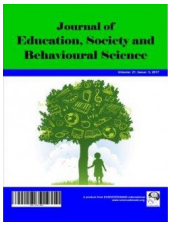

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Attitudes about Climate Change among Mexico City High School Students

Raul Calixto Flores[1*]

[1]Diversity and Interculturality, National Pedagogical University, Carretera al Ajusco 24, Col. Héroes de Padierna, Tlalpan, Ciudad de México, 14200, México.

Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

The article aims to describe the attitudes that secondary school students have about climate change.
The study was developed with a group of each one in a high school of Tlalpan Delegation, in Mexico City. The scale was shaped by a series of statements containing actions related to climate change. The construction of the scale involved working with "judges" and several pilotages, in order that the statements were directed to obtain the attitude before a situation. And problematizing situations constitute "brief cases" of an environmental problem, placing the students before a "dilemma" in which they are involved and have to make a decision, in order to relate the attitudes with the pro-environmental behaviors. In first grade students, a greater number of favorable attitudes to act before the effects of climate change are identified; the number of positive attitudes in students of the subsequent grades decreases. Among the conclusions, it is necessary to emphasize the need for environmental education to promote the development of attitudes and actions to reverse the effects of climate change.

**Corresponding author: E-mail: rcalixto@upn.mx, calixto07@gmail.com;*

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1. INTRODUCTION

The origin of climate change is diverse, but today, climate change, in most cases, has an anthropogenic origin; modifying the chemical composition of the atmosphere, having as main effect the global warming (increase of the earth´s temperature).

Over the last five years, the excessive use of the fossil fuels, the consumption of beef, the excessive deforestation, the contamination of large areas of water and the increasing desertification, has led to an increase of greenhouse effect gases emissions, causing a series of climate transformations that impact significantly in the ecosystems, biodiversity and human societies.

According to the Intergovernmental Panel of Experts in Climate Change [1], change in climate has caused impacts on natural and human systems on every continent and ocean. Before the transformations of the natural climate conditions, several proposals emerge, among which, the ones based on environmental education.

Environmental education is oriented to the holistic understanding of the environment, based on pedagogy, to understand and react to the various environmental problems, such as those derived from the effects of climate change.

For the UNESCO [2] a fundamental goal of environmental education is to ensure that individuals and the community understand the complex nature of the natural environment and the environment created by humans, resulting from the interaction of their biological, physical, social, economic and cultural activities and acquire knowledge, values, behaviors and practical skills to participate in a responsible and effective prevention and solution of environmental problems, and the management of the quality of the environment. Environmental education has among its objectives to promote awareness among people about the interdependence between human societies and the natural environment, through the construction of attitudes, knowledge and environmental values. The research described in this article addresses the attitudes because they constitute a fundamental framework to identify the meaning of the social representations that students have on climate change.

The contributions of environmental education come from multiple pedagogical experiences and research results. Among the latter is research on environmental problems and youth; Montoya and Acevedo [3], show that young people have perceptions towards environmental problems, generating high levels of environmental concern. However, these concerns do not translate into actions. Espejel and Flores [4] point out that the environmental problems that young people most identify the pollution of rivers and lakes, solid waste, and air pollution. Meanwhile Lara, Fernández, Silva and Pérez [5] identify the existence of social representations in young people, regarding environmental problems, with representations related to pollution predominating. Murga [6] finds in the youth, attitudes, perceptions and values related to an ecological concern, especially in the exploitation of natural resources and ecosystem deterioration. For their part, Vásquez and Manassero [7], identify in the youth, passive attitudes of waiting and seeing before the environmental problems are addressed. In this sense, Le Hebel, Montpied, & Fontanieu, [8] and Christensen [9], found that young students generally had positive attitudes in their beliefs that the climate is changing and their ability to make an impact.

As seen in the above studies, young people construct attitudes, perceptions and/or social representations about environmental problems. Social representations can be understood as social knowledges that serve to organize and provide subjects with an interpretative framework to give sense and meaning to various phenomena, facts and/or problems, such as climate change. According to Moscovici [10], social representations comprise three dimensions: Information, representation field and attitudes. The articulation of these dimensions configures the characteristics and elements of social representations. In this way, the information, the amount of data available about the subject matter of the representation, and its degree of exactness; Representation field dimension implies a selective focus on the elements of information in question and their structuration; and attitudes dimension situates individuals or groups in a positive or negative relationship to the different components of the representation. The research that gave rise to this article, the three dimensions were taken into account, but in the present, only the results of the third dimension are analyzed, because this

dimension allows researchers to identify the posture that students have regarding climate change. This article addresses the dimension of attitudes of social representations about climate change present in a sample of high school students.

