

# YOUNG PUPILS' VIEWS ON THE ENVIRONMENTAL CHALLENGES FROM SPANISH ROSE DATA

*Ángel Vázquez Alonso, University of the Balearic Islands, Spain*  
*M<sup>a</sup> Antonia Manassero Mas, University of the Balearic Islands, Spain*

## Introduction

Environmental education is a primary concern in school and mainly for school science education. Well educated population about environmental issues goes far beyond than just understanding the relevant scientific ideas and concepts. Instead, the current challenges in environmental education aim to empower aware citizens, able to promote environmental protection, and respect and to act responsibly for sustainable development. The contents and methods of environmental education are aimed to reinforce or to change the learners' attitudes, values and beliefs.

The environmental education is a key element of the scientific literacy, since it exemplifies science in context, in local environments and the daily life of people. The environmental education has a dominant ethical profile, whose importance is vital for the public understanding of and the civic participation in science and technology, to tackle the current and future challenges in the planet. Years ago the environmental education boomed across the planet, but the specific investigation on attitudes toward environment is scarce.

This study seeks to cover this gap assessing the youth attitudes toward the environment, and to that aim let us consider some trends about youngsters' environmental attitudes. The Spanish adolescents' interest toward the environment and the ecology is relatively high: the topic "environment and ecology" gets the second place - it follows the sport topic - in a table league among diverse interest topics (Echeverría, 2003).

The Third International Study in Science and Mathematics (TIMSS) is a transnational investigation that compares the 14-15 year-old students' achievement in mathematics and science across 45 countries (Vázquez, 2000). The attitudes toward environment are assessed asking the students about the science role in helping to improve six environmental problems (air contamination, destruction of forests, extinction of species, damage in the ozone layer, and nuclear power). The answers are characterized by "scientist faith" pattern across the six problems. A great amount of respondents (around 80%) believes that science can help about them, showing a slightly smaller proportion (73%) in the case of the nuclear power plants. The damage in the ozone layer is the environmental problem that worries most the students (43%), while nuclear power plants (17%), and air and water contamination (7%) worry the least.

The Eurobarometer 2002 (EORG, 2002) about citizens' attitudes toward the environment shows that the Europeans grant a high priority to the environment. The European youth appear less concerned for the environment than the oldest generations, but they feel themselves better informed about the topic, agree more with the passive attitude of "waiting and seeing", and trust more on environmentalist associations and scientists. Spanish stand among the less concerned Europeans about environment problems, - as they get the last place in the citizens' trust on the institutions to solve the environmental problems - far away from its south European neighbors, which are the most concerned.

The 15-24 year-old Balearic youth scores the environmental values lower than other European countries (Elzo, 2002). On a list of several social problems, they locate

the problems of contamination and environment in the seventh position, mentioned by 21% of the sample (in front of 26% in the total national); the most important problems for the Balearic youth are unemployment (73%), drugs (65%) and AIDS (56%).

This panorama from the social polls displays a contradictory profile of the youth's ecological conscience and attitudes toward the environment, as it alternates pessimistic and optimistic features. For example, the environmental challenges don't occupy a relevant place in the scale of values, but a majority sustains the urgency of confronting them.

ROSE, The Relevance of Science Education, is an international research project meant to shed light on some factors that are important to teach and learn science and technology (S&T), from the perception of young pupils about different S&T-related issues. The empirical data for this paper come from the data collected in Spain through the ROSE instrument. The ROSE questionnaire probes pupils' interests, attitudes, experiences, future wishes, etc. related to science, technology and environment about out-of-school experiences, their interests in learning different S&T topics in different contexts, their prior experience with and views on school science, their views and attitudes to science and scientists in society, their future hopes, priorities and aspirations about job, and their feelings of empowerment with regard to environmental challenges (Sjøberg, 2002).

The goal of this paper is to present some preliminary results from the Spanish sample about pupils' views on environmental challenges as surveyed in the ROSE questionnaire. The information from the environmental items would be relevant to know the prior ideas and expectations of young people, and then to improve their environmental education in the school. These results embrace the analyses of the general pupils' attitudes about the future and the environment protection, and some complementary issues such as differences across gender and science subject choice. The results will be discussed from their contributions and implications to empower an informed citizenry in science and environmental education.

