



Research Article

Review of hydric optimization in the Covid-19 era

Cruz García Lirios^{1*}, Alejandra Navarrete Quezada²,
Margarita Juárez Nájera³

^{1,2,3}Department Social Work, Autonomous Mexico State University, Toluca, Mexico

*Corresponding Author email: garcialirios@uaemex.mx

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ABSTRACT

Environmental education programs, assuming an intensive training of skills as the axis of solution in the face of scarce resources, have focused on the optimization of public services. In this sense, the objective of this work has been to observe the effects of an informative workshop in which the prevention and repair of leaks was promoted, as well as saving water through dosing and reuse. A quasi-experimental study was conducted with 100 intact subjects selected intentionally. The results show significant differences before and after the informative workshop. This is the case of the indicator of pluvial catchment that in a beginning was considered the reflective indicator of the factor, but that after the workshop it reduced its value. In contrast, the maintenance of hydraulic facilities revealed a domestic awareness of heritage conservation, although the segmentation of the information workshop is recommended to corroborate latent relationships between water optimization and heritage conservation.

Keywords: Behavior; Vulnerability; Insertion; Environmental Education

1. INTRODUCTION

The objective of this study is to establish the effects of a workshop education for sustainability (ES) centered on 1) the pluvial uptake, 2) the planned storage, 3) the optimization of the resource, 4) metering consumption, 5) water reuse, 6) leak detection, 7) leak repair and 8) hydraulic maintenance. From the establishment of statistical properties of an instrument that measured eight behaviors in favor of water conservation, the differences were established before and after the implementation of the workshop in students at a public university.

Education for sustainability, according to the purposes of this paper refers to one with science of the effects of climate change on environmental public health, within the framework of the Higher Education Institutions (IES) refers to a comprehensive training (1).

This is how policies against climate change and education for sustainability are intertwined at the institutional level of public universities by establishing programs based on international resource conservation guidelines (2).

In the case of actions for the conservation of the environment Maragakis, Dobbeltstein & Maragakis (3) they found that a high percentage of students and academics prefer to adopt

information technologies in order to avoid the use of paper, as í such as digital protocols, associated resources to maintaining a classroom like water and electricity.

Monus & Lechner (4) implemented an education system for the sustainability and promotion of the conservation of water resources through digital protocols, obtaining favorable results in increasing the average of conservation actions.

In particular, the conservation of water resources in HEIs has been in the making since the 1990s. Then defined the SE as local action with effect s overall it is. Little (5) reviewed the corresponding literature to establish a common denominator in international guidelines and institutional actions, such as policies and strategies for optimizing resources rather than innovation in treatment and recycling processes.

Along these lines, education for sustainability has gone from reactive awareness and action to risk events to anticipating scenarios. Noga & Wolbring, (6) carried out a review of the literature concerning the impact of sanitation on community health and its effects on social education, finding a low correlation between preventive measures with respect to performance, but a significant association between the optimization of resources with respect to the increase in school achievement that increased as an awareness of scarcity was promoted.

In that vein, education for sustainability in general and promoting the care of water resources, relate to personal and collective consciousness of scarcity of resources, but reversible from the formation of optimizers resources, care and saving water. In this sense, a model for the study of water care behavior, an education program for sustainability and the evaluation of the effects of a workshop on water saving behaviors will allow a more global analysis of local efforts with respect to international guidelines.

We can see that, education for sustainability has been rather understood as an instrument of resource optimization rather than training for process innovation. It would be possible to observe r a significant reduction in water resources with respect to the inferred optimization skills savings or leak repairs as taps or packaging changes.

The comparison of both elements would be of special importance to understand the development of skills and competencies in water conservation, although it is necessary to observe the phenomenon of optimization and its increase or decrease before a workshop promoting saving and repairing water leaks.

1.1. SPECIFICATION OF A MODEL FOR THE STUDY OF SUSTAINABLE EDUCATION

A model is a mapping of the determinant variables of a behavior based on inclusion criteria such as the consensus of the literature regarding the factors or dimensions of the phenomenon of water conservation, as well as the determinants, including saving and care of water resources (7).

