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## Comments, Debates, Reports and Interviews

# Application of an Instrument for the Diagnosis of Knowledge and Awareness of Climate Change

## A Case Study with Adolescents in Spain

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ABSTRACT

*Environmental awareness is a widely debated topic. This awareness is a general philosophy, an attitude towards life, which has gained particular importance in recent years, when the scientific community has shown that anthropogenic action has a direct and negative impact on the environment. This preliminary study aims to develop a valid and reliable instrument to diagnose knowledge and awareness of the environment and climate change. The ad hoc instrument consists of 41 items grouped into five factors elaborated from the literature review in the state of the art phase. Following an ex post facto design with an empirical-analytical perspective, it was applied to a sample (n = 99) of students representative by gender and modalities of 1st year of Bachillerato, obtaining a reliability of 0.9106 calculated by Cronbach's test. In addition to having created a reliable instrument, its application reveals the degree of ignorance of different factors, especially environmental factors from a humanistic-social perspective and sustainable habits. This leads us to the conclusion that some elements are not working in the way climate change is communicated in the current Spanish educational context.*

*Keywords:* adolescents; awareness; diagnosis; ecofeminism; ecological ethics; ecology; education; high school; instrument; philosophy.

## 1. INTRODUCTION

Based on previous research commenting on the usefulness of measuring the climate awareness of citizens (Ezeudu *et al.* 2016; Luís *et al.* 2018) including adolescents (Gönen *et al.* 2023), we decided to create an

instrument that could measure both knowledge about climate change, which is crucial for understanding its transcendence, but also the level of environmental awareness of the subjects surveyed based on their habits and beliefs. In this way we could obtain a more concrete profile of their level of commitment to environmental issues. This ad hoc instrument also arose in response to the need to offer a precise and solid proposal for environmental education, which in previous research other academics have highlighted the positive impact it has on the struggle to mitigate and adapt to climate change (Acosta and Queiruga-Dios 2022). But also, where some researchers have noted an alarmingly low level of both knowledge and awareness of climate change (Altez Llave 2021).

In this research, once our ad hoc instrument was constructed, we asked a group of high school students to respond to the survey to analyze their degree of knowledge and awareness of the five proposed factors in order to advance in the construction of strategies for the mitigation of climate change.

*General objective*

- To develop a valid and reliable instrument for diagnosing knowledge and awareness of the environment and climate change.

This general objective is specified in the following specific objectives:

- To know the students' perception of:
  - Environmental knowledge from a scientific perspective. The aim of this section is to find out the degree of knowledge that the sample surveyed has about the main natural phenomena that the scientific community relates to climate change.
  - Environmental knowledge from a humanistic-social perspective. This section has been created to recognise the importance of social science in this issue, as we believe it is necessary to be able to also measure the degree of knowledge about the social impact of climate change and the human causes that have led to this environmental crisis.
  - Perception of climate change. In this point, we wanted to measure the degree of concern about the question presented by the respondents in order to measure the level of awareness of the problem presented.
  - Sustainable habits. In this part, we aimed to obtain information on the habits of the sample as part of a solid awareness of the problem that leads to action. To corroborate that greater action comes from greater awareness.

- Own beliefs in sustainability issues. Finally, we created a sub-section in which we asked the sample about beliefs related to climate change in order to better profile the responses obtained in the previous two sections.

## 2. Methodology

The method followed in this research was empirical-analytical/quantitative, with a type of *ex post facto* modality (Del Rincón *et al.* 1995) – since the aim of the study did not require any prior intervention on the part of the researcher and the methods used were descriptive and correlational (Gómez 2018; Sánchez 2020), in the latter case, assessing whether the gender, pathway or qualifications undergo any significant change.

### 2.1. *Sample*

For the purposes of this study, the sample was determined by the 99 students in the 1st year of high school at La Salle Montcada High School in Barcelona (Spain).

