommunication workers, and power station workers) have around 4-9 times more risk to become Alzheimer than the other people do (Bold et al. 2003).

Effects of electromagnetic waves radiated by base stations and radio-TV transmitters on hu-

man health have not detected completely yet (Cerezci 2010). The studies in this area are kept going continuously. Electromagnetic waves radiated by base stations and mobile phones pass through tissues containing ions and make them vibrate. This causes cell membrane's vessels to open and close unconsciously and that makes cell functions to go wrong (Panagopoulos et al. 2000, 2002). Depending to use of mobile phone and the duration of its usage, it is known that diseases such as dizziness, concentration disorder, headache, depression, and ear ache arises (Cherry 2000). In order to reaching precise conclusions, the research studies continue; however, one should be aware of the side-effects and be sensitive about the electromagnetic pollution. At developed societies, the idea of being sensible and taking precautions is taken up seriously. Therefore, when discussing current issues such as global warming, climate changes, air pollution, water pollution, and sound pollution, electromagnetic pollution should also be discussed to make people conscious about this issue.

Because of all the examples given above, we are aware that the perceptions and awareness of the people about the possible harms of electromagnetic waves on human health should be measured. Therefore, there is a need to have such scale to help us to measure that. In the current study the researchers aimed to develop a scale to measure electromagnetic pollution awareness of pre-service teachers. This scale will help us to exhibit concerns about possible effects of electromagnetic waves on environment and health.

2. METHOD

2.1 Sample

The sample of the study was 476 pre-service teachers (330 female and 146 male) from a university at west region of the Anatolia. These pre-service teachers were at second and third grades and from the department of elementary education (social science teaching, classroom teaching, and science teaching). The data were collected from this sample at the spring semester of 2012-2013 academic year.

2.2 Instrument

In the current study, the data was collected with Electromagnetic Pollution Awareness Scale (EPAS). The EPAS was developed by the researchers. The EPAS has 29 Likert type items rated on a five point scale: strongly disagree, disagree, neutral, agree, and strongly agree. These responses were coded as 1, 2, 3, 4, and 5, respectively. Therefore, the possible maximum score was 145 and the possible minimum score was 29.

(1) Item Development: In order to write the items, the first step was to review the related literature. At this step, related studies were reviewed carefully. With the help of the results of the studies, the researchers developed 50 items that aim to measure electromagnetic pollution awareness of pre-service teachers. These 50 items constituted the draft version of the EPAS. At this step, the items were reviewed by the panel of the three researchers to ensure clearness of the items and consistency with the purpose of the scale.

(2) Expert Opinions: The draft version of the EPAS was provided to five experts that has PhD in science education and related fields. In addition to these five experts, the items were checked by two language experts to ensure the correctness of its grammatical structure. After getting the expert opinions, the items were slightly revised and administered to 30 pre-service teachers. This step helped us to see if the items were understood as intended to be by the pre-service teachers. Moreover, readability, and semantic structure of the items were also checked with the help of this implementation. After this step, the researchers have made several changes on the items that come out to be different than what they should be.

(3) Implementation: After all the revisions, the EPAS was administered to 476 pre-service teachers. The data collected from this sample was analyzed. Item-scale correlations and alpha coefficients were calculated. The items with the item-scale correlation values less than 0.3 (Item 5, 6, 7, 8, 11, 17, 21, 28, 29, 35, 36, 40, 41, 42, 43, 44, 45, 46, 47, 48, and 49) were excluded from the scale. After that the remaining 29 items were used in the future analyses. The Cronbach's alpha coefficient of the final version of the EPAS which has 29 items was found to be .92. Moreover, exploratory and confirmatory factor analyses were carried out to confirm factor structure of the EPAS. The results of the analyses can be seen in subsequent sections. The EPAS has four sub-dimensions: electromagnetic pollution and

ecosystem, perception of electromagnetic pollution, effects of electromagnetic pollution on health, and electromagnetic pollution awareness.

