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Environmental Awareness as a Mediator Variable on Conceptions of Science Teaching and Learning

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ABSTRACT

This paper shows the results of a study based on path analysis about the predictive and mediator role of environmental awareness on the conceptions of Pre-service Primary teachers about science education. The model thus obtained is validated through a representative sample of 300 students from a four-year university degree for teacher training. The method of unweighted least squares is used to perform the analysis and the results show a good fit to the data model. Therefore, it is assumed that students with higher levels of environmental awareness may be more effective in their future teaching profession. Consequently, the increase in environmental practices in schools makes a small but important contribution to the overall improvement of the environment and the training of future citizens.

KEYWORDS
Environmental awareness. Path analysis. Affective-emotional domain. Science literacy. Conceptions of science teaching and learning

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Introduction

The absence of environmental awareness leads to a lack of implication of human beings, as species, in the treatment of environmental issues that affect them and, to a great extent, are linked to the use of natural resources. To deal with global environmental problems that affect us, such as the loss of biodiversity or the climate change, for instance, the role that science and scientific knowledge play appears to be relevant. Castro & Lima (2001) point out that environmental issues are linked to the scientific knowledge that identifies. Moreover, as suggested by Martinez-Losada (2010), scientific knowledge has a

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significant role in the perception of risk and has an active participation in its recognition. According to these premises, the intermediation of education is a necessary element that allows people to acquire knowledge to identify environmental hazards and make them more explicit to the full citizenship, improving social behavior and generating concern towards these issues. In line with this point of view, Malka, Krosnick & Langer (2009) affirm that knowledge about environmental issues increases the implication of citizens in their solution.

This research is motivated by a starting hypothesis that sees environmental awareness as a theoretical construct that can contribute to the integration of the need for protection of the environment as well as to the conviction that humans should contribute to the resolution of human-made environmental issues through formation activities at the core level lead by science teachers.

It has been widely reported by several authors that pre-service teachers show a worrying deficit in their enviromental education even when they are graduating (Acebal, 2010; Alvarez & Vega, 2002; Barrón, Navarrete & Ferrer-Balas, 2010; Suarez & Marcote, 2016; Vilches & Gil, 2007). Such lack of knowledge and preparation prevents development of environmental awareness in their future pupils on aspects such as knowledge, values and behavior (Acebal, 2010; Chulia, 1995; Dunlap & Van Liere, 1978; Fernández, Rodriguez y Carrasquer, 2006; Jimenez & Lafuente, 2010; Maloney & Ward, 1973). For this reason, the initial work with pre-service teachers on the aspects mentioned above must be considered as a key element of the educational process. They are responsible, to a great extent, for setting the basis for the acquisition and development of environmental awareness of children at early ages.

Teacher training programs that conduct such a challenge must foster questioning, analysis, reflection, etc. of reality, demanding effective methods and several pedagogical and didactical strategies aligned with the learning needs of 21st century. An essential concept to define these policies includes conceptions about teaching and learning. Shulman (1987) did investigate about the need for developing knowledge in teaching through the transformation of content in order to meet the teaching-learning requirements in the desired way, that is, he defended the requirement of what is known as Content Pedagogical Knowledge (CPK). Thus, teachers' knowledge must go beyond content knowledge and must incorporate the capacity to think about the impact of their current and future actions.

Taking into account these considerations, the aim of this work is to analyze the role of environmental awareness within an interdependence model that considers various variables related to the conceptions we referred to before. By means of this analysis, we look for elements to incorporate into the design of strategies to foster the implication of potential teachers of Primary schools as a key factor in the preservation of the environment through the teaching of sciences.

Theoretical framework

To identify the role played by environmental awareness in the improvement of teaching practice in science classrooms, an initial relationship to

analyze is the one that is established with scientific literacy understood as the knowledge and vision of science and its utility to solve problems. This influence can be observed in as a real fact since environmental awareness requires an atmosphere of scientific culture and its relationship with human beings. Besides, it must be taken into account that environment and science are two closely related fields. In this sense, Hadzigeorgiou & Skoumios (2013) maintain that the development of environmental awareness through science is possible given the postmodern perspectives on science and science education. These provide different opportunities for students to work a wide range of social, economic, etc. issues that make the relationship between scientific and environmental education more evident. As pointed out by Eden (1996), science is initially in charge of defining environmental issues as social problems, because it can measure them through techniques and scientific reasoning. In consequence, science is essential in the identification of environmental risks and threats. As an example we can look at the study by Birdsall (2010), who found that scientific knowledge could help students to better understand the effects of garbage on the environment, from an aesthetic point of view to a scientific understanding, such as decomposition problems. This scientific knowledge not only gives rise to the students' feelings of concern, but also justifies actions to solve the problem . In this way, Uitto, Juuti, Lavonen, Byman and Meisalo (2011) point out that the better the scientific knowledge of students, the more aware they are of environmental problems, and the greater their sense of responsibility. Sterling (2010) also agrees that knowledge is necessary when dealing with the complex environmental problems facing today`s world.

