# The Handprint Initiative: Identifying learners' attitudes towards the environment

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## Abstract

The Handprint Initiative was born out of the need for a new pedagogical approach to deal with current global challenges. It is founded in the social responsibility of educators and learners to actively participate in the decision-making process of our society. To achieve this, there was the need for a statistical basis to measure learners' attitudes towards the environment. A 19-item survey was used to determine five key attitudes in high school students in Mexico. With appropriate statistical tools (including PCA, KMO, normality tests and others), it was possible to measure ecocentrism, eco-apathy, naturalism, pessimism, and scientism attitudes and to confirm the data of other studies. The results of this study contribute to assessment of the impact of the way we teach, as well as the promotion of quality education and the implementation of the Handprint Initiative.

***Keywords:*** *handprint; attitudes towards environment; eco-apathy; sustainability, quantitative study*

## Introduction

Environmental education and education for sustainable development play a key role in shaping our future world (Nagel, 2005; UNESCO, 2017). Building the future will require not only the strongest of wills, but the right approach in encouraging the minds of those who will create it, namely, our students (UNESCO, 2020). Few if any initiatives have succeeded in achieving this goal (Nagel, 2005), due to the 'doom and gloom' feeling most of them create, and there is no apparent framework to follow for what we all share as a common objective: saving our world from the climate and social crisis by transforming the way we teach in favour of and about our environment.

Environmental education's purpose is to provide a mechanism to address environmental challenges. As Davis (1998) explained, environmental education is about values, attitudes, ethics and actions, a way of thinking and a way of practice. Environmental education is a positive contribution to counteract the 'doom and gloom' feelings associated with social and environmental challenges (Nagel, 2005).

Furthermore, education for sustainable development (ESD) aims to develop competences that empower learners with knowledge, skills, values, and attitudes. ESD seeks to encourage


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reflection on our own actions and taking informed decisions for environmental integrity, economic viability and a just society by empowering people of all genders, for present and future generations, while respecting cultural diversity (Bagoly-Simó et al., 2018; Draghici, 2019; UNESCO, 2012, 2017, 2020). There is a global call to take action for a common future (UNESCO, 2020), to see beyond the challenges and start thinking of solutions to environmental problems.

However, several studies (Aguilar Montes de Oca et al., 2015; Boca & Saraçlı, 2019; Gómez, 2014; Juneman & Pane, 2013; McKnight, 2010; Railean et al., 2016; Sashittal, Jassawalla, & Markulis, 2012) have found adolescents' (namely secondary and high school students') attitudes towards the environment to be marked by an increasing apathy. The current environmental challenges (e.g. global warming, biodiversity loss, food insecurity, deforestation, politic and social conflicts, poverty, hunger, peak waste, population growth, planet slums) are generally perceived by young people as impossible to solve or they feel very little can be done, or it is not of their concern. That means that after some fifty years of development and implementations, the behaviours being created are not positive (Nagel, 2005).

Expecting learners' attitudes and actions towards the environment to change is unrealistic when the main message we deliver is 'The world is about to end and it's your fault'. According to Schreiner and Sjøberg (2004), a person's actions in the present are affected by their images of the future.

Analysing the current attitudes of our learners is a key step to changing perspectives of how we face global challenges. Understanding how their attitudes are defined will allow them to move from the theory of how to achieve a common future towards active participation.

The Handprint Initiative is an action-oriented educational approach based on the development of the key competences for sustainability, namely systems thinking competency, anticipatory competency, normative competency, strategic competency, collaboration competency, critical thinking competency, self-awareness competency and integrated problem-solving competency (UNESCO, 2017). Its aim is to empower secondary and high school students and teachers to become changemakers for our common future, by actively participating in the decision-making processes of our society. The purpose of the initiative is to overcome the limitations (for example, eco-guilt, doom and gloom, apathy) of other approaches of education towards the environment. This can be achieved by identifying the current learners' attitudes towards the environment first, followed by implementing a framework that integrates the handprint concept, as well as the key competences for sustainability and the Sustainable Development Goals into best practices in the classroom. Therefore, the Handprint Initiative seeks to move away from discussion and debate to focus on how to best meet the goals established in the Agenda 2030 (Nagel, 2005).

