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Environmental Education, a Way to Introduce and Improve Urban Environmental Pollution

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Background: In this study, high school students in Tehran were selected to investigate the role of environmental education in the prevention and control of pollution.

Objectives: In this regard, 10 high schools from different areas of Tehran City were used to implement an Environmental Education (EE) intervention program.

Patients and Methods: The students of 5 high schools (first group) were trained by the paper-based guidebook and students of other 5 high schools (second group) trained by a teacher (EE expert). This study has been designed as a quasi-experimental pretest/posttest design with comparison groups. The impact on the participant's environmental literacy was assessed by measuring a number of environmental literacy components, including knowledge, attitude, values, and concerns as well as behavioral intention/behavior. The results were presented in a bipolar 5-point Likert response format, with an "undecided" category. Relationships among variables were examined using the general linear model formulation with subsequent ANOVA analyses.

Results: Results for the participants show a significant increase in the scores of knowledge and attitude about air pollution. Educational program and training tools had no effect on the concern indexes, values, and behavior toward air pollution. Review of the score changes toward waste component, shows that posttest scores (in comparison with pretest ones) increases in 4 indicators of knowledge, attitude, concern, and behavior, however the value index did not change so much.

Conclusions: We can conclude that educational program can be used to convey the knowledge of the environment and in this regard, its implementation is necessary.

Keywords: Environment; Air Pollution; High School

1. Background

An urban area is characterized by higher population density and diverse culture compared to its surrounding areas. Urban areas may be cities, towns, or conurbations, but it does not extend to rural settlements such as villages and hamlets (1-3). Urban areas are created and further developed by the process of urbanization. Measuring the extent of an urban area helps in analyzing population density and urban sprawl (4, 5). Urbanization has been not only the dominant demographic trend in the Asia-Pacific region, but also in the entire world, during the last half century. Regarding the high pace of social and economic development in Asia and the resulting growth of city and town population, lack of infrastructure, congested traffic, environmental degradation, and a housing shortage became the major issues faced by cities and towns in their sustainable development (6). Over the past half century, a great rural-to-urban population shift has occurred and the process of urbanization (the concentration of people and activities into areas classified as urban) continued into the 21st century. Major demographic evidence has indicated that the Asia-Pacific region has already been advanced in the transition from predominantly rural to predominantly urban societies. Although population growth rate has slowed down in many countries for the past decade, 62% of the world population will live in urban areas by 2020. Furthermore, the Asia-Pacific region will settle about 49% of that urban population with a 55% level of urbanization. It means that an additional 1.2 billion people will be living in the urban centers of the Asia-Pacific region by 2020 (6). Almost all major cities of the region are increasingly plagued by environmental problems; one of them is environmental pollutions. Major urban environment pollutions affect air, water, and soil (7, 8). The best solution for reducing pollution in urban areas is preventing the emissions of pollutants into the urban environment (9, 10). One of the ways to prevent pollutant emissions is to provide educational programs for citizens (11, 12). Environmental education is a learning process that promotes people's knowledge and awareness about the environment and related issues, develops the necessary skills and expertise to ad-

dress the challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action (13). The modern environmental education movement, which gained significant momentum in the late 1960s and early 1970s, stems from Nature Study and Conservation Education. During this period, many events such as Civil Rights, the Vietnam War, and the Cold War placed Americans at odds with one another and the U.S. government. However, as more people began to fear the fallout from radiation, the chemical pesticides mentioned in Rachel Carson's Silent Spring, and the significant amounts of air pollution and waste, the public's concern for their and natural environment health has led to a unifying phenomenon known as environmentalism.