3. RESULTS

3.1 Construct Validity

In order to have evidence about construct validity of the EPAS, factor analysis was carried out. The exploratory factor analysis (EFA) was carried out with Principal Component Analysis with Varimax rotation. Moreover, in order to determine relationships between total score and scores of the sub-dimensions, Pearson correlation coefficients were calculated. Barlett test of sphericity and Kaiser Meyer Olkin (KMO) coefficient of sampling adequacy were used to see if we have an interpretable data set. KMO was found to be .93 and Barlett test of sphericity were significant. Therefore it can be stated that our data set is suitable for factor analysis (Tavsancil 2006; Buyukozturk 2008).

Eigenvalues and Scree plot was taken into account at the process of factor extraction. There were four factors with the eigenvalues over 1. Moreover, this can also be seen in the Scree plot (see Fig. 1).

These four factors of the EPAS explain 50.13% of the variance of the data. At a well-constructed scale, this value is expected to be high. If there is a single factor, the values around 30% are enough. However, if there is more than one factor, the higher percentages were required (Buyukozturk 2008). Here, 50.13% is acceptable for four-factor scale. The explained variance in for each factor can be seen in Table 1. Explained variance percentages for each factor and cumulative explained variance percentages are at acceptable levels.

Table 1: Factor structure of the EPAS

Factor	*Eigenvalue*	*Variance (%)*	*Total variance (%)*
Factor 1 - Electromagnetic pollution and ecosystem	5.059	17.444	17.444
Factor 2 – Perception of electromagnetic pollution	3.444	11.875	29.319
Factor 3 – Effects of electromagnetic pollution on health	3.202	11.043	40.361
Factor 4 – Electromagnetic pollution awareness	2.832	9.764	50.125

Item distributions to sub-dimensions can be seen in Table 2. Moreover, descriptive statistics such as factor loadings, item-total correlation, mean, and standard deviation of each item.

As can be seen in Table 2, factor loadings of all 29 items range from .37 to .77. Eight items of the EPAS were loaded on Factor 1, seven of

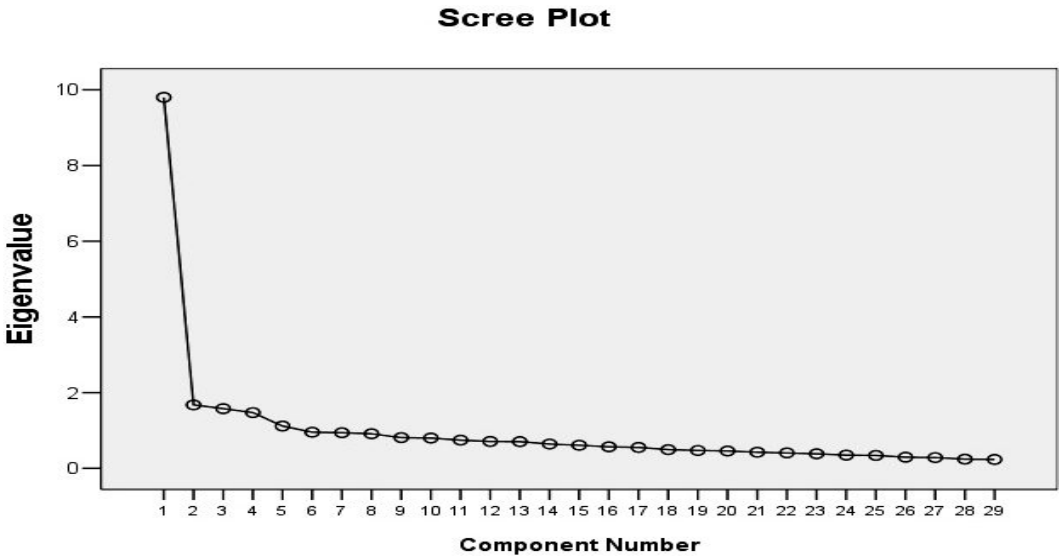

Fig. 1. Scree plot of the EPAS

Table 2: Factor loadings, item-total correlations, mean, and standard deviations of each items