> *It should be stressed that the social representation of climate change- like that of any other environmental problem- contains scientific information or comes from scientific sources, but reaches to the vast majority of citizens through media, mediators and contexts that obey other type of logics, which simplify, reduce, distort, interpret and modulate it according to multiple variables and interests, Meira and Arto [11].*

Different attitudes are part of the social representations. From this theory, they are affective dispositions that influence the positioning of a situation, fact or problem, such as climate change.

2. METHODOLOGY

An exploratory study design was performed, Yin [12]; Used the modelling approach of social representations based on the de Rosa [13]. The social representation itself permits the understanding of construction and use of knowledge of common sense in real everyday life according to Jodelet [14]. The research was oriented to the knowledge of the social thinking of high school students, regarding one of the most complex global environmental problems: Climate change, which is a problem that is based on the programs of the Mexico high schools through environmental education. In addition, this problem is known by the students through diverse television and radio programs and is a reason for articles in newspapers and cyber-newspapers. Environmental issues are communicated in the family and among friends.

The research was carried out in a high school of Tlalpan Delegation, in Mexico City. This was chosen based on two considerations: a) teachers's opinions about the existence of environmental problems outside and within the institution and b) the facility to access the school and stay in it as long as necessary. This school included six groups of each grade (first, second and third). The study was developed with a group from each grade considering that in each grade we deal with contents related to the care of the environment with different levels of depth. The choice of the sample is not probabilistic, so the results can't be generalized.

To identify in this research the information's dimension, a survey with evocative questions was applied to the sample of participants. In order to deal with the dimension of the field of representation, a drawing elaboration was used, complemented with interviews. And for the dimension of attitudes, we worked with the Likert scale and the development of problematizing situations. The scale was shaped by a series of statements containing actions related to climate change. The construction of the scale involved working with "judges" and several pilot projects, in order to ensure that the statements were directed to obtain the attitude before a situation. The scale comprised 20 items with an interval of five options indicating the degree of agreement or disagreement. The statements are related to the social representations previously identified.

Connel, S.; Fien, J. ; Lee, J. , Sykes, H. & Yencken, D. [15], affirm that students have feelings and ideas on the causes and possible solutions to environmental problems, and their own assessments of their ability to care for the environment. It is for this reason that the problematizing situations are an ideal resource for qualitative research situations. These constitute "brief cases" of an environmental problem, placing the students before a "dilemma" in which they are involved and have to make a decision, in order to relate their attitudes with the pro-environmental behaviors. These situations have been developed by Calixto's previous work [16]. To the problematizing situations, students present the alternatives associated with climate change. The sample of students was constituted by 36 of first grade, 25 of second grade and 27 of third grade.

3. RESULTS

Dimensions of information and representation field: In a summarized form, some of the results obtained in the dimension of information and representation fields are presented. About the dimension of information, in the students of the three grades, elements of climate change were found. In the first grade students, the most used words were: sun, planet Earth, rain, clouds, air, glacier, moon, and stars. In the second grade students, the most common words were: sun, rain, Earth planet, trees, rainbow, air, buildings, clouds, tornados, ice and moon. And in the third grade students, the words that were most

frequently found are: Sun, Earth planet, clouds, moon, forests, tornados, rain, winds, storms, heat, factories and snow. As it's observed, most of the elements of the social representations can be found in the area of natural sciences; we also identified the existence of alternative conceptions with partial knowledge. The principal sources of information about climate change, referred by the students were: television (46.5%), Internet (32.9%) and newspapers (11.3%). In the youth of this educational level, television is the main source of information. The importance of this media stands out to transmit, inform and educate the youth about the prevention and alternatives to mitigate the effects of global climate change. In the dimension of the field of representation, the predominance of the naturalist social representations was confirmed. In according to Reigota [17], the highest diversity of elements which conform the dimension of the field of representation was found in third grade students.

A field of representation comprises many levels because of the relation between its elements and the integration of these elements, in addition to the existence of a figurative nucleus as detected in this sample population of students. In first grade students, the quantity of elements identified on the first level of this field were 12, the elements found in the second level were 50, and the elements of the third level were 87. In the second grade students, on first level, 8 elements were identified, 26 elements on the second level and 61 elements on the third level. And in the third grade students, 15 elements were identified on the first level, 59 on the second level and 109 elements on the third level.

Dimension of attitudes. When we examined the dimension of the attitudes as a predictive virtue that was identified by, Moscovici [10], bridges between what the subject says about environmental issues and what that same subject chooses to do. We examined this aspect using a Likert scale and the development of problematizing situations. On the Likert scale, students were given a series of statements in which they chose an alternative according to their own way of thinking, which revealed an attitude to the situation. Students might or might not have considered that the actions described in the statements would affect the environment and the human species in future generations, as well as all life forms that inhabit the planet. That is how, in the answer, it is possible to associate the decision to the attitude.