One of the first articles about environmental education as a new movement appeared in the Phi Delta Kappan in 1969, by James A. Swan (14). A definition of "Environmental Education" first appeared in *The Journal of Environmental Education* in 1969, by William B. Stapp (15). He later went on to become the first Director of Environmental Education for The United Nations Education Scientific and Cultural Organization (UNESCO), and then the Global Rivers International Network. Internationally, environmental education gained recognition when the UN Conference on the Human Environment held in Stockholm, Sweden, in 1972, declared that environmental education must be used as a tool to address global environmental problems. UNESCO and United Nations Environment Program (UNEP) issued 3 major declarations that have guided the course of environmental education. The goal of environment training is increasing the public information about environment offering some probable solutions and making a basis for completely logical and active participation of the society members in protecting the environment and cautious and rational consuming of natural sources (13).

Generally, 4 target groups can be distinguished for tertiary environmental education: the technical group, the subject specialist group, the management group, and the lay group. Each of these groups requires different sets of skills and abilities. The technical group should know how to measure environmental parameters. The subject specialist group needs to know about environmental systems. The management group must have the skills and abilities to resolve complex environmental issues and problems. Finally, the lay group needs to have attitudes, philosophies, and values about the environment. Each of these groups in turn requires different teaching strategies. For the technical group, the practical experimental teaching methods based on the traditional subject approach appear to be suitable. The subject specialist group needs presentational methods based on either an infusion approach or a new subject approach. For the management group, a combination of high level disciplinary teaching with intensive short skills courses and more extensive 'junctions' or 'environmental encounters' (all of which make use of practice methods of teaching) are suggested. For the lay group, experiential methods, where the student's attitudes are challenged by experiences in either an in-service situation or through simulation exercises, seem to be most appropriate (16). Ordinary citizens are one of the members of the lay group. Ordinary citizens' duty is to preserve urban environment and improve it. In this regard, protecting the urban environment of cities has the main role in environment management (17).

2. Objectives

This study sought the role of environmental education in control and improvement of urban environmental pollution of Tehran city.

3. Patients and Methods

3.1. General Attributes of the Case Study

Tehran is the capital of Iran and Tehran Province. With a population of around 8.3 million and surpassing 14 million in the wider metropolitan area, it is the largest city and urban area in Iran and Western Asia (18). Tehran is in the north-central part of the Iran at the southern edge of the Alburz Mountains, some 115 km from the Caspian Sea. Tehran has 35.6833° N, 51.4167° E coordinates with an elevation of 1200 to 1980 m above the sea level. In the last two centuries, Tehran has been the subject of mass migration of people from all around Iran. The modern structures, notably Azadi and Milad towers, have come to symbolize the city. Tehran is ranked 29th in the world by the population of its metropolitan area. In spite of a variety of unofficial languages (notably Kurdish and Azeri Turkish) roughly 98% of the Tehran population understand or speak Persian. Tehran features a semi-arid, continental climate (Koppen climate classification: BSk). The northern parts can reach a Mediterranean climate (Csa) bordering humid continental (Dsa). Tehran's climate is largely defined by its geographic location, with the towering Alborz Mountains to its north and the central desert to the south. It can be generally described as mild in the spring and autumn, hot and dry in the summer, and cold in the winter.

3.2. Tehran Pollutants

Major pollutions of Tehran, which are caused by humans, include air pollution (19) and wastes (20, 21). In the following sections, each of them are described separately.

3.3. Current Situation of Air Pollution in Tehran

Municipality of Tehran established Air Pollution Control Company (AQCC) in 1993. This is a research company involved in presentation of countermeasures to improve the air quality in Tehran. It has a few monitoring stations

in Tehran (22), which monitor several parameters relating to air pollution as follows:

- Carbon Monoxide (CO)
- Particulate Matter (PM)
- Nitrogen Dioxide (NO_2)
- Sulfur Dioxide (SO_2)
- Ozone (O_3)

Table 1. compares some of the mean annual parameters of air pollution taken in Tehran area and standards belong to WHO and US EPA.