At this stage, we try to establish how scientific literacy can influence the way to deal with environmental issues in teaching activities in two core aspects. Firstly, by contributing to generate environmental awareness through information about the degradation of the environment, the causing factors, and the risks that stem from these environmental issues, and secondly, by reinforcing the link between environmental awareness and pro-environmental action by identifying efficient teaching strategies. Considering the previous, it is proposed as a first hypothesis that scientific knowledge exerts a positive impact on environmental awareness.

The accomplishment is the next point to consider. This action is shown by teachers through the instruction and, given the close relationship between sciences and environment, the interest is focused on how the action is developed throughout the teaching of sciences. Nowadays a significant trend in education is to increase the accessibility of sciences to all students. In this context, from a constructivist perspective, knowledge is not directly transmitted from one expert to a given audience of students or whoever, but learning is the result of interaction between what is known or believed and the phenomena of ideas accessed. It means that learning is only built when students actively build meanings through individual and social processes and integrate new mental models about the world around them (Luera & Otto, 2005). Based on this idea, science education is oriented towards a constructivist approach that is promoted by teacher-oriented models. This new approach requires from teachers also a deep understanding of students' learning processes to adapt their instruction and reorient their ideas. As a consequence, teachers that have a high level of

environmental awareness would develop the particular form of knowledge that allows them to select adequate scientific content and adapt them to interests, knowledge, abilities and experiences that include environmental components. The fundamental idea of this process is the capability of teachers to transform specific subject matter knowledge into powerful and significant knowledge to be taught and learned adapting it to the integration of environmental aspects and levels taking into account learning difficulties of students. Moreover, Shulman conceptualized (1986,1987) that as pedagogical content knowledge (PCK) and, when analyzing teaching practices and knowledge, related this construct to the idea of professional behavior or practice. Being more explicit, the PCK can be seen as the knowledge teachers use to transform the matter they teach into knowledge accessible to students (Grossman, 1990) and takes into account a deep subject matter knowledge, curricular knowledge and didactic strategies and methods, among other elements.

Recent research shows that human action, educational level included, is influenced by emotions (Borrachero, Dávila, Costillo & Bermejo, 2016; Cortés, Acedo, Mero, del Amo & Bermejo, 2016; Costillo, Borrachero, Brígido & Mellado, 2013; Dávila, Borrachero, Martínez & Sánchez, 2015; Otero, 2006). In the field of teaching, emotions, attitudes and self-concept, teacher educational experiences as well as their students´ have an impact on their daily teaching activity (Costillo et al., 2013; de Pablos Pons & Pérez, 2012; Mellado, Blanco, Borrachero & Cárdenas, 2014). The affective domain plays a relevant role in the professional development of science teachers, especially in their first educational experiences (Mellado, Garritz & Brígido, 2009; Mellado et al., 2014). There would be no educational reform unless valuable and positive achievements were proven at an affective level. Thus, it is of vital relevance a regulation at the emotional level starting at the initial stages of the teacher traing programs since later these aspects are difficult to modify. Therefore, a second hypothesis is the one that establishes a positive relation between the affective-emotional domain of the student and the conceptions towards the teaching-learning of the sciences.

Taking into account what has been previously expressed, the work about environmental awareness at formative stages influences attitude about sciences. The image that science presents seems to be related to variables such as the level of knowledge or information, but also to conceptions about the relationship of individuals with the environment (Muñoz & Plaza, 2005), that is, in terms expressed in this work, environmental awareness directly influences the attitude towards science. In fact, Gough (2008) argues that building such a relationship could address declining interest in science. This author argues that due to environmental concerns students' interest in environmental issues is increasing, which can be harnessed from environmental education to rekindle interest in the study of science. This leads to a third hypothesis: environmental awareness is positively related to the affective-emotional domain towards the sciences.