We worked with a non-probabilistic information-producing sample, as the subjects were selected according to the researcher's access to them, since being their professor during a whole year. The representativeness of the sample was guaranteed by the fact that there were students with differents genres – 47.47% were women and 52.52% were men –, from the three class groups – A, B and C – and from all the modalities offered at the centre – 52.52% were in Science and Technology (S&T) and 47.47% in Humanities and Social Sciences (H&SS) (Drost 2011) (*Tab. 1 - own source*).

*Table 1*

| | Women | Men | ∑ general | % |
|---|---|---|---|---|
| S&T | 20 | 32 | 52 | 52,53 |
| H&SS | 27 | 20 | 47 | 47,47 |
| ∑ general | 47 | 52 | 99 | 100 |
| % | 47,47 | 52,53 | 100 | |

With regard to the size of the sample, we took into account the statistical suggestions that recommend a *ratio* of two to three subjects per item in order to be able to carry out the psychometric analysis of the instrument.

## 2.2. *Instrumentalization*

The final instrument consisted of a questionnaire and a scale in digital format (available in the annex). The questionnaire collected information on demographic and personal variables of the subjects in the sample. With regard to the scale, a set of statements or descriptions related to the object of the study were presented, which acted as responses asking the subjects to position themselves in relation to them.

Thanks to the literature review (Barceló *et al.* 2002; Ezeudu *et al.* 2016; Salvador *et al.* 2019) and the analysis of studies related to the same topic or similar to ours (Stevenson *et al.* 2014; Dal *et al.* 2015) it was possible to obtain useful information to prepare the different items of the instrument presented in this article (Al-Shidi *et al.* 2021; Altez 2021; Vargas 2021; Aikowe and Mazancová 2023).

The preparation of the items went through different phases: an initial forecast of items obtained through different sources of information was made; from this reserve, items were selected considering their relevance – relation to the research objective –, the clarity of their formulation and the univocality of the wording – not including more than one opinion in an item.

The way of presenting the different statements was by means of a Likert-type scale (Zaragoza 2003), consisting of statements with five levels of response and parity without a central response.

> *Indicate to what degree it best reflects your opinion with the following statements, according to the following scale:*
> 1. *Strongly disagree*
> 2. *Somewhat disagree*
> 3. *Indifferent/Undecided*
> 4. *Some agreement*
> 5. *I fully agree*

When considering the length of the scale, it was known that the number of items influences the reliability of the scale as long as it does not become redundant, i.e., the fact that different similar items are contributing to measure the same thing. Similarly, the number of response options also affects reliability.

Once the instrument had been designed and elaborated, the validity and reliability, psychometric characteristics, of the instrument were checked. The questionnaire and the scale that make up the instrument designed to assess knowledge and awareness of the environment and

climate change, will be applied electronically in group class sessions of the subject of philosophy – which is part of the common curriculum of the 1st year of baccalaureate – on 17, 18 and 19 April 2023.

## 3. Research results

### 3.1. *Psychometric characteristics*

#### 3.1.1. Validity

The mastery of the content of a characteristic is usually provided by the review of the literature when the researcher establishes the state of the question, i.e. the contributions from theory and previous research (Lamprea and Gómez-Restrepo 2007).

#### 3.1.2. Reliability

According to Cronbach's alpha (α) formula, reliability was calculated using the data analysis tools of the Excel statistical add-in, obtaining a α Cronbach = 0.9106; a value which, according to the interpretation criteria set out by different authors, corresponds to excellent reliability.

### 3.2. *Descriptive results of the scale*

#### 3.2.1. Global analysis of the scale

The application of the scale has made it possible to obtain a total score that is the sum of the 41 items that make up the scale; the minimum score that can be obtained is 41 – number of items multiplied by the lowest score – and the maximum rating is 205 – number of items multiplied by the highest rating. The punctuation that can be obtained on the scale is either direct (*Tab. 2 - own source*) – or transformed – out of five.

*Table 2*

| Arithmetic mean | Mode | Medium | Std. dev. | Punt. min. | Punt. max. | Nº items | Scale grades | No. subjectes |
|---|---|---|---|---|---|---|---|---|
| 104,11 | 108 | 102 | 21,03 | 56 | 156 | 41 | 5 | 99 |

The transformed mean score of the subjects in the sample for each item can be seen in own source in the following graph (*Fig. 1 - own source*).