3.4. Current Situation of Waste in Tehran

Tehran with the population of more than 10 million people produces more than 7000 tons of solid waste per day. In some parts of the city, household waste is mixed with hazardous waste. Most of this amount of waste, which is collected from 22 regions on daily basis, is dumped on to the land. The Table 2 shows the average composition of urban solid waste collected in Tehran in one year. About 2.5 million tons of solid waste have been collected by the Organization for Waste Recycling and Composting during one year (23). As it is shown in the Table 2, about 67.8% of the waste materials in Tehran is the organic waste, named wet waste by adding 1% bread waste. This amount is significantly high compared to other countries. The organic waste weight is 70% of the total municipal solid waste weight in Tehran.

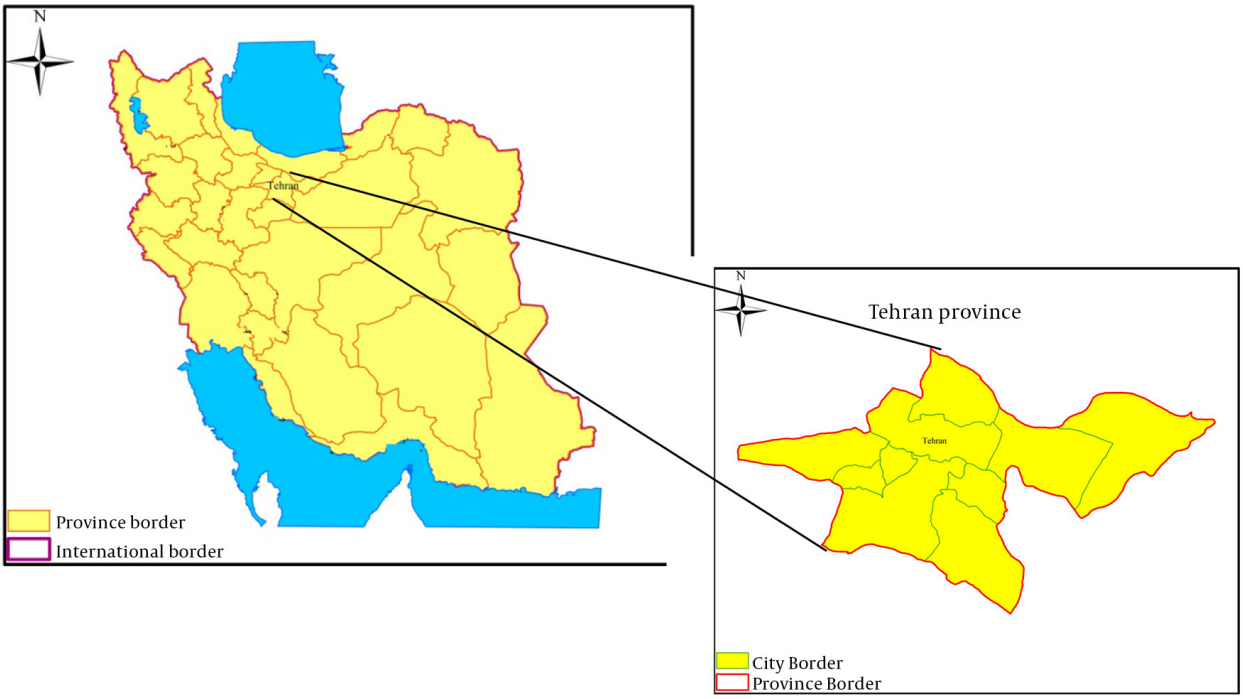

Figure 1. Location of the Study Area

Table 1. Annual Average Concentration of Pollutants and Environmental Standards[a]

Variables	SO_2	NO	NO_2	NO_x	O_3	CO	PM-10
	PPB	PPB	PPB	PPB	PPM	PPB	$\mu g/m^3$
2010	58.2	59.7	28.3	86	15.8	6.3	82.3
2012	63.8	63.2	36.7	94.3	17.2	7.6	86.4
WHO Standard	17-26	-	--	--	--	--	60-90
USA Standard	35	-	60	--	--	--	50/50

[a] Abbreviations: SO_2, Sulfur Dioxide; NO_2, Nitrogen Dioxide; NO, Nitrogen oxide; O_3, Ozone; CO, Carbon Monoxide; PM, Particulate Matter; PPB, parts-per-billion; PPM, parts-per-million.