The model described in this paper is based on the conceptual works developed by Stern & Dietz (1994), the theory of Reasoned Action of Fishben & Azjen (1980) and the theory of activation of altruistic norms of Schwartz (1977), where it is pointed out that the care of the environment becomes an obligation fostered by the knowledge possessed, and triggers the beliefs of individuals in

the consequences of their acts and their feelings of responsibility. These theories are widely accepted as a framework for researchs taking advantage of behavioral intentions. They have previously been applied to a wide range of disciplines, for example, as determinants that affect the choice of an ecological hotel (Quintal, Lee & Souter, 2010), the consumption of organic products (Paul, Modi & Patel, 2016) or on the behavior of health education (Chen & Tung, 2014, Mohamed, Arifin, Samsuri & Munir, 2014). Thus, for the purposes of this research, knowledge, values and behavioral intention are considered as the main antecedents of a pro-environmental behavior, and will be used in this model to predict behavior.

The model

From the revised, analyzed and commented theory a model is proposed about the relationship between the construct of environmental awareness and the rest of implied variables in professional development of a teacher in charge of teaching science with an environmental dimension in class. The proposal is thus a behavioral model based on cognitive variables that stem from the consideration of scientific literacy as a necessary component to acquire a level of environmental awareness and develops a model of behavior of a Primary school teacher towards environmental topics, which leads to a comprehension of a given personal behavior or cognitive factors implied in a social behavior such as teaching behavior.

From this perspective, theory suggests the need to relate to other individual variables (Ajzen & Fishbein, 1975; Báez Gómez, 2016; Corraliza & Berenguer, 2000; Corral & Verdugo, 2001; Mobley, Vagias & DeWard, 2010; Steg & Sievers, 2000, Slimak & Dietz, 2006; Stern, 1992, among others) considering sociodemographic variables with environmental awareness, affective domain and conceptions towards the teaching and learning of science. In summary, taking into account suggestions from previous research on this topic, a model is proposed to predict the influence of environmental awareness, considering variables such as affective-emotional domain, scientific literacy, and conceptions of science teaching and learning.

The hypothesized model linking science literacy with conceptions of teaching and learning science with environmental awareness as a mediator variable is shown in the following diagram (Figure 1):

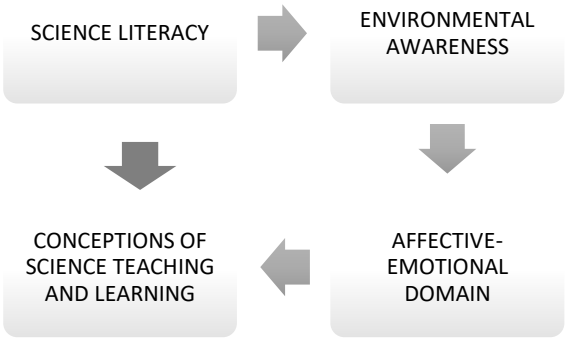

Figure 1. Theoretical model

To analyze the specified model that will be described in more detail in this Section, a path analysis technique is used, and the direct and indirect effects among variables are analyzed. This study, as pointed out by Cook & Campbell (1979), is especially appropriate when "theoretical knowledge, empiric knowledge and common sense" provide a logical mapping of present latent variables and their likely causal relationships. Path analysis is, thus, primarily adequate in an investigation in which the principles of social cognitive theory and the previous results are such that the possible relationships have a strong theoretical and empirical support (Álvaro et al., 1990).

The path model reads as follows: scientific literacy has an impact on environmental awareness and students' conceptions of science teaching and learning; environmental awareness influences the affective domain, and consequently, at the same time, conceptions.

Methodology

Sample and procedure

The sample consisted of 305 university students from two different campuses (X and Y) from University Z, in their third year of a four years training programme oriented to Primary schools' contexts.

The average age of participants was 21, with a range comprised between 19 and 48 years old. 69% of the participants were women and 31% men, which reflected faithfully to the usually present in such a university degree all over the country. Concerning the syllabus followed by these students in their high school studies it is shown that 67% were concerned with social and humanistic study plan orientations while 32% joined scientific and technological courses and the remaining 1% did it in art-like topics.

The administration of scales was done between December 2015 and January 2016 by authors and assistant teachers. The scales were self-completed with no intervention at all from any agent apart from the respondent themselves. In all cases, the motivation and purpose of the research were in an informed consent way, and the participants were free to answer or not. Data were dealt as anonymous and confidential. The average time for the completion of the whole pack of scales was 35 minutes.

Instruments

The environmental awareness was measured by a scale designed and validated for that aim (Laso, Marbán y Ruiz, 2017). It was composed of 30 items, and it is mainly answered on a Likert scale of four points (values from 1 to 4), while the rest of the questions were multiple choice ones. The internal consistency of this scale was supported by a value of Cronbach Alpha of 0.87.