In the case of the relationship between the promotion of care and the optimization of water resources with respect to water conservation lifestyles, it is necessary to observe not only the increase in skills or the reduction of satisfaction in water consumption, but, in addition,

the variations in the availability and supply of water on the strategies of scarcity prevention, austere lifestyles or household leak repair skills (8).

Therefore, promoting water saving in a water resource conservation sense can increase the optimization of an intermittent supply system, but can also be seen in leak prevention or repair skills with respect to the maintenance of hydraulic installations. (9).

Thus, it is that, education for sustainability and promotion of saving water are two key elements in strategies residential conservation, local authorities would be interested in linking its policies of austerity and irregular supply of water (10).

The guiding question of the present investigation is: Will there be significant differences in a group of users of the drinking water service before and after an informative workshop regarding the optimization of the water available for personal consumption?

The null hypothesis that answers the question is: Significant differences before and after the workshop promoting prevention of leaks, repair leaks and save water.

The alternative hypothesis is: There will be no significant differences before and after an informative workshop on preventing leaks, repairing installations and saving on water consumption.

2. METHOD

A first parametric study among students from UAEM to determine whether environmental education they receive has changed their behavior, reduce their vulnerability or type the challenges posed by the environmental crisis in everyday life.

Applied the Inventory Behavior pro-environmental Bustos, Juarez and Sandoval (in press), which also analyzes the sociodemographic and psychosocial characteristics of students surveyed.

The instrument was applied to UAEM students in the campuses that concentrate the largest number of students from this university: Chamilpa and Cuautla; In a simple random manner, being a non-probabilistic study, the sample included 316 students from the Economics, Public Relations, Human Communication and Psychology degrees in order to have a representative sample, taking into account that all these study programs have been accredited.

The questionnaire was adapted so that students could answer it online voluntarily without the presence of a pollster, avoiding bias in their answers as much as possible. The data were grouped in the *Google Forms* platform from which they were downloaded to MS-Excel 2013 in order to perform their validation, as well as their purification, discarding 11 questionnaires that presented inconsistencies. Later they were exported to IBM-SPSS-AMOS v.25 where the corresponding statistical analyzes were performed. Considering that the UAEM has about 50 thousand students, this was taken as the universe.

Analyzes were performed and normal distribution kurtosis parameters considered univariate and multivariate analysis and bias. Correlations and covariances were estimated

to infer the relationships between the factor with other indicators, as well as the structural model for the establishment of reflective trajectories between the factor and the indicators.

By way of conjecture, it is expected that UAEM students have modified their behavior, lifestyle, knowledge, beliefs, attitudes and perceptions about their relationship with the environment as well as the impact of their actions. To a lesser extent it is expected that the knowledge acquired in environmental education will be reflected in ways in a sustainable behavior.

Environmental education turns out to be a means that since the Tbilisi meeting in 1977 was defined as one of the main strategies through which the environmental crisis could be faced since it can generate behavioral change. The Intergovernmental Group of Experts on Climate Change recognizes how behavioral and lifestyle choices influence the way to face this dimension of the environmental crisis.

Considering that education can be defined as "a change in behavior" and that the HEIs that in Mexico enter the stimuli of the Comprehensive Institutional Strengthening Program (PIFI) of the Ministry of Public Education (SEP) must provide environmental education in a transversal, as is the case of the Autonomous University of the State of Morelos (UAEM). For its part, since 2000 in the National Development Plans, environmental education has been promoted at various educational levels, as public policies generated in the Ministry of Public Education, which implements them through sectoral programs.

In a second study, the sustainability education program was implemented in its workshop modality with a two-hour session in which eight behaviors were promoted in favor of saving water, such as 1) rain catchment, 2) planned storage, 3) resource optimization, 4) consumption dosage, 5) water reuse, 6) leak detection, 7) leak repair, 8) hydraulic maintenance.

The workshop was held at the facilities of the public university after the survey on the eight pro-environmental behaviors. Participants were informed of the objective of the study, as well as the caveat that the results would neither negatively nor positively affect their work or academic status.