Table 2. Waste composition analysis in Tehran (23)

Waste type	Composition, Ton/y [a]	Density, Ton/m^3 [b]	Composition, m^3/y [b]
Wet waste	1732800 (67.8)	0.7	2475000 (26.4)
Bread	25000 (1.0)	0.1	250000 (2.7)
Soft plastic	55000 (2.2)	0.04	1385000 (14.8)
hard plastic	14800 (0.6)	0.04	370000 (4.0)
PET	18100 (0.7)	0.02	905000 (9.7)
Plastic bags	157100 (6.2)	0.1	1571000 (16.8)
Paper	112700 (4.4)	0.3	375000 (4.0)
Cardboard	95000 (3.7)	0.2	475000 (5.1)
Ferrous metals	39600 (1.6)	0.4	99000 (1.1)
Non-ferrous metals	5100 (0.2)	0.4	12800 (0.1)
Fabric	876003.4	0.1	876000 (9.4)
Glass	61300 (2.4)	0.3	204300 (2.2)
Wood	42400 (1.7)	0.3	141000 (1.5)
Tires	18100 (0.7)	0.3	60300 (0.6)
Leather	15800 (0.6)	0.4	39000 (0.4)
Dust & Rubble	32200 (1.3)	0.6	53700 (0.6)
Special waste (residue)	41600 (1.6)	0.6	69300 (0.7)
Total	2555000 (100.00)		9362900 (100)

[a] Data are presented as No. (%).
[b] Based on info from manufacturer.

Table 3. Demographic Information of the Sample

Group	Male	Female	Total
Group 1, Brochure based	76	52	128
Group 2, Teacher based	49	77	126

3.5. Analysis Method

To investigate the role of environmental education in the prevention and control of pollution in Tehran, the target population was high school students. In this regard, 10 high schools from different areas of Tehran were used to study the Environmental Education (EE) intervention and in each of these high schools, one class was selected. Out of these high schools, two schools in the city center, and two schools in each one of the parts of the North, South, West, and East of the city were selected.

3.6. Education Methods

This study did not focus on the effectiveness of the content of the intervention itself, though. The treatments in the study design represent two different interpretive media employed to administer the schools with the aim to determine differences in their effectiveness in supporting the achievement of EE goals. The students of 5 high schools (first group) were trained by the paper-based guidebook, which was a booklet, containing 18 pages (9 pages for air pollution and 9 pages for waste) of text and color images as well as a foldout paper map of the City. The center of city was highlighted and the map included references to the area with high pollution (air and waste) in the form of a photograph as well as title and page reference. Also it contained texts and images relating to waste and air pollutants, their harmful effects for mankind and how to control and prevent these pollutants. Students of this group had to read the presented texts themselves.

The students of other 5 high schools (second group) were trained by an EE expert. All students of the second group were always attended by the same educator in order to keep the variation between sessions low. The EE expert gave oral presentations at each class, based on the same textual content used in the first group. At each of the 5 classes, the students were presented with a brief text and images, explaining waste and air pollutants, their harm for mankind and how to control and prevent these pollutants.