On the other hand, scientific literacy, as a measure of a scientific-technological educational level, was measured through the proposed items designed to that end by the Survey of Social Perception of Science (Encuesta de Percepción Social de la Ciencia, 2014). These items evaluate perception about scientific education received, the consideration of what is scientific and what is not, the actions accomplished to obtain information with science, the knowledge of experimental procedures, and the knowledge of basic scientific theories.

The instrument for the measurement of emotions selected for this work was based on an adapted questionnaire of Brígido et al. (2009). This survey was chosen to measure attitudes, emotions, and beliefs of students about science.

Finally, to evaluate the conceptions of pre-service teachers, in terms of behavior intention about science teaching and learning are assessed using an adapted version of the questionnaire of Al-Lal & García (2014). The scale is divided into four categories: students' ideas, curricular contents, learning methodology, and evaluation of the teaching and learning process and it is measured by means of a Likert scale of four points.

For the sake of clarity a direct translation of the set of instruments used is presented in the appendix. The appendix shows the scales previously mentioned in the following order: first, scientific literacy; second, environmental awareness; third, affective-emotional domain and the last, conceptions of science teaching and learning. Nevertheless, for the presentation of the scales to the students, the items were randomly distributed.

Analysis of data and results

Firstly, normality tests were performed, and data were shown not to be normally distributed for any of the variables involved in the model. As a consequence of this, the UL-Unweighted Least Squares method was used through the LISREL 8.80 program, being this an option that does work quite well without the assumption of normality and under analytical conditions such as small samples or excessive kurtosis (Huba & Harlow, 1987). Obtained standardized results are provided (Figure 2).

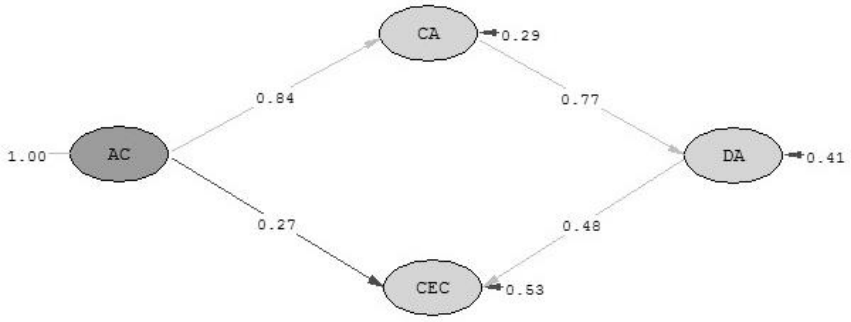

Figure 2. Model's representation with latent variables

In order to test the significance and goodness of fit for the proposed model Chi-squared statistics, ratio of Chi-squared over grades of freedom ($\chi 2$ /gl), index of comparative adjustment (CFI), Tucker-Lewis index (NNFI) and mean squared approximation error (RMSEA), were considered taking as reference values the following: ratio of Chi-squared over grades of freedom lower than 3.0 (Hair,1999); for indices CFI and NNFI, values between .90 and .95 were considered between acceptable and excellent (Bentler, 1995; Byrne, 2001); for RMSEA index values between .05 and .08 were found to be acceptable and lower than .05 as optimum (Browne & Cudeck, 1993); for GFI, AGFI and NFI values

over .90 (Byrne, 2001) were considered acceptable and values over .95 are indicators of a good fit (Ruíz, Pardo & San Martín, 2010) .

Table 1. Evaluation of quality of adjustment of the model

Obtained value	χ^2	χ^2/gl	CFI	NNFI	RMSEA	GFI	AGFI	NFI
	96.30	1.72	1.00	1.00	0.050	0.997	0.995	1.00

As observed in Table 1, all the criteria for goodness of fit were met since the indices of the specified model were found to present acceptable or excellent values (as in the cases of values of CFI, NNFI, GFI, AGFI and NFI) or even above optimal limits (as in the cases of absolute index of fit (χ2 /gl) and RMSEA). Consequently, we could consider them adequate to conduct the interpretation.

Discussion and conclusions

The main aim of this research was to analyze to what extent environmental awareness behaves as a mediator variable on the conceptions of pre-service primary teachers about the teaching and learning of science. For that purpose, an inter-relational model was designed, and its goodness of fit approached through Path Analysis technique. The results thus obtained support the original hypothesis, and the expected mediator effect seems to be confirmed by data.

The conclusions will be presented in order of relevance, taking into account the weights within the model, where the following factors were identified: scientific literacy, environmental awareness, affective domain, and conceptions about science teaching and learning.