Once the session ended, the participants were surveyed again in order to establish significant differences before and after the workshop. The information was processed again in IBM-SPSS-AMOS version 25.0 in order to establish the comparative analyzes in a general linear model, as well as the estimation of the adjustment and residual parameters.

3. RESULTS

Table 1 shows the statistical properties of the instrument that measured the eight indicators of pro-environmental behavior related to water conservation. It is possible to observe that the bias and kurtosis values allow us to infer the normal distribution of the responses to the inventory, although the value that determines the normal distribution is the multivariate kurtosis, which reached a value just above the minimum of 15.00.

Table 1. Statistical properties of the pre-workshop instrument

R	MN	MX	S	CU
R1	1,000	5,000	.610	-.540
R2	1,000	5,000	-.202	-.837
R3	1,000	5,000	1,748	2,821
R4	1,000	5,000	-.389	-.785
R5	1,000	4,000	1,317	.851
R6	1,000	5,000	-.190	-.589
R7	2,000	5,000	-.702	-.226
R8	1,000	5,000	1,423	.711
CM				15,088

Source: Prepared with the study data; R = Reactive, MN = Minimum, MX = Maximum, S = Bias, CU = Univariate kurtosis, CM = Multivariate kurtosis

Once the normal distribution of the pro-environmental behavior indicators was established, their correlations and covariances were estimated in order to measure the incidence of other factors associated with the water conservation construct (see Table 2 and 3).

Table 2. Correlations between indicators

R	R8	R7	R6	R5	R4	R3	R2	R1
R8	1,000							
R7	.111	1,000						
R6	.438	.072	1,000					
R5	.035	.311	.082	1,000				
R4	.420	.052	.316	-.073	1,000			
R3	.124	.323	.190	.350	.201	1,000		
R2	-.046	.279	.082	.143	-.086	.149	1,000	
R1	.354	.228	.434	.220	.165	.117	.041	1,000

Source: Prepared with the study data; Condition number = 5,255; Eigenvalues: 2.345 1.606 .938 .895 .703 .560 .507 .446

The correlations show a prevalence of positive associations between the indicators, although in some cases this relationship was spurious and negative, a condition for assuming that the indicators are associated with a common factor.

Table 3. Covariances between indicators

R	R8	R7	R6	R5	R4	R3	R2	R1
R8	1,039							
R7	.128	1,273						
R6	.382	.070	.733					
R5	.037	.367	.073	1,092				
R4	.386	.053	.244	-.069	.813			
R3	.132	.382	.170	.383	.190	1,096		
R2	-.043	.289	.064	.137	-.071	.143	.842	
R1	.433	.309	.445	.276	.178	.147	.045	1,435

Source: Prepared with the study data; Condition number = 6,347; Eigenvalues: 2,555 1,636 1,043 .887 .715 .620 .465 .403; Determinant of sample covariance matrix = .321

In the case of covariances, the values show that other indicators could be included in the water conservation factor, but their value close to zero implies their convergence in the factor and the non-incidence of other indicators.

The structural model of reflective trajectories shows that rainwater catchment is the main indicator that reflects water conservation. In other words, the sample surveyed seems to show a propensity to adopt rainwater harvesting technology more than other actions registered in the inventory.

The adjustment parameters [$\chi^2 = 345.24$ (23 l) $p = 0.005$; CFI = 0.990; GFI = 0.995; RMSEA = 0.006] suggest the non-rejection of the null hypothesis regarding the significant differences between the model specification with respect to the structure of the relationships between the factor and the indicators.

Once the first diagnosis had been established, a second study was carried out after the intervention focused on a workshop to promote water saving, considering eight indicators: 1) rain catchment, 2) planned storage, 3) resource optimization, 4) the dosage of consumption, 5) the reuse of water, 6) the detection of leaks, 7) the repair of leaks, 8) the hydraulic maintenance.

Table 4 shows the psychometric properties of the instrument that was applied after the informative workshop on prevention, repair, maintenance and saving water in residences.