This study has been designed as a quasi-experimental pretest/posttest design with comparison groups. A pretest/posttest design is commonly used in the field of EE in order to determine the effect of the intervention (24). In this study a pretest was done, which was similar for all 10 schools (one class from each school). After performing these tests, schools were divided into 2 groups. As noted earlier, the first group was taught using a brochure and second group an EE expert attending the classes. The first group (who studied the brochure content) had more time for training. The evaluation of the effects of interventions

requires a valid instrument (25). In this study, the impact on the participant's environmental literacy was assessed by measuring a number of environmental literacy components, including knowledge, attitude, values, and concerns as well as behavioral intention/behavior. According to these components, scales were developed to obtain a pretest and posttest measure of the human role in air pollution and solid waste generation in Tehran City. The questions of the attitude, value, concern, and behavior scales were presented in a bipolar 5-point Likert response format, always, including an "undecided" category. Items were generally accredited 1 to 5 points with the most pro-environmental response receiving 5 points and the least pro-environmental 1 point.

3.7. Statistical Methods

For testing differences between two groups, we applied parametric 2-sample tests. Relationships between variables were examined using the general linear model formulation with subsequent ANOVA analyses. As per graphical methods, we used box and interaction plots. ANOVA for short, is a statistical test that looks for significant differences between the means (26). This analysis is a powerful and common statistical procedure in the environmental researches. It can handle a variety of situations. In descriptive statistics, a box plot is a convenient way of graphically depicting groups of numerical data through their quartiles. Box plots may also have lines extending vertically from the boxes (whiskers) indicating variability outside the upper and lower quartiles, hence the terms box-and-whisker plot and box-and-whisker diagram. Outliers may be plotted as individual points (27).

4. Results

4.1. Effects on the Components of Air Pollution

Results of this study showed a significant increase in the scores of air pollution knowledge. As shown in Figure 2, increasing knowledge is almost identical for two groups and data analysis did not show a significant difference between two groups.

With regard to attitude index, data analysis showed that educational program has led to an increase in the rating of this index and there was no significant difference among the various groups. Educational program and training tools had no effect on the concern indexes and values. During the educational procedure of this research, the average behavioral scores of people did not change toward air pollution, because people believed that they did not have any role in the air pollution.

4.2. Effects on the Components of Waste Control

Reviews of waste component knowledge indicated that both group scores increased after education. This increase was almost identical for the two groups. Attitude index scores toward waste indicated that educational program in this research has increased this index score. Also concern index scores towards waste showed a slight increase, while value index scores did not show a significant change. During the educational procedure in this research, the average behavioral scores of people toward waste increased dramatically. As shown in Figure 3, there was no significant difference between 2 training groups.

Reviews of score change toward waste component, showed that posttest scores compared to pretest increased with regard to 4 indexes of knowledge, attitude, concern, and behavior and just value index did not change so much. One of the reasons for these results is the nature of the feature values, which are formed during the long years and need more education to change.