After testing the model, it was confirmed that the most intense effect was found between scientific literacy and environmental awareness (0.84). Such results were not surprising due to the positive and favorable impact of having knowledge that leads to the awareness of being able to cope with environmental issues. Many studies have been developed around these variables (Paur, 2014; Rickinson, 2001; Gifford & Nilsson, 2014, among others). It is also confirmed the weak effect of scientific literacy on conceptions of science teaching and learning (0.27). From this fact, it can be concluded that scientific literacy is more relevant for environmental awareness than for conceptions of science teaching and learning. The main reason could be that knowledge has an impact on decisions on the environment, leading greater knowledge to a more moderate position towards the care of the environment and leading an insufficient knowledge to a more extreme position of defending or abandonment of taking decisions about the environment, conduct already mentioned, for example, in the works by Uitto et al. (2011) or Hadzigeorgiou & Skoumios (2013).The relationship between the environmental awareness and the affective domain in science (0.77) is also confirmed. Thus, we can accept the hypothesis that an acceptable level concerning aspects of the environment, in their affective, conative, cognitive, and active aspects, provide potential teachers the adequate and necessary context for the development of cognitive and emotional skills, giving way to significant benefits in the development of their future professional practice. In this sense, it

is important to consider that the environmental awareness of students is not an advantage in itself, but a good feeling from students about science is needed for a more warranted practice. Moreover, a higher scientific culture is associated with a positive assessment of science as knowledge. Thus, scientific literacy is considered an element that helps interpret in a convenient way environmental and scientific information. As a result, citizens, in general, would be less sensitive to campaigns that foster distrust around environmental issues or measures to solve them. López Cerezo (2005) points out clearly states that citizens should use scientific knowledge in all scopes of their lives, in order to provide them the capacity to generate a practical point of view of environmental challenges that are being confronted.

Another observed effect is the one established between the affective domain and the conceptions towards the science teaching and learning (0.48). The availability of a sound theoretical framework supports the hypothesis that connects them causally (Garriz & Mellado, 2014; Mellado et al., 2009; Gess-Newsome & Carlson, 2013; Sinatra, 2005; Dolan, 2002; Southerland, Sinatra & Matthews, 2001; Goswami, 2006; Zembylas, 2007). Nonetheless, it is necessary to develop wider conceptual models that allow the integration and comprehension of a contribution of the ensemble of influences.

Thus, from the proposed path analysis, it can be said, as a conclusion, that environmental awareness is a variable that affects the way environmental issues are evaluated in a classroom teaching-learning context and, as a consequence, has an impact on the generated answer. As environmental awareness is culturally being empowered by the students, it will influence the educational paradigm that determines the relationship between students and the environment, where it will eventually reach the acknowledgment that will allow students to modify and work toward a better environment. Last, taking into account what has been said before, working towards an environmental awareness in class with student teachers would not only provide the society with qualified scientifically and environmentally trained professionals but, simultaneously, it would improve the conditions of the planet in which we live.

This paper has provided an opportunity to analyze the close relationship between the teacher's characteristics ecosystems and the environmental context. To confront environmental deterioration, it is basic to know the processes to carry out in the educational environment. The relationship between population and environment has been determined, nearly from the start, by the capacity of service of natural resources for the development of human species. Besides, the current socioeconomic system is in constant growth that has an impact on ecosystems on Earth. In this way, teacher educators, knowing the elements on which future Primary school teacher define their behavior, both in terms of their environmental involvement and the management of the science` class, should include in their teaching planning issues that act on the environmental awareness, orienting the values that guide the life of the people and their intentions, so that they behave in a more responsible way. Thereby, it is suggested the development of programs that improve the students' environmental awareness, promoting certain behaviors, such as the treatment of environmental issues in the Primary school classroom, the promotion of

integration initiatives with nature and the promotion of collaboration initiatives with a socio-environmental cause.

Thus, this research paper shows, using an interdisciplinary approach, that environmental awareness allows to structure and comprehend the set of elements that determine the relationship between environment and teaching of sciences. Likewise, it has been considered that scientific literacy plays a key role in the development of environmental awareness. It has been pointed out that the knowledge of environmental issues, their causes, and most efficient strategies increase the implication of students in actions, even in cases that require a higher level of compromise. At the same time, the close bonding between attitudes towards science and environmental awareness is also pointed out.

Prior studies have shown the recognition of the need of a varied approach that takes into account aspects of context (Ajzen & Fishbein, 1975; Corraliza & Berenguer, 2000; Stern, 1992; Steg & Sievers, 2000, Corral & Verdugo, 2001, among others) to understand the concern about environment and explain the behavior. Nevertheless, this point has not been confirmed, and even though initially it was included as an influencing variable, finally it was ruled out due to the homogeneity of the sample in this study. However, it will be taken into consideration as a future line of work.