In Table 1, a higher percentage of students showed a favorable attitude (47.4%) to the environment in their responses of either Agree or Totally Agree. The one who didn't have a favorable attitude (20.2%), were the ones who chose in their answer Disagree and Totally Disagree. Although the favorable percentage is more than double the unfavorable ones, the percentage of students who are undecided is also high (31.6%). If we remember that environmental education has among its objectives to promote awareness of the consequences of our actions on the environment, we still have a long way to go to work with the students of this school. It should be noted that the highest percentages are identified in the first and third grade students (these results need to be validated in future investigations). The difference is relevant because in other studies Rudd, P., Reed, F. and Smith, P. [18], the trend is opposite; since a higher percentage of favorable attitudes are expected as a higher level of education is obtained.

In Table 2 it's observed that a higher percentage (56.7%) of students chose the answers *Agree* and *Totally Agree*. Non-favorable attitudes are identified, since students consider that their actions have little influence, although the percentage of undecided students is also considerable (22.7%). As for those who don´t agree on the statement and therefore disagree or totally disagree (20.3%) they are the students who have a favorable attitude, since they consider that their actions can influence the reduction of climate change. An apparent contradiction is observed in relation to the responses to the first statement. This shows the lack of consistency of attitudes towards climate change. As for the actions carried out in the family, it was observed that a greater number of students, especially those in the first grade, consider that the actions they perform in the family contribute to the reduction of climate change. The percentage of students in the three grades who agree and totally agree is 46. 3%. The percentage of those who neither agree nor disagree is 30.6% and that who disagrees, or totally disagrees is 22.4%. Considering these percentages, the predominance of a favorable attitude in the students, regarding the actions realized in family, was observed. It seems that attitudes are the result of social pressure rather than a genius concern for the environment, Tarrant & Cordell [19], and Mogensen & Mayer [20].

Table 1. My actions influence the reduction of climate change

Option	First grade	Second grade	Third grade	Total
TD	4.5%	4.5%	2.2%	11.2%
D	3.4%	2.2%	3.4%	9%
ND/NA	14.7%	7.9%	9%	31.6%
A	10.2%	11.3%	10.2%	31.7%
TA	7.9%	2.2%	5.6%	15.7%
Total	40.7%	28.1%	30.4%	99.2%

TD: Totally Disagree; D: Disagree; ND/NA: Neither Disagree nor Agree; A: Agree; TA: Totally Agree

Table 2. My actions have little impact on reducing climate change

Option	First grade	Second grade	Third grade	Total
TD	2.2%	1.1%	1.1%	4.5%
D	5.6%	4.5%	5.6%	15.8%
ND/NA	10.2%	2.2%	10.2%	22.7%
A	15.9%	10.2%	9	35.2%
TA	6.8%	10.2%	4.5%	21.5%
Total	40.7%	28.2%	30.4%	99.7%

TD: Totally Disagree; D: Disagree; ND/NA: Neither Disagree nor Agree; A: Agree; TA: Totally Agree

As for the actions carried out in the school, a higher percentage of favorable attitudes was observed in the students (37.1%), who chose the options of agree and totally agree. There is a difference compared to the percentage of students with a non-favorable attitude (29.4%). This percentage is lower than the percentage of students who chose the option neither disagree nor agree. Students recognize the development of actions to address climate change in the school.

The application of the scale was complemented by the development of problematizing situations, in which young people are involved in an environmental problem, verbally expressing an attitude, as is described by Schmidt [21]. From the moment students face a situation, they were presented with an alternative to determine an attitude towards climate change which predominates. The main results show favorable attitudes as not favorable, but contrary to what was expected, in first grade students, the highest percentage of favorable attitudes could be identified, while these percentages are reduced in subsequent grades.

We analyzed the results of a problematizing situation related to energy expenditure: the cell phone. “You waited a long time for your parents to buy you a cell phone, but you know that the phone battery your parents have chosen for you, consumes a lot of electrical energy to run, it lasts only a short time and you have to constantly recharge it. Besides, in a short time, this product will be non-functional what would you do?”

In this situation, students doubted more in their answer, the biggest percentage of favorable attitudes correspond to first grade students, 41.6%. Meanwhile, second graders are 20% and third graders are 7.4%.

Most third graders would accept the cellphone, despite the unfavorable implications of its use for the environment. The students of first grade reject the phone and in some cases, propose to postpone its acquisition, but of a phone with different characteristics. In the other situations, there is a similar tendency in the students’ attitudes, with the percentages of favorable attitudes being more extensive in the first grade.