Table 4. Statistical properties of the instrument after the workshop

R	MN	MX	S	CU
R1	1,000	5,000	.317	.723
R2	1,000	5,000	.080	.155
R3	1,000	5,000	1,952	.182
R4	1,000	5,000	1,662	.960
R5	1,000	5,000	-1,583	.584
R6	1,000	5,000	.477	-.237
R7	1,000	5,000	-1,799	.699
R8	1,000	4,000	.083	.262
CM				58,030

Source: Prepared with the study data; R = Reactive, MN = Minimum, MX = Maximum, S = Bias, CU = Univariable Kurtosis, CM = Multivariable Kurtosis

It is possible to observe that the indicators maintain a normal distribution, although the multivariate kurtosis shot up from 15.088 in the first diagnosis to 58.030 in the second diagnosis (see Table 4 and 5).

Table 5. Correlations between the indicators

R	R8	R7	R6	R5	R4	R3	R2	R1
R8	1,000							
R7	.620	1,000						
R6	.628	.594	1,000					
R5	.429	.511	.630	1,000				
R4	-.542	-.399	-.310	-.174	1,000			
R3	.373	.325	.277	.207	-.456	1,000		
R2	-.460	-.393	-.297	-.079	.554	-.358	1,000	
R1	.574	.456	.526	.310	-.545	.336	-.320	1,000

Source: Prepared with the study data; Condition number = 15,750; Eigenvalues: 3.983 1.272 .695 .638 .417 .398 .345 .253

In the case of the correlations between the indicators, an increase in their negative values is observed, which suggests the possible relationship of these indicators with another factor, but the low covariances between these indicators denote that the conservation factor would only be observed and inferred by these eight indicators (see Table 6).

Table 6. Covariances between indicators

R	R8	R7	R6	R5	R4	R3	R2	R1
R8	.598							
R7	.398	.690						
R6	.385	.391	.629					
R5	.312	.399	.470	.884				
R4	-.347	-.275	-.204	-.136	.686			
R3	.265	.248	.202	.179	-.348	.847		
R2	-.286	-.262	-.189	-.060	.370	-.265	.648	
R1	.354	.302	.332	.233	-.360	.247	-.205	.635

Source: Prepared with the study data; Condition number = 16,419; Eigenvalues: 2.726 .961 .559 .414 .310 .266 .214 .166; Determinant of sample covariance matrix = .002

However, the most significant difference around the effects of the workshop can be observed in the first indicator, which went from being the main one with a value of .55 to the fourth place with .47, evidencing that the rain catchment no longer reflected the conservation of the Water.

In contrast, the last indicator related to the maintenance of hydraulic installations ranked second in importance with .52 became the first reflective indicator with .57 after the workshop had been held.

Finally, the adjustment parameters [$\chi^2 = 345.25$ (34gl) $p = 0.005$; GFI = 0.990; CFI = 0.995; RMSEA = 0.008] suggest non-rejection of the null hypothesis regarding the differences before and after the informative workshop.

4. DISCUSSION

The present study has shown a significant difference before and after an informative workshop was carried out in which the participants seem to have been influenced by the information regarding the prevention and repair of leaks, as well as the saving of water in their residences.

However, the type of study with intact subjects limits the results to the sample of participants, although the indicator that finally reflected water conservation seems to show a propensity to care for household facilities rather than awareness of saving water for future generations.

In this sense, some studies have shown that the conservation of heritage is more important than the optimization of resources. In such a scenario, the innovation of water conservation processes could be motivated by the conservation of residential heritage.

This would imply the design of a more effective workshop since the promotion of the prevention and repair of leaks seems to be more oriented to the conservation of heritage.

Consequently, the optimization of resources would be linked to the awareness of preserving water for future generations.

It is necessary to segment the workshop and orient it according to these findings in order to innovate the maintenance processes of hydraulic installations based on the conservation of residential heritage, at the same time, promote the optimization of water resources based on an awareness savings for future generations.

5. CONCLUSION

The objective of this work has been to establish the effects of an informative program on the importance of preventing and repairing residential leaks, as well as conserving water from savings, considering an ecological conscience.

However, the type of quasi-experimental study limits the results to the sample of participants, although the contrast of models in which the maintenance of hydraulic installations is observed as the main indicator of water conservation is of special importance.

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