Factor	*Item #*	*Factor loading*	*Item-total correlation*	*Mean*	*Standard deviation*
Factor 1	Item24	.77	.63	4.3151	.69393
	Item26	.74	.66	4.2080	.72709
	Item23	.71	.63	4.2248	.64718
	Item25	.70	.68	4.2332	.72709
	Item27	.68	.52	4.1155	.84186
	Item22	.62	.56	4.1555	.78203
	Item39	.51	.64	4.2626	.76801
	Item37	.42	.56	4.2500	.73878
Factor 2	Item31	.71	.51	3.8634	.86100
	Item30	.65	.61	4.1008	.76111
	Item33	.64	.65	4.1891	.76362
	Item32	.61	.70	4.1408	.76718
	Item10	.51	.37	3.8067	.96269
	Item34	.50	.56	4.1429	.83387
	Item38	.37	.48	3.8445	.88078
Factor 3	Item16	.70	.55	4.3508	.86379
	Item15	.63	.65	4.4076	.71809
	Item20	.57	.66	4.4160	.73933
	Item50	.56	.36	4.2437	1.03388
	Item13	.54	.38	4.3445	1.00890
	Item14	.49	.46	3.9349	.93243
	Item18	.45	.45	3.7290	.94037
	Item19	.44	.56	4.4013	.73465
Factor 4	Item2	.70	.32	3.9643	.86132
	Item4	.63	.37	3.8550	.81175
	Item1	.62	.39	3.7458	1.06251
	Item3	.61	.45	4.3445	.75043
	Item12	.41	.45	4.2227	.76557
	Item9	.39	.46	3.9664	.75598

them at Factor 2, eight of them at Factor 3, and the remaining six items were loaded on Factor 4. Moreover, each of the items was loaded on respective factors only. The results of the EFA suggested retaining all of the 29 items for the EPAS. Furthermore, correlations between each factor scores and between factor scores and total scores were found to be significant (see Table 3). The highest correlation between each factor was .695, whereas the lowest value was .483. This values show us that there is no multicollinearity and sub-dimensions of the EPAS are intercorrelated which is expected to be.

Table 3: Correlations between factor scores and total score

	Factor 1	*Factor 2*	*Factor 3*	*Factor 4*	*Total*
Factor 1	1	,695**	,634**	,507**	,873**
Factor 2	,695**	1	,622**	,492**	,856**
Factor 3	,634**	,622**	1	,483**	,847**
Factor 4	,507**	,492**	,483**	1	,715**

** $p<0.01$

3.2 Internal Consistency

In order to check internal consistency of the EPAS, Cronbach's alpha coefficients were calculated for each dimension and for all items. It was found to be .92 for the EPAS. Moreover, the coefficient values were found to be .88 for the Factor 1, .81 for the Factor 2, .79 for the Factor 3, and .69 for the Factor 4. All of these values are acceptable. Therefore, it can be said that the items that constitutes the EPAS are consistent with each other and help us to collect reliable data.

4. DISCUSSION

The EPAS has four factors to measure electromagnetic pollution awareness of pre-service teachers. These factors are as follows: Electromagnetic Pollution and Ecosystem, Perception of Electromagnetic Pollution, Effects of Electromagnetic Pollution on Health, Electromagnetic Pollution Awareness. The results of the factor analysis showed that the each items on the EPAS has a significant contribution to the corresponding factor. Moreover, internal con-

sistency for the overall scale and each factor was acceptable (minimum Cronbach's alpha was .69). There is no such scale found by the researchers in the literature. Therefore, the EPAS will serve as an valid and reliable instrument for the researchers to measure electromagnetic pollution awareness.

5. CONCLUSION

As a conclusion, it can be said that the EPAS is a reliable and valid instrument to measure electromagnetic pollution awareness of pre-service teachers. With the use of the EPAS, we can have detailed information about our future teachers on this issue, and we can further talk about the how to increase this awareness.

6. RECOMMENDATIONS

The EPAS is a valuable instrument to measure electromagnetic pollution awareness of pre-service teachers. However, it can be recommended to adapt and use the EPAS for the students from different grade levels such as elementary and secondary levels. Such usages can help us to measure and increase awareness of the students about the possible harms of electromagnetic waves on human health.

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