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The importance of environmental education in students: analyzing the transition from middle to high school in Nuevo Laredo, Tamaulipas, Mexico

Herrera-Izaguirre, Juan A.[1]; Roque-Hernández, Ramón V.[1*]; Llamas-Mangin, Yuritzi[1]; Juárez-Ibarra, Carlos M.[1]; Ramos-Monsivais, Cynthia L.[1]

[1]Universidad Autónoma de Tamaulipas, Facultad de Comercio, Administración y Ciencias Sociales de Nuevo Laredo. Nuevo Laredo, Tamaulipas, México, 88000.
***Corresponding author**: rvHernandez@uat.edu.mx

ABSTRACT

Objective: A poll on first-semester high school students (n=246) took place at Nuevo Laredo, Tamaulipas, Mexico, to find out if they received environmental education as an extracurricular class during middle school and how this training could influence their perceptions and positions on environmental issues.

Design/methodology/approach: A questionnaire that contained aspects regard water culture, recycling, species care and transportation, as well as general knowledge of the environment and its regulations, was applied to students. The SPSS statistical software was used to categorize two groups: students who received extracurricular environmental education and those who did not. Subsequently, the non-parametric Mann Whitney tests were performed on the data.

Results: Out of the total number of participants, 167 said they had received extracurricular environmental education in middle school. The other 79 participants reported not to have done so. Students who received more environmental education in middle school exhibit a better attitude regard water management.

Limitations of the study/implications: To interpret the results, it is necessary to consider that the study took place only in the city of Nuevo Laredo, Tamaulipas and that a convenience sampling was used.

Findings/Conclusions: There are still students that do not receive enough environmental education. We conclude that it is important to intensify efforts to change this situation, as environmental training has shown to positively influence the attitudes of students who received it.

Keywords: Environmental awareness, environment, protection of non-renewable resources.

INTRODUCTION

The presence of environmental problems in a country may reflect a lack of awareness of a society that daily demands the consumption and extraction of natural resources from its ecosystems and other global sites. For this reason, it is important to develop programs whose main purpose is a social construction, focused on generating environmental awareness and empathy. Training and information dissemination strategies must be developed to mitigate the presence of activities and actions that do not lead to good environmental practices. For example, the "Earth Charter", since 2000 establishes a series of items where the incorporation of formal environmental education (EE) is requested worldwide as an element of social construction for a sustainable lifestyle (Estrella Suárez & González Vázquez, 2014). In addition to the above, EE represents a set

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of efforts that requires the participation of diverse social actors, government, and business sectors. Formal environmental education is described as a process incorporating the subject into the education programs at the propaedeutic level. Likewise, the Earth Charter in its heading 14 indicates the necessity to add this knowledge and values to construct a sustainable lifestyle (SEMARNAT, 2006). Formal EE in Mexico is set in the curricular profile as part of the obligations established by the environmental legal framework in the country at the federal, state, and municipal levels. In the General Law for Ecological Balance and Environmental Protection (LGEEPA, 2018), article 3, fraction 38, EE is defined as an educational process directed to society formally and informally to build a society with environmental values and respect for nature to guarantee life preservation.

At the federal level, the LGEEPA has a section entitled Ecological Research and Education. It is made up of articles 39, 40 and 41. This section only establishes that the competent authorities must promote the incorporation of formal environmental education content (SEMARNAT, 2006) at the basic level (Primary-Secondary) and Higher Education. Article 39 requests the Ministry of Public Education (SEP) to build this content under the supervision of the Ministry of the Environment and Natural Resources (SEMARNAT) (LGEEPA, 2018). Also, the Code for the Sustainable Development of Tamaulipas, Mexico, (CODE, 2019) in article 4 fraction 19, indicates the legal definition for the environmental education term in the same way as it is presented for the LGEEPA. In the state, EE incorporation is contained in Chapter III "public utility and social interest in sustainable development"; therefore, it must be part of the citizen's actions and state educational institutions as indicated in article eight section four, where it indicates that the state education system must incorporate formal EE (CODE, 2019). Following what is established in the Tamaulipas state code, the Secretary for the Environment has, as part of its competences, monitoring the incorporation of environmental contents into state educational programs. Placing this research in the context of Nuevo Laredo, Tamaulipas, the regulation for environmental protection and sustainable development (Regulation, 2017), in its article four describes the concept of environmental education in the same way as the Code and the LGEEPA, which generates concordance at the three government levels and ensures understanding in the usage of the concept. Based on the above, the objective was to determine if the first-semester high school students had participated in any extracurricular modality for environmental education during middle school and if this training relates to their perceptions of environmental aspects and their present life.

MATERIALS AND METHODS

In this study n=246 first semester students from public high schools at Nuevo Laredo city, Tamaulipas, Mexico, participated, from which 136 were women, 102 men, and eight provided no information (Table 1).