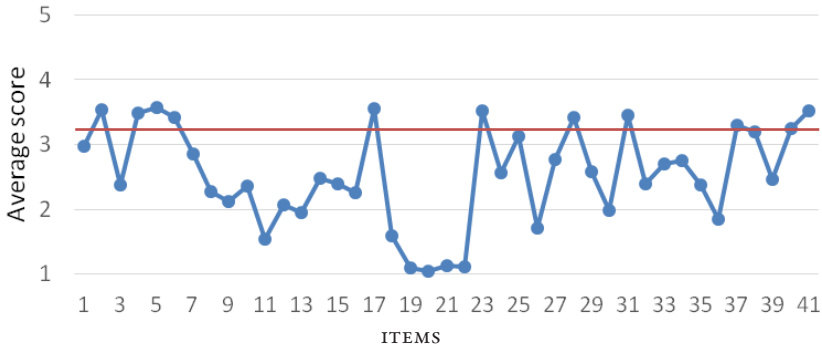



*Figure 1*

### 3.2.2. Analysis of scale factors

The 41 items that make up the scale have been grouped into five factors (*Tab. 3 - own source*).

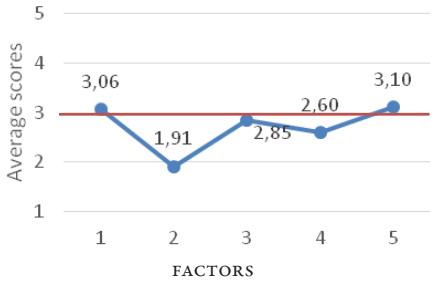
*Table 3*

| Factor | Item name |
|---|---|
| Environmental knowledge from a scientific perspective | 8 |
| Environmental knowledge from a humanistic-social perspective | 14 |
| Perception of climate change | 6 |
| Sustainable habits | 9 |
| Own beliefs in sustainability | 4 |

The following graph (*Tab. 4 - own source*) shows the profile of the mean scores – transformed over five – of the 99 students in the sample in each of the five factors of the scale. It can be seen that four of the five factors are around the scalar mean; three factors are below the scalar mean – of which factor II is more than one point away – and two of them are slightly below it.

*Table 4*

| Factors | |
|---|---|
| I. | Environmental knowledge from a scientific perspective |
| II. | Environmental knowledge from a humanistic-social perspective |
| III. | Climate change perception |
| IV. | Sustainable habits |
| V. | Own beliefs in sustainability |




Below (*Tab. 5 - own source*) are the profiles of the average scores obtained by the students in the different items of each of these factors. Thus, in factor I – made up of 20 items – the profile of the mean scores shows that in two of these items the sample scores around the scalar mean, two others score slightly below it and the remaining four are below it.

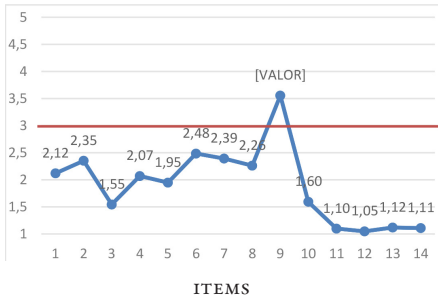
The range of the mean scores in the items is just over one unit, which together with the value obtained for the standard deviation ($\sigma$ = 0.5228) shows the low dispersion of the scores in the items of this factor.

*Table 5*

| Factor I. Environmental knowledge from a scientific perspective |
|---|
| 1. The hole in the ozone layer |
| 2. The greenhouse effect |
| 3. The thawing of the permafrost layer |
| 4. The functioning of the food chain |
| 5. Atmospheric pollution |
| 6. The scarcity of fossil fuels |
| 7. Biodiversity loss |
| 8. The feedback of chain processes |


With regard to factor II – which includes fourteen items – the profile of the mean scores shows that in thirteen of these items the sample scores well below the scalar mean – between half and two points – , and in only one item do we see that it scores above. The range of the scores – two and a half points – and the standard deviation ($\sigma$ = 0.7098) are indicators of the heterogeneity of the scores on these items (*Tab. 6 - own source*).