Disclosure statement

The Authors reported that no competing financial interest.

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Appendix

Questionnaire on attitudes and practices of future Primary School Teachers

Introductory note: for reasons of confidentiality, the personal data of the respondents will be reserved, under the Ley Orgánica 15/1999, of December 13, on the protection of personal data (BOE No. 298, of December 14, 1999).

The present questionnaire that we present is part of an investigation aimed at analyzing the attitudes of Primary Education students. Its development is part of the training of future Primary teachers at the University of Valladolid.

The data that are reflected in it will be treated in a totally **CONFIDENTIAL** manner, analyzed statistically and used for the purposes of the research work in which the questionnaire itself is framed. Therefore, do not have any objection to answer with **SINCERITY**, being this condition essential so that the obtained results have real practical value.

Before answering each question, carefully read its contents and the form of answer that is requested in each of them.

THANK YOU FOR YOUR COOPERATION

SCIENTIFIC LITERACY

How would you say the level of scientific and technical education received?

- ☐ Very high
- ☐ High
- ☐ Normal
- ☐ Low
- ☐ Very low

People may have different opinions about what is scientific and what is not. I'm going to read a list of topics for each of them, please tell me how much you think you are scientific or you are not.

	NOTHING SCIENTIFIC	*LITTLE SCIENTIFIC*	*SOME SCIENTIFIC*	*ENOUGH SCIENTIFIC*	*VERY SCIENTIFIC*
Medicine					
Physics					
Biology					
The maths					
The astronomy					
Psychology					
Homeopathy					
Acupuncture					
The history					
The economy					
The horoscopes					

The following describes behaviors that people can adopt in their daily lives. For each of them, please tell me if you describe something you often do, from time to time or very rarely.

	OFTEN DO	*FROM TIME TO TIME*	*VERY RARELY*	*NOT KNOW*
Treat to keep informed before a health alert				
Takes into account medical opinion by following a diet				
Read the prospects of the medicines before using the same				

	OFTEN DO	*FROM TIME TO TIME*	*VERY RARELY*	*NOT KNOW*
Read the labels of food is not interested by its qualities				
Consider the dictionary when you do not understand a word				
Pay attention to the technical specifications of appliances or manuals of appliances				

Suppose some scientists are studying the efficacy of a medicine for high blood pressure. I will present you with four options to carry out that study, which of the options would be the most useful for scientists to establish the efficacy of medicine?

- ☐ Ask patients to see how they are to see if they notice any effect
- ☐ Analyze each of the drug components separately
- ☐ Administer the drug to some patients, but not to others, and compare what happens to the groups
- ☐ Use your knowledge about medicine to establish drug efficacy
- ☐ Not know

Please tell me if each of the following statements is true or false

	TRUE	*FALSE*	*NOT KNOW*
The Sun revolves around the Earth			
The oxygen we breathe in the air comes from plants			
Antibiotics cure diseases caused by both viruses and bacteria			
The continents have been moving for millions of years and will continue to do so in the future.			
Laser beams work by concentrating sound waves			
All the radioactivity on the planet is produced by humans			
The center of the Earth is very hot			
Humans come from previous animal species			
Early humans lived at the same time as dinosaurs			
Umbilical cord stem cells can be extracted from mammals			
When a person eats a genetically modified fruit, their genes can also be modified			
Mobile phones produce electromagnetic fields			

ENVIRONMENTAL AWARENESS

Thinking about global environmental problems, how do you value the environmental situation in the world?

- ☐ Nothing concerning
- ☐ Little worrisome
- ☐ Quite worrying
- ☐ Very worrying

A series of behaviors are presented, could indicate if I would be willing to do them?

	YES, I ALMOST ALWAYS DO	*YES, I DO IT SOME TIMES*	*DON´T DO IT BUT I WOULD DO IT*	*DON´T DO IT NEITHER I WOULD DO IT*
Reuse used paper				
Provide a second use of different materials for classroom work				
Promote activities in the natural environment				
Include environmental issues as a basic component in the training of my students				
Participate as a volunteer in school environmental conservation campaigns				
Choose subjects that deal with environmental issues because I feel I do not know enough				

What didactic models do you know to work on environmental issues?

- ☐ Classroom research
- ☐ Projects
- ☐ Problem-based learning
- ☐ CTSA

How do you consider the following environmental problems to be of concern?