### **Method**

ROSE is aimed to gather and analyze the perception of young pupils towards the end of secondary school (age 15 and 16) about different S&T-related issues. The ROSE questionnaire has hundreds of items that are merged into composite variables or clusters; the data presented here correspond to the cluster labelled "Me and the environment challenges". In the foreword of the cluster such problems as the air and water pollution, the overuse of resources, and the climate global changes are explicitly cited.

The Spanish version of this cluster contains 19 items, which display the students' agreement about different aspects: optimistic or pessimistic expectative about the future (D2, D7, D9, D15, D18), importance of environmental protection in society (D3, D8, D11), helplessness or empowerment to cope with the environmental challenges (D1, D4, D6, D12, D13, D14), interest about environmental protection (D5, D10, D16, D17, D19).

Between December 2002 and April 2003, 774 10<sup>th</sup>-grade randomly sampled Spanish pupils were polled in clusters across 37 schools in the Balearic Islands (one class per school). The pupils agree or disagree on a four-point Likert scale, whose categories rang from 1 'Disagree' to 4 'Agree'. The students express their views ticking one point on the scale, located besides each environmentalist ROSE question.

## Results

The table I summarizes the percentages from the direct answers to the questions on each of the four points of the agreement / disagreement Likert scale. The young respondents highly agree (higher than 80%) with different items: the possibility of solving the environmental problems, the duty of taking care more than protecting the atmosphere, the importance of the personal contribution to the protection of the atmosphere and the animal rights. The hardest disagreements are displayed in three questions, which refer to the environmental threats as non personal matter, the environmental problems as exaggerated, and people worry too much for the environmental problems. As they are worded negatively, the results must be interpreted inversely, as if they were equivalent to big agreements with the positive statements.

Table I. Agreement / disagreement percents on the 4-point scale for each question.

QUESTIONS	DISAGREEMENT		AGREEMENT	
	High	Mild	Mild	High
	1	2	3	4
D01*	46	36	13	4
D02	9	25	39	28
D03*	34	48	14	4
D04	19	42	31	9
D05	7	31	41	21
D06	11	29	37	23
D07	2	10	43	45
D08*	33	49	13	5
D09*	32	42	21	6
D10*	17	36	35	12
D11	3	8	36	53
D12*	29	31	29	11
D13	3	13	35	49
D14*	27	46	21	6
D15	11	30	42	17
D16	5	16	34	45
D17	19	31	32	19
D18*	7	43	41	9
D19	5	23	42	29

\* : negative statements.

Some specific data are specially important; for example, two thirds of the interviewees perceive a desperate future, almost one in five young respondents thinks that the environmental problems are exaggerated or that excessive concern exists for them, one in four believes that the problems should be left in the experts' hands, approximately half of the respondents believe that the solution of the problems won't require big changes in the people current way of life, and also consider that almost all the human activities damage the environment.

In order to represent simply the agreement degree using a single statistic parameter, the sample arithmetic mean has been computed for all the questions. The mean direct score distribution along all the questions spreads quite symmetrically around the half point of the scale (2,5 points). Five questions have mean scores that

correspond to very high agreement (above the value 3 or near that value), while other five items stand in the disagreement symmetrical position (under or around 2 points).

The questions with the highest agreement scores (3.40 to 2.95 points) are the following ones (descending score order):

11. People should care more about protection of the environment

7. We can still find solutions to our environmental problems

13. I think each of us can make a significant contribution to environmental protection

16. Animals should have the same right to life as people

19. The natural world is sacred and should be left in peace

The first three statements express a clear positive expectation regarding the environmental challenges based on the concerted action of everybody to construct a sustainable future. The last ones display a clear recognition of the rights of the natural world, animals, vegetables or minerals.

The lowest score questions (biggest disagreement), listed from the smallest to the highest scores (1.76 to 2.06), are the following:

1. The environmental threats are not my business

3. Environmental problems are exaggerated

8. People worry too much about environmental problems

9. I hate humanity for what it has done to the natural world

14. Environmental problems should be left to the experts

In spite of displaying the lowest scores, the attitudes corresponding to these items must be interpreted as positive ones, because the original sentences are negatively formulated. So their low score disagreements correspond, in fact, to symmetric high score agreements, which represent an appropriate attitude. This is the case of the students' disagreement with the statements saying that the environmental threats are not our matter, or because it exists an exaggeration of the problems, or the environmental concerns, or hating the humanity for the environmental aggressions.