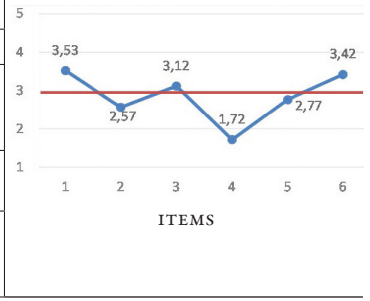
*Table 6*

| Factor II. Coneixement mediambiental des d'una perspectiva humanística-social | |
|---|---|
| 1. Climate refugees |  |
| 2. Climate justice | |
| 3. Speciesism | |
| 4. Green growth | |
| 5. Interdependence | |
| 6. Climate change as a violation of human rights | |
| 7. Capitalised happiness | |
| 8. The main activist groups | |
| 9. Consumerism | |
| 10. Ecofeminism | |
| 11. The theories of Yayo Herrero | |
| 12. The theories of Vandana Shiva | |
| 13. Jorge Riechmann's theories | |
| 14. Alicia Puleo's theories | |



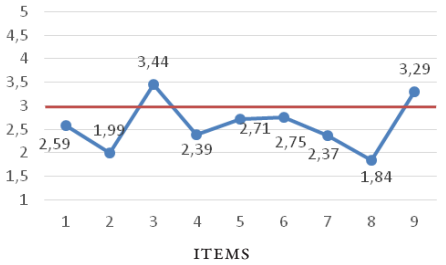
As for factor III – made up of six items – we observe that in the profile of the mean scores one item scores close to the mean scalar score, two slightly below and the remaining three below. The range of the scores – one point and eight tenths – and the standard deviation ($\sigma$ = 0.6678) indicate a certain dispersion in the scores on these items (*Tab. 7 - own source*).

*Table 7*

| Factor III. Climate change perception | |
|---|---|
| 1. I am concerned about climate change. |  |
| 2. I am anxious about the consequences of the environmental issue. | |
| 3. I think about climate change. | |
| 4. I want to focus my academic and/or professional future on changing the climate emergency. | |
| 5. When I can vote it will be decisive whether a political party considers the Climate Issue. | |
| 6. I think it is important that climate change is also addressed in the classroom from a socio-humanistic perspective. | |

On factor IV – made up of new items – it can be observed that, with the exception of two items, the rest all score below the scalar mean. From the range of the scores – one point and six tenths – and the standard deviation ($\sigma$ = 0.5329) we can see that the scores on these items are not very dispersed (*Tab. 8 - own source*).

*Table 8*

| Factor IV. Sustainable habits | |
|---|---|
| 1. I read or have read content (books, articles, magazines ...) about the environment. |  |
| 2. CI follow climate change influencers on social media. | |
| 3. I recycle. | |
| 4. I buy second-hand. | |
| 5. I consider what I buy so that I don't make unnecessary purchases just on a whim. | |
| 6. I try to avoid using single-use plastics. | |
| 7. I buy sustainable cosmetics (soaps, brushes, make-up ...). | |
| 8. I eat a plant-based diet (little meat, fish and animal by-products). | |
| 9. I use public transport, usually as a substitute for the private car. | |



Finally, factor V – made up of four items – shows how, with the exception of one item, the rest score above the scalar mean.

The range of one point and the $\sigma$ = 0.4548 indicates a certain homogeneity in the scores obtained in this factor (*Tab. 9 - own source*).

*Table 9*

| Factor V. Own beliefs in sustainability issues | |
|---|---|
| 1. I try not to base my happiness on material things. |  |
| 2. When I imagine my future life I imagine myself living a life far away from consumerism. | |
| 3. I value positively that a person is an ecologist. | |
| 4. I value doing activities in nature positively. | |

### 3.3. *Correlational analysis of the factors of the scale*

An analysis of the correlations – using Pearson's r coefficient – of the scores obtained in the different factors of the instrument was also carried out using those perspectives (*Tab. 10 - own source*).