Table 1. Characterization of this study participants.

Age (years)	Female	Male	Total
16	76	46	122
17	53	49	102
18	7	7	14
Total	136	102	238

The study was conducted in public high schools in the city of Nuevo Laredo, Tamaulipas, Mexico. Each one of them was visited, and permission was requested to access the first-semester class groups. There, students gave their consent to be part of the poll and explained what their participation would consist of. The students received the questionnaires printed on white paper sheets, answered the questions, and returned their questionnaire. The anonymity of their information and responses was guaranteed.

Table 2. Categories and topics addressed in this research.

Category	Topics
Environmental knowledge	Biological diversity. Ecosystem. Invasive species. Exotic species. Protected Natural Areas.
Environmental culture for daily life.	Management of polluting waste at home. Transportation and care of living organisms. Saving water. Recycling at home. Existing regulations.

Instrument

A 20-question questionnaire was applied, the contents of which dealt with the categories and topics shown in Table 2. The questions presented to the students are shown in Table 3.

The questionnaire was prepared by the research team and was reviewed by two experts, who provided feedback on the content and approach of the instrument. Fifteen students

also participated in a pilot test that allowed adjusting the wording of the statements. For all questions, a four-point Likert scale was used as follows: totally disagree, disagree, agree and totally agree. The type of study carried out was quantitative, observational, cross-sectional and relationally oriented to the comparison of two independent groups.

The data analysis was carried out using the SPSS version 24 statistical software and consisted of four phases below detailed.

Phase 1. Data cleaning. This phase consisted of identifying missing values in each set of responses, as well as looking for outliers and poorly captured values. A visual inspection and contrasting of the values captured in SPSS with the answers directly obtained from the students on paper of the questionnaires was conducted. No outliers or wrong values were identified.

Phase 2. Data preparation and characterization. A contingency table was obtained to visualize the age and gender of the participants. Subsequently, through frequency tables, the characterization of the responses obtained by the two groups approached in this research was obtained, for which, the responses "Totally disagree" and "Disagree" were unified, as well as the "Totally agree" and "agree " responses in all questions.

Phase 3. Mann-Whitney tests Development. In this phase, a Mann Whitney test was performed for each of the questions in the questionnaire. Interest groups were defined based on the question that indicates whether students received extracurricular environmental education in middle school or not. The test, which was conducted with the original responses that the students provided, recorded the Mann-Whitney U value and the PValue to indicate the significance of the differences found.

Phase 4. Search for statistically significant results. Values of less than 0.05 were sought to consider them significant since a 95% confidence level was taken as a reference. For statistically significant values, the mean ranks were inspected to identify which of the groups answered with a greater tendency towards "totally agree" and which with a "totally disagree" tendency.

RESULTS AND DISCUSSION

The obtained responses characterization is shown in Table 4, the results of the Mann-Whitney tests in Table 5 and their mean ranks are presented in Table 6.

Table 3. Questionnaire applied to participants.

Id	Statements presented to the participants
1	I know the concept of biological diversity
2	I know the concept of ecosystem
3	I know the meaning of invasive species
4	I know the meaning of exotic species
5	It is good to transport insects or plants from one city to another
6	It is good to transport fish from one city to another
7	I turn off the faucet when I brush my teeth
8	I take a shower in less than five minutes
9	It is good to take care of water
10	Water in Nuevo Laredo is scarce
11	It is good to throw away plastic bottles
12	Aluminum cans should be thrown away
13	It is good to throw oils in the sink
14	It is good to throw oils in the W.C.
15	I recycle at home
16	There are laws that fine those who pollute
17	I know the meaning of Protected Natural Area

The results indicate that students who received more environmental training had more knowledge and a good attitude towards most of the investigated aspects. However, it could only be shown that in-favor-of-water care positions were statistically significant ($p<0.05$). According to the collected responses, it is also evident that there are still students who do not receive sufficient environmental education. These results reveal the importance of environmental education in students and are consistent with the recommendations issued at the global, federal, state and municipal levels. For the interpretation of these results, it is necessary to consider that the study was carried out only in the city of Nuevo Laredo, Tamaulipas and that a convenience sampling was used.

These results suggest that the environmental training received during middle school positively influence the knowledge, attitudes and perceptions of students in high school. Specifically, this could be statistically demonstrated with the culture of water care.

CONCLUSIONS

Environmental education for sustainability is a strategy incorporated into the different educational levels of the country. Middle school and high school are no

Table 4. Characterization of the obtained responses.