A special case is the sentence that proposes to leave the environmental problems in the experts' hands. Although the disagreement with it could seem irrational, it has been considered appropriate and valuable, because it fits with the current proposals about the public participation in the control of science and technology, through consent congresses, panels of citizens or similar entities of negotiation and participation on the decision making on socio-scientific issues, which is opposite to leave the problems to experts. Other assessments show some moderately negative attitudes, such as those regarding the vision of the somber and desperate environmental future, little agreement about the exaggeration of environmental problems, and the lack of trust on science and technology to solve the environmental problems.

On the whole, interpreting conversely the statements having a negative wording, the attitudes toward the environmental challenges are moderately positive, because the assessments in most questions are located in the moderately positive area (between 2.5 and 3 points), which corresponds to positive attitudes. Some items display the most positive attitudes, reaching scores above 3 points, or below 2 the negative sentences

(reverse score). The following list displays the sentences that represent the most positive attitudes, in descending order from the top score (3.40):

- 11. People should care more about protection of the environment
- 7. We can still find solutions to our environmental problems
- 13. I think each of us can make a significant contribution to environmental protection
- 1. The environmental threats are not my business (reverse score)
- 16. Animals should have the same right to life as people
- 8. People worry too much about environmental problems (reverse score)
- 9. I hate humanity for what it has done to the natural world (reverse score)

The previous sentences highlight the following issue: the personal responsibility in the care of the atmosphere (11, 13, and 8), a hopeful and optimist character for the future of the environment (7 and 9) and, finally, the support to the animal rights (16, 9)

### Gender differences

The analysis of gender differences on the environmental challenges show that, on the whole, the girls have got better ecological attitudes than boys, because the differences are favorable to girls in the majority of questions in the environment scale (table II).

Table II. Statistical parameters, significant probability (ANOVA and chi-square), and effect size of gender differences.

QUESTION	Girls			Boys			Total			Effect Size (Girl – Boy)	SIGNIFICATION	
	Mean	N	S.D.	Mean	N	S.D.	Mean	N	S.D.		ANOVA	Chi-2
D01*	1,70	438	0,82	1,83	326	0,87	1,76	764	0,85	0,15	0,0394	> 0,05
D02	2,88	425	0,93	2,79	323	0,94	2,84	748	0,93	-0,11	0,1539	> 0,05
D03*	1,80	415	0,74	1,98	315	0,86	1,88	730	0,80	<b>-0,22</b>	<b>0,0032</b>	0,004
D04	2,18	423	0,82	2,45	323	0,92	2,30	746	0,87	<b>-0,31</b>	<b>0,0000</b>	0,000
D05	2,78	420	0,84	2,75	318	0,87	2,77	738	0,85	0,03	0,735	> 0,05
D06	2,74	435	0,95	2,68	325	0,94	2,71	760	0,95	0,06	0,4231	> 0,05
D07	3,32	433	0,71	3,29	328	0,77	3,31	761	0,73	0,04	0,6279	> 0,05
D08*	1,87	438	0,79	1,96	329	0,85	1,91	767	0,82	0,10	0,1636	> 0,05
D09*	1,99	433	0,86	2,03	327	0,89	2,01	760	0,87	0,05	0,4859	> 0,05
D10*	2,43	429	0,89	2,41	327	0,93	2,42	756	0,90	-0,03	0,7202	> 0,05
D11	3,46	433	0,72	3,30	315	0,79	3,39	748	0,76	<b>0,22</b>	<b>0,0035</b>	0,022
D12*	2,05	435	0,95	2,44	327	0,98	2,22	762	0,98	<b>0,40</b>	<b>0,0000</b>	0,000
D13	3,38	436	0,75	3,16	326	0,87	3,29	762	0,81	<b>0,27</b>	<b>0,0002</b>	0,002
D14*	1,96	429	0,80	2,19	326	0,88	2,06	755	0,84	<b>0,28</b>	<b>0,0002</b>	0,000
D15	2,68	433	0,87	2,63	323	0,90	2,66	756	0,88	0,06	0,4445	> 0,05
D16	3,31	438	0,79	3,02	329	0,96	3,19	767	0,88	<b>0,34</b>	<b>0,0000</b>	0,000
D17	2,41	437	0,99	2,63	326	1,01	2,50	763	1,00	<b>-0,22</b>	<b>0,0032</b>	0,006

D18*	2,48	437	0,72	2,57	328	0,80	2,52	765	0,76	0,11	0,1274	0,015
D19	2,98	436	0,81	2,91	329	0,92	2,95	765	0,86	0,08	0,2616	> 0,05

\* : negative statements.