The Handprint Initiative is based on the handprint concept, launched in 2007, described as actions towards sustainability (Alvarenga et al., 2020). The handprint concept has been defined as a complementary concept to the footprint (which considers human demands on

nature) as a measure of what we can do individually and as a society, to restore the balance between consumption and the planet's carrying capacity (Pandya, Vyas, & Schwarz, 2013). Handprints are also about the good society does for the environment (Biemer, Dixon, & Blackburn, 2013) and can be seen as an extension of the concept of the hand as a symbol for action (Guillaume et al., 2019). Norris (2015) referred to the handprint concept as the footprint-consistent estimate of positive change. Thus a handprint can be seen as the measure of the good we do in ways that are consistent with the measurement of the harm we cause.

Based on the above, the handprint concept could be defined as a solution-oriented approach, which promotes systemic thinking for sustainability and fosters individual and collective positive action, namely actions towards sustainable development (Centre of Environment Education [CEE], 2007; Gunawardene, 2008; Husgafvel, 2021; North American Association for Environmental Education [NAAEE], 2017; *Times of India*, April 7, 2013). Handprint is a symbol of, measure for, and commitment to sustainability (Pandya et al., 2013).

Since the handprint concept was first introduced, there have been several examples of its use around the world. Firstly, in education programmes to represent an individual's 'action competence' (for example, CEE's programmes and Sustainable Schools West Australia) (Hayward, 2011). Secondly, it has been used by organisations to incentivise citizen action (for example, Handabdruck [Handprint] Germanwatch [https://www.handabdruck.eu/was-ist-der-handabdruck]; Corporate Sustainability Handprint GIZ Germany [https://www.giz.de/en/aboutgiz/34118.html]; ecologicalhandprints.org, handprinter.org; RESOLVE UK [Howard, 2021], SHINE Harvard [http://shine.mit.edu/what-shine]). However, these examples lack a common framework for implementation in formal education (elementary, secondary, and high school levels).

Implementing the Handprint Initiative started from the reality and first-hand experience of students from middle school to high school, by identifying their attitudes towards the environment. We carried out a pilot project with the aim of developing the best instrument to measure key attitudes towards the environment. A secondary aim was to define the most suitable age for implementing the Handprint Initiative.

## Materials and methods

### Participants

The pilot project was conducted in four South Mexico City private schools, with which there was already established collaboration as well as the interest to conduct future joint research. These four institutions included traditional, alternative, and religious schools, mostly attended by middle class learners. A total of 548 students between 11 and 19 years were surveyed in class. The age was chosen based on Piaget's final cognitive stage, the *formal operational stage* (Babakr, Mohamedamin, & Kakamad, 2019). During this stage, adolescents achieve the final stage of cognitive development; they are able to think logically and deal

with abstracts (Babakr et al., 2019; Huitt & Hummer, 2003). The survey was conducted in person by teachers as an activity in class.

Of the sample of 548 students, 314 were studying at secondary school (junior high school) and 234 were students in high school; 49.6% were female and 50.4% male.

## Instrument

To measure students' attitudes and to build a statistical basis for the Handprint Initiative, we applied a questionnaire consisting of 19 items of which the first 18 were inspired by the Relevance of Science Education study (ROSE) (Schreiner & Sjøberg, 2004) and the last item was adapted from Vázquez and Manassero (2005) (see Table 1 for a list of the items).