	NOTHING CONCERNING	*LITTLE WORRISOME*	*QUITE WORRISOME*	*VERY WORRISOME*
Contamination of the atmosphere and oceans				
Contamination of the oceans				
Decrease of the ozone layer				
Climate change and global warming				
Extinction of animal and plant species				

	NOTHING CONCERNING	*LITTLE WORRISOME*	*QUITE WORRISOME*	*VERY WORRISOME*
Discharges of industrial waste				
Desertification and soil erosion				
Discharges to inland water bodies				

Point the degree of agreement or disagreement with the following affirmations:

	STRONGLY DISAGREE	*DISAGREE*	*AGREE*	*STRONGLY AGREE*
Plants and animals have as much right as humans to exist				
If things continue on their present course, we will soon experience a major ecological catastroph				
The balance of nature is very delicate and easily upset				
Humans are severely abusing the environment				
In order to achieve sustainable development, a balanced economic situation is needed in which economic growth is controlled				
When humans interfere with nature it often produces disastrous consequences				
There are more important things to do in life than protecting the environment				

How do you consider your level of environmental knowledge?

- ☐ High
- ☐ Normal
- ☐ Low
- ☐ Very low

What teaching material do you think works on environmental issues?

- ☐ Scientific articles
- ☐ Textbooks
- ☐ Special software

Point the degree of agreement or disagreement with the following affirmations:

	STRONGLY DISAGREE	*DISAGREE*	*AGREE*	*STRONGLY AGREE*
There are more important things to do in the classroom than to teach to protect the environment				
The degree of environmental commitment of the teacher influences his students				
I consider it interesting to receive environmental training				
The university should include more field activities because they help to better understand the subject				

What strategy is most beneficial to address the environmental issue?

- ☐ Classroom research
- ☐ Practices
- ☐ Using TIC
- ☐ Posing a problem

AFFECTIVE-EMOTIONAL DOMAIN

Submit a series of affirmations. Please, tell until you agree it:

	STRONGLY DISAGREE	*DISAGREE*	*AGREE*	*STRONGLY AGREE*
The contents of letters are more important in the world today than those of science				
Scientific knowledge is secondary to the development of society				
The detrimental effects of science are greater than the benefits it could have				
Science has very little influence on the progress of mankind				
Science contributes to the improvement of the quality of life				
Scientific topics are useful in my daily life				
Understanding the contents of science requires effort, perseverance and patience.				
In general I liked the study of science more than that of letters.				
I liked the subjects of science because they were useful in my daily life				
I prefer to teach scientific content that subjects of letters				
Science subjects require more hands-on activities than letters				
I want to give a science class in Primary				
Science teachers are willing to help and clarify doubts and difficulties that arise in their class				
The teaching of science can dispense with new technologies				

Points the emotions that you believe you will feel when you have to impose content of sciences:

	I WILL EXPERIENCE IT	*I WON´T EXPERIENCE IT*
Anger		
Fear		
Tension		
Worry		
Hate		
Anxiety		
Despair		
Nervousness		
Impotence		
Frustration		
Burdem		
Oppression		
Pride		
Tranquility		
Pleasure		
Sympathy		
Enthusiasm		
Trust		
Satisfaction		
Capacity		
Fun		
Motivation		
Interest		
Curiosity		

Point the degree of agreement or disagreement with the following affirmations:

	STRONGLY DISAGREE	*DISAGREE*	*AGREE*	*STRONGLY AGREE*
I am a negative person				
I think others are better at dealing with problems than I am				
I may be able to achieve all the goals I set for myself in life.				
I have a positive attitude towards myself				
When something worries me, I try to cheer myself up and think about cheerful things				
When I can not solve a topic that concerns me I look for different solutions				
If I have a problem in my life I face it and I never leave it aside				
I often seek support from others when I can not solve a problem				
If I compared myself to other classmates I felt that I was				