The boys put more mute to the environmental threats (don't personalize them so much, diminish their importance, believe that they are exaggerated, they have more trust in the help of the science and the technology) and externalize more the causes and possible remedies (attribution to the rich countries, faith in the experts and use of experimentation animals). The girls believe that it is more important the implication of the whole people in the care of the environment and they believe more in the rights of the animals. However, looking at statistical significance across gender, only eight questions display significant differences between boys and girls, and the difference sign, positive or negative, spread similarly between girls (5) and boys (3).

In general, although significant differences are observed in some questions, the effects size is generally small, even the highest value is lower than half a typical deviation. The most significant effect of differences among boys and girls is produced in the question that refers to the responsibility of the rich countries to solve the world environmental problems. The boys agree more than girls with this idea, and the effect size is quite moderate (0.40).

#### *Differences between science and non-science students*

The science students hold more positive attitudes, because the score differences are favorable to them in the majority of the environment scale questions. The science students perceive the future of the world most somber and desperate than their counterpart, agree more in solving problems through sacrifices, believe more than they can individually influence on the future and contribute to the protection of the environment, but they are also more optimistic on the future, they agree with using animals in experiments to get benefits, they believe that almost all the activities damage the environment and that the nature should be sacred. The non science students have a less concerned attitude toward the environment than the science students, because they perceive a less somber future and believe that not all the activities damage the environment. In the rest of the questions, the science students show significantly better scores and attitudes than non-science students.

Table III. Statistical parameters and effect size of differences between science and non science pupils for the questions that show significant differences.

QUESTION	Science			Non science			Effect size Science – Non science
	N	Mean	D.E,	N	Mean	S.D.	
D01*	419	1,67	0,85	327	1,90	0,83	-0,27
D02	414	2,93	0,91	316	2,74	0,95	0,20
D05	406	2,88	0,85	314	2,61	0,83	0,32
D06	416	2,79	0,97	326	2,62	0,91	0,18
D13	418	3,36	0,80	326	3,19	0,82	0,20
D15	412	2,75	0,87	326	2,55	0,89	0,23
D17	416	2,62	1,02	329	2,37	0,97	0,25
D18*	418	2,57	0,75	329	2,45	0,76	0,16
D19	420	3,01	0,85	327	2,86	0,87	0,17

\* : negative statements.

These results show some coherent features together with other less consistent ones. For example, the more individual responsibility about the environment (personal control) is coherent with a bigger belief in contributing personally to improve the future; if it is believed that the future can be improved on the basis of an individual commitment, it seems rational hoping the future would be better. But it seems contradictory, and difficult to interpret, to perceive the somber future, and at the same time to agree with an optimistic future, as it also appears.

The most prominent feature of the differences between science and non-science students is that the first group displays significantly better scores than the second group, so the science students' attitudes are significantly better than the non science students' attitudes. However, the difference effect size is small (maximum value 0,31).

### **Discussion and conclusions**

The environmental education is crucial for the future of the life on Earth, so its curricula have been broadly implemented in schools and universities. It is a scientific knowledge very related to the citizens' values and behaviors and stirs up a bigger consent on their necessity, like a part of the basic scientific literacy. This study focuses on the paper of the environmental education from an attitudinal perspective, a specific focus frequently neglected in science education, as an instrument for the modelling of decisions and the civic behaviors related to the planet challenges on sustainability (Edwards, Gil, Vilches & Praia, 2004).

The results show ecologically favorable attitudes and positive expectations regarding the solution of the environmental challenges, based on the concerted action of everybody to find the most appropriate solutions. At the same time, they also display some shades and pessimistic trends about the future, regarding the violation of the natural world rights (animals, vegetables or minerals), the somber and desperate vision about the environmental future and the weak trust on science and technology to solve the environmental problems.

The main information about environmental attitudes stems from the aforementioned sociological polls rather than specific didactic investigations, which are scarce, and sometimes evidence the failure of school environmental education to change the pupils' environmental attitudes Leeming, Dwyer, Porter y Cobern (1993). The polls try to outline the broad trends about the citizens' attitudes and concerns on environment. These attitudes stand quite far away from didactic goals, which are usually related to the environmental problems, science, and current technology. The scarcity of didactic research on environmental attitudes and the big diversity of referenced polls, because of the use of different checklists, also hinder a longitudinal, and systematic comparisons as well as the pursuit of the evolution of attitudes regarding these questions.