**Table 1:** *Items developed by ROSE project (Schreiner & Sjøberg, 2004) and adapted by Vázquez and Manassero (2005)*

| **Me and environmental challenges** | |
|---|---|
| **Item** | **Sentence** |
| 1 | Threats to the environment are not my business. |
| 2 | Environmental problems make the future of the world look bleak and hopeless. |
| 3 | Environmental problems are being exaggerated. |
| 4 | Science and Technology can solve all environmental problems. |
| 5 | I am willing to have environmental problems solved even if this means sacrificing many goods. |
| 6 | I can personally influence what happens with the environment. |
| 7 | We can still find solutions to our environmental problems. |
| 8 | People worry too much about environmental problems. |
| 9 | I hate humanity for what it has done to Nature. |
| 10 | Environmental problems can be solved without big changes in our way of living. |
| 11 | People should care more about environmental protection. |
| 12 | It is responsibility of the rich countries to solve the environmental problems of the world. |
| 13 | I think each of us can make a significant contribution to environmental protection. |
| 14 | Environmental problems should be left to the experts. |
| 15 | I am optimistic about the future. |
| 16 | Animals should have the same right to life as people. |
| 17 | It is right to use animals in medical experiments if this can save human lives. |
| 18 | Nearly all human activity is damaging for the environment. |
| 19 | Nature is sacred and should be left in peace. |

The 19 items were designed to present general perspectives regarding prevalent concerns for the environmental future and the role of science and technology, without specific references to concrete environmental problems or risks (Vázquez & Manassero, 2005). Items 1 to 14 were inspired by literature on alienation, powerlessness, and meaninglessness. Items 15 to

19 were related to quasi-religious views on nature and whether protection of nature is good in itself (Vázquez & Manassero, 2005).

In addition, the scale was adjusted to permit learners to take a neutral stand, modifying the 4-point to a 5-point Likert scale, to allow for students who felt indifference towards certain topics. According to Vázquez and Manassero (2005), this instrument identifies five environmental attitudes, and each of the 19 items is related to one of these attitudes (see Table 2):

**(a) Ecocentrism** – optimistic attitude of greater personal involvement and better care of the environment. Describes an optimistic, involved and proactive attitude towards environmental protection and conservation (Vázquez & Manassero, 2005). It refers to the idea that nature has value in itself and does not exist simply for human transformation (Macías Zambrano, 2017). Ecocentric attitudes are linked to addressing environmental issues because the individual sees nature as worth preserving regardless of the economic or lifestyle implications of conservation (Macías Zambrano, 2017; Thompson & Barton, 1994).

**(b) Eco-apathy** – a psychological defense against feelings of hopelessness, and emotional and physical deprivation (Okada, 1995). However, in their research, Aguilar Montes de Oca et al. (2015) noted that according to Cabrera, Peral and Barajas (2012), the concept of apathy was more acceptable in popular culture after the First World War, when it was qualified as one of several forms of war neurosis characterised by a feeling of emotional numbness and indifference to normal social interaction. Nowadays apathy is defined as "lack of interest, motivation, attention, concentration, emotion or feeling indifferent and disengagement (Aguilar Montes de Oca et al., 2015; Ishii, Weintraub, & Mervis., 2009; Itaaga, Muwagga, & Kaahwa, 2013; Riconscente, 2007) leading to disruption in consciousness and to the waste of psychic resources and skills" (Sashittal et al., 2012).

According to Nagel (2005), an eco-apathetic attitude surfaces as result of fear of the world and susceptibility to the negative emotions that arise as a result. Furthermore, Thompson and Barton (1994) claimed that individuals who are environmentally apathetic generally do not assign any value to nature for any reason. Vázquez and Manassero (2005) defined this as an indifferent, passive, insensitive and resistant attitude to the protection of the environment.

**(c) Pessimism** – can be understood as a psychological process or state, or as an argued position of expecting a negative outcome of processes (Nordgren, 2021). In this context, Vázquez and Manassero (2005) described pessimistic characteristics towards the situation and future of the environment.

**(d) Naturalism** – refers, in philosophy, to the theory that all beings and events in the universe are natural. Consequently, all knowledge of the universe falls within the realm of scientific investigation (Encyclopaedia Britannica, 2017). Vázquez and Manassero (2005) considered this term in the light of rights of nature.

**(e) Scientism** – the view that hard sciences (for example, chemistry, biology or physics) provide the only genuine knowledge of reality, or that such knowledge is inherently superior to what we can know from any other disciplines (Moreland, 2018). For Vázquez

and Manassero (2005), this attitude refers to the solutions of environmental problems from the perspective of a blind trust in science and technology.