The results of this exploratory study show an evident contradiction, and coincide with the reported results of Agozie, Ezeudu and Sampson [22] who showed that the senior secondary school students posses low attitudes of climate change.

4. DISCUSSION

The obtained results revealed the existence of social representations of climate change in students, where the attitudes constitute a favorable predisposition to the environment. The results of the Likert scale and the problematizing situations are consistent in showing the existence of favorable attitudes towards the environment, but these attitudes in the place of the sphere, are the older ones. These results are similar to those found by Kilinc, A. Boyes, E. and

Stainsstreet M. [23]. These authors identified similar results in high school and middle school students, regarding different attitudes to actions that affect climate change. For example, students are willing to turn off electrical items, but are unwilling to carry out other actions such as using public transport instead of the private car. Students consider planting more trees a useful action to reduce climate change, but are unwilling to change their consumption habits. Erduran and Darcin [24], worked with a sample of high school students, finding that students have a very low level of knowledge about the causes and negative effects of some of the global environmental problems. In our research, students are knowledgeable about negative effects of climate change, but there is a resistance to changing behavior. Meanwhile, the Ozbayrak [25], research group finds that high school students are more aware of climate change through ideas acquired from television programs than the lessons they give at school; these are similar results to those obtained in our study.

It is possible to identify favorable attitudes in students, but these attitudes do not necessarily translate into actions when they involve a decision that affects them in a personal way.

The attitudes are relevant, since they identify the position assumed by students in many environmental problems, such as climate change, due to their capacity as indicators and guidelines of behavior, according to Campell, J., Waliczek, T.M and Zajicek, J.M [26] , García and Orozco [27], and Sarkar [28].

It is certainly time to review environmental education strategies, as mentioned in the Green at Fifteen Report: How 15-years-old perform in environmental science and geoscience in PISA, OECD[29], which showed that fifteen-years-old of the countries participating in the PISA test, do not necessarily have a sense of responsibility towards the environment even though they have information and knowledge about climate change The results show the importance of the design of educational alternatives that influence the constitution of social representations based on scientific knowledge and attitudes favorable to the environment. The results obtained draw attention to the revision of the programs for environmental education at the high school; As González-Gaudiano in a document from the UNESCO [30] warns. Programs based on scientific literacy processes, providing information on the discoveries of climate science and consequences for the natural systems, are insufficient and have had little impact in terms of achieving behavioral change to reverse the situation. It is necessary to take into account the results of educational research in the design of the curricula, and to consider the social representations that the students have regarding climate change.

5. CONCLUSION

The results obtained are not generalizable. They constitute an approximation to understand the implications of environmental education in the formation of attitudes in students and secondary education to climate change.

The study allowed researchers to detect differences in the attitudes of the students by the grade in which they are enrolled. Students in first grade differ from students in other grades, for having a higher number of favorable attitudes, data that make evident a diminution of these attitudes. Given this fact, it is necessary to consider the need to generate educational proposals that influence the shaping of social representations on climate change.

Attitudes reveal the global orientation of students towards climate change. In the present study, we see the predominance of a greater number of favorable attitudes in first grade students, and in the students of subsequent grades, these favorable attitudes diminish. Second and third graders are raising doubts about how to deal with environmental problems, although they already have information on the causes and effects of climate change. The obtained results show the importance of the study of social representations for environmental education, since through it, it is possible to link scientific knowledge with daily life knowledge, thereby making it possible to incorporate new knowledge or modify previous knowledge. They also articulate the link between attitudes and behaviors; That is, knowledge is not enough; If resistance to change attitudes persists, it is difficult to achieve changes in behavior over time. It is fundamental in this sense, to know the social representations of the students, and to implement strategies that affect gradual, but permanent changes in attitudes, based on meaningful learning about the implications of the effects of climate change on biodiversity and human societies.

Attitudes can be favorable or unfavorable to the environment, so this dimension in social representations should be studied to a greater depth, since its constitution not only occurs in schools, but specially in the social and cultural context and they reaffirm the environmental behaviors in the different stages of the subjects' life. Given the current situation of the environment, and the serious consequences of industrial activities and anthropocentric attitudes, it is necessary to begin to educate about all the problems associated to climate change. Education about environmental issues has to be given, hoping to generate an environmental conscience in children, youth and adults and in those responsible for public decisions, which translates into environmentally responsible and sustainable behavior. Second and third grade students may be more susceptible to the influence of their friends and peers, so their favorable attitudes decrease. It is recommended that future studies develop methodologies designed specifically for know the different processes social influencing attitudes

COMPETING INTERESTS

Author has declared that no competing interests exist.

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