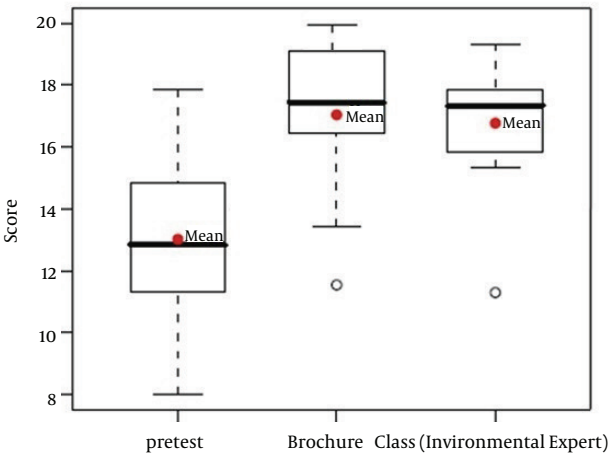

Figure 2. Boxplot of Pretest and Posttest Air Pollution Knowledge Scores

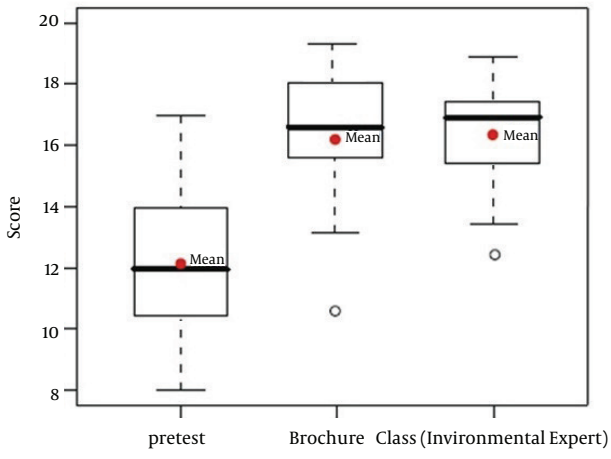

Figure 3. Boxplot of Pretest and Posttest Behavioral Scores of Wastes

4.3. Satisfaction of Participants in Research

In the posttest, users satisfaction about guidance method during the period (brochure or classes), was explored and then evaluated based on the participants motivation during the educational program (e.g. offering this educational course to others, motivation of participates in the same courses, and their attention during the relevant period). Comparison of motivational statements showed a significant difference between two groups. As illustrated in Figure 4, total scores of participant's motivation using the brochures are more than those participated in the class lectures.

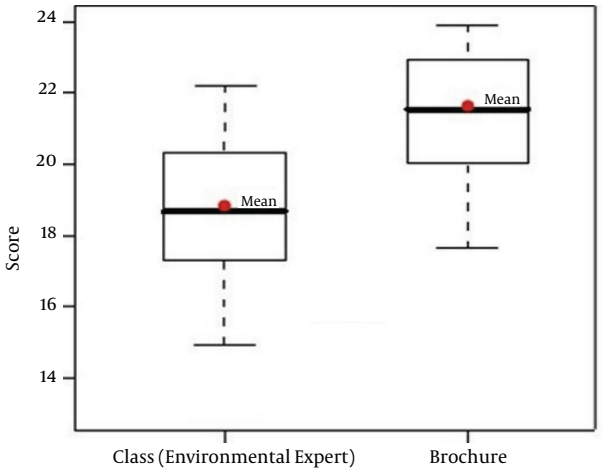

Figure 4. Boxplot of Motivation Scores

5. Discussion

Results of this study, revealed some of educational effects. Participation in this environmental program led to a significant rise in knowledge and also changed attitudes and behavior. With regard to the effects of the guidance method, results showed no difference between them in terms of their impact in environmental information. With respect to individual components of environmental data, the most obvious impact of educational program was seen on its knowledge component because during the course, a significant increase in knowledge was observed. Therefore, educational program can be used for conveying knowledge of the environment and its implementation is recommended. Attitude components are investigated as a mediating variable between knowledge and behavior. Attitudes can be used for immediate impact and regarding this issue, Pooley and Connor (28) have suggested that environmental educators must work to change attitudes. In most studies of this field, attitude changes through environmental educational courses were considered short-term or sometimes negligible. However in this study, most of the environmental determinants of behaviors, including valuable and important indexes remained unchanged. Since values during life time are fixed, their influence over a short training course is more difficult to assess than their influence over the attitude indexes. According to Kals et al. (29), future educational efforts should include ethics and values and encouraging participants to examine their beliefs.

Improvement of environmentally responsible behavior is the ultimate goal of environmental education initiatives. Bogner et al. (30) in the same study, reported a small effect on behavior, while Leeming et al. (31) achieved a greater impact on individuals' behavior. In their study, adolescents and their families have been participated in a game by mobile phone with the aim of changing household energy consumption, which showed short-term results on their behavior. In most situations, the educational program may cause people to feel socially committed to the experiment, and are likely to respond favorably. Field test analysis in the research emphasized the impact of demographic and social factors on the environmental components data, as the alienation or incoherence in urban communities is growing fast. Finally, environmental education institutions can seek help from incentive educational programs to engage participants in direct experiences of urban environment.

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