The preliminary analysis of Schreiner and Sjoberg (2003) offers a comparative reference for the results of this study, since they applied the same questionnaire in Norway. In general, global significant differences are not observed among the Norwegian and Spanish young respondents. Only in three questions the Norwegian students significantly show higher agreement: they have more trust in the personal influence on the environment, they believe more that people worry too much for the environmental problems and, specially, they are more optimistic on the environmental future.

The differences of attitudes across gender and the choice of science subject discriminate the relevance of these variables on environmental attitudes. Although the effect size of the differences displays similar very moderate strength, the number of significant differences obtained from both independent variables is relatively high, inasmuch as almost half of the questions yield significant differences. Women and science students hold more appropriate ecological attitudes than their counterpart.

The planet's global environmental crisis has re-valued for years the importance and interest of environmental education for citizenship literacy, becoming a center of curricular interest for science teachers. However, the concern to achieve attitudinal and behavioral objectives, which make more operative the environmental education in the daily life and in the citizen participation, doesn't appear so clear (Perales, Gutiérrez, and Álvarez, 1996). Many teachers center their environmental teaching in providing students with scientific knowledge without specifically addressing attitude education, hoping that this information would be enough to induce positive and valid ecological attitudes.

According to attitude theory and evidence, the knowledge of the attitudinal object is an important factor to create attitudes. Some attitudinal studies suggest that school achievement correlates to attitudes: the most knowledgeable students are also likely to have more favorable attitudes (Benayas, 1992; Moore, 1981; Ramsey & Rickson, 1976). This result is attributed to the ability of knowledge to stabilize the ecological attitudes (Eagly and Chaiken, 1993, p. 201-202).

Although environment information could be a facilitating condition to achieve ecological attitudes, it could not be a sufficient condition to define the attitude sign, strength or change direction. On the other hand, covariation between factors never implies causation, so the knowledge could not be the cause of attitude, and by no means the unique cause of the attitude change. As depicted in literature (Manassero-Mas, and Vázquez-Alonso, 1996, the relationship between attitudes and educational variables (knowledge or anyone else) are complex, and far from linearity and consensus. This fact is good news to education, because it is expected that all the students could achieve ecological attitudes; if it were not so, the environmental attitudes would stand outside the influence of education, and would just be attainable for the most able or knowledgeable pupils. The results displayed here reflect this statement: the science students display better attitudes than non-science students, but the differences are not universally significant, and the effect size small.

The sustainability of the planet requires the combined effort of all, so everybody should feel committed about the ecological attitudes, as inalienable part of education (Pigozzi, 2003), no matter the personal knowledge about environmental issues. Therefore, the development of positive environmental attitudes should be a global and prioritizing objective of the scientific education, as an important part of science literacy for all, to empower citizens' ecological behaviors. This means that the environmental knowledge should be subordinated to the construction of ecological attitudes, not just the other way around. In consequence, the cognitive objectives should not be the only ones of the environmental education, even not the most important, at least in the compulsory education levels, where science for all should be a priority of science literacy.

The education and improvement of environmental attitudes don't drain the topic, because the real objective is ecological behavior, as a translation of appropriate attitudes. The relationship between attitudes and behavior is too a complex, non lineal

process, so the possession of positive attitudes doesn't guarantee automatically appropriate ecological behaviors (see for instance, Ajzen & Fishbein, 1980; Fazio, 1986). The investigation on the relationship between attitude and behavior shows that many factors can act as mediators in the process, whose decisive action can switch dramatically the final behavior. These factors are contextual (demography, personality), personal previous beliefs, subjective norms, implications of the result of the behavior, perceived moral obligation, habits or previous behaviors (regarding the object of attitude), the orientation to goals, the perception of the attitudinal situation and object, and different types of attitude (toward an object, toward a behavior, toward goals, etc.) as well as their accessibility, intensity, etc.