*Table 10*

| | | | | | |
|---|---|---|---|---|---|
| I. | Scientific perspective | 1 | | | |
| II. | Soc/hum perspective | 0,58261539 | 1 | | |
| III. | Perception of climate change | 0,38788149 | 0,28199656 | 1 | |
| IV. | Habits | 0,43747284 | 0,31726385 | 0,60574279 | 1 |
| V. | Beliefs | 0,27349729 | 0,21647511 | 0,52754394 | 0,519598 |
| | | I | II | III | IV |

In all cases a positive correlation has been found, which is an indicator of the consistency of the object of assessment; however, not all factors have the same values. According to Guilford's classification, it can be observed that habits correlate highly with the perception of climate change, the humanistic social perspective has a medium correlation with the scientific perspective as well as beliefs with their view of climate change and habits (Zaragoza 2003).

## 4. Conclusions

This work on a reality that affects both teachers and researchers has led us to delve deeper into environmental knowledge and awareness, focusing both on the subject – the student, an important but not the only actor – and on the object of study – the environment and climate change.

The conclusions are then presented in relation to the objectives that had been set.

The methodology used involved obtaining direct information from the participating students by means of questions on digital support. The contributions of ICT have allowed the development of a questionnaire and a scale in digital format, its publication, filling, analysis and analysis of the answers provided.

The study provided a reliable and valid instrument for diagnosing the knowledge and awareness of 1st year Baccalaureate students of

the environment and Climate Change (α Cronbach = 0.9106). The theoretical validity of the different types of validity – theoretical, content and construct – was carried out by means of a review of the literature, which allowed the different items of the scale to be completed with sufficient theoretical support. We believe that for future research it would be necessary to complement this with the validation of content using the agreement of different experts acting as judges, in order to have a more accurate verification. The mean of the scores obtained by the subjects is almost half a point below the scalar mean (2.5392 < 3). We have also obtained a range that the transformed mean scores adopt for each item; 27 are below the scalar mean (3 out 5 scale), and 13 are below.

The grouping of the items, which were used as responses to measure the perception of the object of study, made it possible to determine the factors of the scale. The results found allow these conclusions to be drawn about the five factors into which knowledge and beliefs about the environment and climate change have been structured. On the one hand, students score low on all five factors. In the factor environmental knowledge from a humanistic-social perspective, the lowest score is given, more than one point below the scalar mean. The environmental knowledge from a scientific perspective, as well as one's own beliefs in sustainability, score above, but very close to the scalar average. Perception of climate change and sustainable habits, although around the scalar average, are slightly below. On the other hand, the small difference found between the scores on factors III, IV and V – which correspond to perception of climate change, sustainable habits and beliefs about sustainability – makes sense, as in general these three vectors should always be united – values and actions. Although of the three, habits are the lowest scoring factor, this could be due to the fact that beliefs are not always necessarily transformed into behaviour, as it is more difficult to act than to believe.

When considering in detail the items of each of the factors: As far as environmental knowledge from a scientific perspective is concerned, four of the eight items used as items, the pupils score above the scalar average – the highest being only six tenths. The presence of different issues – the greenhouse effect, atmospheric pollution, scarcity of fossil fuels, etc. – which have been included in the pupils' curriculum throughout their schooling, as well as their treatment from other areas, possibly contribute to the good score they obtain. The factor about environmental knowledge from a humanistic-social perspective has the lowest scores, with thirteen of the fourteen items below the average – four of them at two points; this factor also contains the items on the scale on which

students score the lowest. These results could be due to the fact that the different educational laws enacted have not promoted environmental education much in subjects linked to the humanistic-social itinerary, because traditionally it was believed that environmental knowledge was only a scientific aspect. With regard to the perception of climate change, the scores on three of the items are above and on the other three below. In terms of sustainable habits, the scores on seven of the new items do not reach the scalar mean.

Finally, in personal beliefs in sustainability – the factor with the highest score – three of the four items are above the average. The results obtained in the level of knowledge and environmental awareness of the sample – measured through the instrument we have presented in this research – improve and lead us to propose an educational intervention linked to ecological ethics because some elements are not working in how climate change is being communicated in the current educational context.

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