	STRONGLY DISAGREE	*DISAGREE*	*AGREE*	*STRONGLY AGREE*
not a good science student				
No problems to pass science subjects				
The attitude of the teacher influenced my performance in science				
The contents of science were difficult for me to comprehend				
I used to learn the scientific contents of memory				
When he did not understand a concept, he abandoned it				
When I could not solve a scientific problem, I preferred to ask the solution to the teacher to keep looking for it myself.				
I was more encouraged when my science teacher was sympathetic and patient with me				
I felt reassured if the science teacher had me in mind how my work continued during the course when evaluating me				
I enjoyed practicing field activities in nature in science subjects				
I would feel empowered if I were to give a kind of knowledge of the environment right now				
It gives me anxiety to think that someday I will have to impart complex scientific content				
I will feel more insecure if my students are in the upper elementary school				
I will feel more confident when I teach theory that when students do practical activities				
I believe that science performance depends to a large extent on the attitude and motivation of the teacher				
When I have doubts about the scientific contents that I must explain, I will seek information through other means				
It will be inevitable that my students will notice my preferences for imparting content or other				
When I do not fully understand a scientific concept that I have to explain to my students, I will spend less time				
I will try to prevent my students from asking me questions about complex scientific content				
If a student asks me a question that he does not know how to answer, I will become so nervous that I will not know how to control myself				
If a science topic I do not like, I will spend less time in class				
I will seek support in other people to prepare some science topics that I must teach				
In science classes I would prefer that my students work in groups				
I will try to establish relationships between the scientific concepts that I must teach my students and their daily lives				
I will prepare my science classes in depth				
I will look for new ways to innovate in my science classes				
In my science class I will further encourage class participation of competent and intelligent pupils				
My science class will be mostly theoretical, following the textbook				
I will try to be patient and understanding with my students in science subjects always				

CONCEPTIONS OF SCIENCE TEACHING AND LEARNING

Point the degree of agreement or disagreement with the following affirmations:

	STRONGLY DISAGREE	*DISAGREE*	*AGREE*	*STRONGLY AGREE*
In the teaching of science, content must be relevant to everyday life and social integration of people.				
Scientific contents should consider not only concepts, but also procedures and attitudes.				
For students it makes more sense to investigate problems that interest them than the usual list of topics.				
Scientific contents must include the processes characteristic of scientific activity (observation, hypothesis, etc.).				
In order to select and to sequence the school contents of sciences one has to take into account several referents (the ideas of the students, the history of the science, the context in which the student lives ...				
The so-called procedural and attitudinal contents do not have much interest in teaching-learning science.				
Students interpret personally the information they perceive from reality.				
Students learn when they mentally incorporate the scientific content taught.				
The exploration of students' ideas should be done at the beginning of a topic to determine the starting level.				
The debate of the ideas and interests of the students throughout the whole process of education is essential to learn science.				
Learning occurs when students' conceptual mistakes are replaced by correct scientific ideas.				
The results of the initial exploration of the students' ideas regarding a specific topic are of interest only to the teacher.				
Learning involves re-elaborating one's own ideas in a progressive way through interaction with different sources of information.				
The manifestation of ideas and interests of the students along the teaching of a subject cause changes in the teaching planning.				
The ideas students routinely use in their daily lives constitute an alternative				

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	STRONGLY DISAGREE	*DISAGREE*	*AGREE*	*STRONGLY AGREE*
knowledge to scientific knowledge.				
Students do not have the capacity to spontaneously develop ideas about the natural and social world around them. .				
Students' ideas about science concepts are often erroneous and of little use.				
Activities are situations to clarify, reinforce or test the theory.				
The activities must be diverse, so that they respond to the educational purpose, the content treated and the characteristics of the students.				
Research in the classroom of interesting problems for the student encourages the learning of concrete contents.				
The sequence of activities is determined exclusively by the order in which they are intended to teach the contents.				
The verbal explanation of the subjects is the basic activity for the student to learn the contents to teach.				
The activities aim to facilitate the student to build the knowledge.				
The activities proposed in a good textbook are essential and sufficient for the teaching of science.				
In order for students to be able to carry out activities, they must first be given a theoretical basis.				
Practical experiences are essential activities for the construction of significant knowledge by the student.				
Activities should be organized in a way that facilitates the evolution of students' ideas about teaching content.				
The activities should generate an atmosphere and dynamic in the classroom that enhances the interaction between the students and of these with different sources of information.				
In evaluation, we must be concerned with both learning and teaching.				
The evaluation should use as many instruments as possible (class notebooks, participation registers, laboratory work, self-assessment reports, etc.).				
When evaluating students, the learning of procedures and attitudes, as well as concepts, must be considered.				
The evaluation is necessary, fundamentally, to decide on the promotion of the student.				
Evaluation is a basic tool for understanding and improving teaching-learning processes.				
The basic and most reliable instrument for assessing learning is the written exam.				
In an evaluation, the fundamental thing is to determine the level reached in the				

	STRONGLY DISAGREE	*DISAGREE*	*AGREE*	*STRONGLY AGREE*
conceptual apprenticeship of the student.				
Evaluation tools should be prepared to assess pupils, teachers and developed teaching.				
Students should be evaluated positively if there is a significant evolution of their own ideas, even if they do not arrive at the most adequate formulation.				
The evaluation should focus on measuring the level reached by the pupils in relation to the intended objectives.				