Id	Statement	Students who did not take extracurricular environmental education in middle school		Students who took extracurricular environmental education in middle school	
		Disagree	Agree	Disagree	Agree
1	I know the concept of biological diversity	13(16.5%)	66(83.5%)	27(16.2%)	139 (83.2%)
2	I know the concept of ecosystem	9(11.4%)	69(87.3%)	14(8.4%)	150(89.8%)
3	I know the meaning of invasive species	38(48.1%)	40(50.6%)	79(47.3%)	88(52.7%)
4	I know the meaning of exotic species	20(25.3%)	59(74.7%)	29(17.4%)	138(82.6%)
5	It is good to transport insects or plants from one city to another	60(75.9%)	19(24.1%)	129(77.2%)	36(21.6%)
6	It is good to transport fish from one city to another	55(69.6%)	24(30.4%)	129(77.2%)	37(22.2%)
7	I turn off the faucet when I brush my teeth	12(15.2%)	67(84.8%)	17(10.2%)	150(89.8%)
8	I take a shower in less than five minutes	58(73.2%)	21(26.6%)	123(73.7%)	39(23.4%)
9	It is good to take care of water	8(10.1%)	70(88.6%)	6(3.6%)	153(91.6%)
10	Water in Nuevo Laredo is scarce	43(54.4%)	34(43.0%)	69(41.3%)	88(52.7%)
11	It is good to throw away plastic bottles	37(46.8%)	41(51.9%)	65(38.9%)	94(56.3%)
12	Aluminum cans should be thrown away	54(68.4%)	23(29.1%)	105(62.9%)	53(31.7%)
13	It is good to throw oils in the sink	76(96.2%)	2(2.5%)	153(91.6%)	8(4.8%)
14	It is good to throw oils in the W.C.	74(93.7%)	4(5.1%)	145(86.8%)	17(10.2%)
15	I recycle at home	34(43.0%)	44(55.7%)	52(31.1%)	107(64.1%)
16	There are laws that fine those who pollute	27(34.2%)	51(64.6%)	48(28.7%)	112(67.1%)
17	I know the meaning of Protected Natural Area	21(26.6%)	57(72.2%)	26(15.6%)	136(81.4%)

Table 5. Mann-Whitney Tests Results.

Id	Statement	Mann-Whitney's U	PValue
1	I know the concept of biological diversity	5945.00	0.18
2	I know the concept of ecosystem	6346.00	0.91
3	I know the meaning of invasive species	6510.50	0.99
4	I know the meaning of exotic species	6215.50	0.42
5	It is good to transport insects or plants from one city to another	6357.00	0.73
6	It is good to transport fish from one city to another	6068.50	0.31
7	I turn off the faucet when I brush my teeth	5962.50	0.15
8	I take a shower in less than five minutes	6312.50	0.85
9	It is good to take care of water	5306.50	0.01 *
10	Water in Nuevo Laredo is scarce	5012.50	0.02 *
11	It is good to throw away plastic bottles	5747.50	0.34
12	Aluminum cans should be thrown away	5645.50	0.34
13	It is good to throw oils in the sink	5955.50	0.44
14	It is good to throw oils in the W.C.	5772.50	0.19
15	I recycle at home	5671.00	0.24
16	There are laws that fine those who pollute	5692.50	0.24
17	I know the meaning of Protected Natural Area	5657.50	0.15

Table 6. Mean ranks obtained for both groups in the Mann-Whitney test.

Id	Statement	Students who did not take extracurricular environmental education in middle school		Students who took extracurricular environmental education in middle school	
		N	Mean Rank	N	Mean Rank
1	I know the concept of biological diversity	79	115.25	166	126.69
2	I know the concept of ecosystem	78	122.14	164	121.20
3	I know the meaning of invasive species	78	123.03	167	122.99
4	I know the meaning of exotic species	79	118.68	167	125.78
5	It is good to transport insects or plants from one city to another	79	124.53	165	121.53
6	It is good to transport fish from one city to another	79	129.18	166	120.06
7	I turn off the faucet when I brush my teeth	79	115.47	167	127.30
8	I take a shower in less than five minutes	79	122.09	162	120.47
9	It is good to take care of water	78	107.53	159	124.63
10	Water in Nuevo Laredo is scarce	77	104.10	157	124.07
11	It is good to throw away plastic bottles	78	113.19	159	121.85
12	Aluminum cans should be thrown away	77	112.32	158	120.77
13	It is good to throw oils in the sink	78	115.85	161	122.01
14	It is good to throw oils in the W.C.	78	113.51	162	123.87
15	I recycle at home	78	112.21	159	122.33
16	There are laws that fine those who pollute	78	112.48	160	122.92
17	I know the meaning of Protected Natural Area	78	112.03	162	124.58

exceptions. However, few subjects address this content; therefore, it is important to strengthen the issues of environmental awareness and valuing natural resources with extracurricular activities. In this way, we consider that it is also important to incorporate regional elements that promote the student's location in the environmental context with information that is useful in their daily life.

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