Two broad theoretical models account for the attitudes as the guide lines to behavior. On one hand, the reasoned action and the planned action models (Ajzen and Fishbein, 1980; Ajzen, 1991) accurately explain the simple intentionally controlled behaviors, suggesting that people systematically elaborate the available information to act or not to act, and to decide the direction and strength of behavior. On the other hand, according to Fazio's model (1986) most of behaviors take place in a spontaneous way, and attitudes guide behavior through relatively automatic psychological processes. All in all, for the education of attitudes and ecological behaviors it is interesting to stand out, the role of the norms and the stabilization of the attitude from the first model, and the importance of the previous experience and the accessibility of the educated or created attitude from the second one. These factors suggest the main educational guidelines within the classroom, which should be addressed: the previous experiences (it is the core of constructivist learning), the clarification of the ecological norms (clarifying values is a core content of moral education), and the design of appropriate educational activities to stabilize and to make accessible the ecological attitudes (curriculum design). The objective is to empower the attainment of ecological and sustainable behaviors and decision making (Edwards et al. 2004).

Young people are growing up among the awareness on the vulnerability of the natural world and the growing feeling that the environmental problems are the domain of citizens, rather than the exclusivity of some scholars (engineers, chemists, scientists, ecologists, politicians or researchers). Environmental future relies on full participation of all the actors in society, and depends crucially on an aware and informed citizenry about sustainable development values. Thus, the education of environmentally active citizens is crucial for the future of our society and for the individual well-being. This data will hopefully shed light on the challenges that science educators are facing in order to educate pupils' attitudes to meet the environmental problems.

## References

- Ajzen, I. & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs: Prentice Hall.
- Ajzen, I. (1991). The theory of planned behavior. *Organisational Behavior and Human Decision Processes*, 50, 179-211.
- Benayas, J. (1992). *Paisaje y educación ambiental. Evaluación de cambios de actitudes hacia el entorno*. Madrid: MOPT.
- Eagly, A.H. & Chaiken, S. (1993). *The psychology of attitudes*. Forth Worth: Harcourt Brace College Publishers.
- Echeverría, J. (coord.) (2003). *Percepción Social de la Ciencia y la Tecnología en España*. Madrid: Fundación Española de Ciencia y Tecnología.
- Edwards, M., Gil, D., Vilches, A. y Praia, J. (2004). La atención a la situación del mundo en la educación científica. *Enseñanza de las Ciencias*, 22, 47-64.
- Elzo Imaz, J. (dir.) (2002). *Joves balears*. Palma de Mallorca: Fundació "SA NOSTRA".

- CIS - Centro de Investigaciones Sociológicas (1996). *Datos de Opinión 6 - Ecología y Medio Ambiente. Estudio Cis 2.209*. Madrid: CIS.
- EORG - The European Opinion Research Group (2002). *The attitudes of Europeans towards the environment (EUROBAROMETER 58.0)*. Bruselas: EU.
- Fazio, R.H. (1986). How Do Attitudes Guide Behavior?. En R.M. Sorrentino & E.T. Higgins (Eds.), *Handbook of Motivation and Cognition. Foundations of Social Behavior*, pp. 3-19, New York: Guilford Press.
- Leeming, F.C., Dwyer, W.O., Porter, B.E. y Cobern, M.K. (1993). Outcome research in environmental education: a critical review. *Journal of Environmental Education*, 24, 4, 8-21.
- Manassero-Mas, M.A. y Vázquez-Alonso, A. (1996). Factores determinantes de las actitudes relacionadas con la ciencia. *Revista Española de Pedagogía*, 203, 43-78.
- Moore, H.K. (1981). Energy related information-attitude measure of college age students. *The Journal of Environmental Education*, 17, 30-33.
- Perales, F.J., Gutiérrez, J. y Álvarez, P. (1996). *I Jornadas sobre Actitudes y Educación Ambiental*. Granada: ICE Universidad de Granada.
- Pigozzi, M. J. (2003). UNESCO and the international decade for sustainable development (2005-2015). *Connect*, XXVIII (1-2), 1-7.
- Ramsey, C.E. y Rickson, R.E. (1976). Environmental knowledge and attitudes. *The Journal of Environmental Education*, 8, 10-18.
- Schreiner, C. y Sjoberg, S. (2003). *Optimists or pessimists? How do young people relate to environmental challenges?* Comunicación presentada en ESERA 2003 Conference, Agosto 19 – 23, Noordwijkerhout, The Netherlands.
- Sjoberg, S. (2003). ROSE information documents. University of Oslo. En línea <http://folk.uio.no/sveinsj/ROSE files.htm>
- Vázquez, A. (2000). *Análisis de los datos del tercer estudio internacional de Matemáticas y Ciencias (TIMSS) desde la perspectiva del sistema educativo español*. Memoria final de investigación. Madrid: MEC-CIDE.