According to Vázquez and Manassero (2005), each item can be related to one of the above five environmental attitudes (see Table 2).

**Table 2:** *Attitude related to each item*

| Item | Sentence | Related Attitude |
|---|---|---|
| 1 | Threats to the environment are not my business. | Eco-apathy |
| 2 | Environmental problems make the future of the world look bleak and hopeless. | Pessimism |
| 3 | Environmental problems are being exaggerated. | Eco-apathy |
| 4 | Science and technology can solve all environmental problems. | Scientism |
| 5 | I am willing to have environmental problems solved even if this means sacrificing many goods. | Ecocentrism |
| 6 | I can personally influence what happens with the environment. | Ecocentrism |
| 7 | We can still find solutions to our environmental problems. | Ecocentrism |
| 8 | People worry too much about environmental problems. | Eco-apathy |
| 9 | I hate humanity for what it has done to Nature. | Pessimism |
| 10 | Environmental problems can be solved without big changes in our way of living. | Ecocentrism |
| 11 | People should care more about environmental protection. | Ecocentrism |
| 12 | It is responsibility of the rich countries to solve the environmental problems of the world. | Scientism |
| 13 | I think each of us can make a significant contribution to environmental protection. | Ecocentrism |
| 14 | Environmental problems should be left to the experts. | Scientism/Eco-apathy |
| 15 | I am optimistic about the future. | Eco-centrism |
| 16 | Animals should have the same right to life as people. | Naturalism |
| 17 | It is right to use animals in medical experiments if this can save human lives. | Naturalism |
| 18 | Nearly all human activity is damaging for the environment. | Pessimism |
| 19 | Nature is sacred and should be left in peace. | Naturalism |

## Statistical methods

When conducting research such as for this article, it is necessary to ensure that the results are statistically relevant, and if not, to provide suggestions for improving them. By statistically relevant, we mean that results are reliable and valid.

Reliable means that the results can be reproduced under the same conditions (internal consistency). Validity means that the questionnaire is accurate. These two concepts are

crucial, as a questionnaire could theoretically be reliable, but wrong. Alternatively, it could deliver good, but irreproducible results (Sürücü & Maslakçı, 2020).

Each statistical concept can be assessed using different tools. Reliability is normally assessed through Cronbach's alpha, which is obtained by calculating the pairwise correlations in a questionnaire. The higher the alpha, the better, as this means there is greater internal consistency and greater reliability (Cronbach, 1951)

Validity (that the instrument is accurate) can be analysed in several ways since there are various forms of validity or various degrees of 'correctness'. The most important of these is known as 'construct' validity, which means that the questionnaire is measuring what it intends to measure. This is measured by a Confirmatory Factor Analysis, which normally follows an Exploratory Factor Analysis (EFA) (Watkins, 2018).

However, an alternative to the EFA is a PCA (Principal Components Analysis), which though not exactly equivalent, is also a variables reduction technique. The purpose of both the PCA and the EFA is to reduce the number of variables (items) affecting the main underlying factors/components (in this case, the attitudes) (Tharwat, 2016). The PCA considers not only the common variance, but also the error variance. This may result in the need to redefine attitudes and underlying factors/components – specifically in the case of a PCA, since the construction of artificial variables by reducing the original number requires interpretation.

Additionally, a questionnaire should be able to properly differentiate groups of people based on the questions. In other words, should everybody answer the same, the questionnaire would be useless in practice, as it would be unable to set groups apart. Running normality tests is helpful in this regard, though most questionnaires fail due to the small number of possible answers (1 through 5 for example) or other factors. Thus it is common practice to carry out an initial frequency and descriptive analysis, purely to see if respondents have answered differently in each question.

Finally, comparisons between groups are of the utmost importance to better understand which may be subject to further studies. Several statistical tests are available, though each applies to different scenarios, depending on the number of respondents, and the number of questions, for example. In this particular case, the T-Student test was used to compare means between groups. The test carried out in this study can only tell whether two means are different, not which one is greater (Sánchez, 2015).

## Data analysis

Once the statistical methods were defined, the first step of the data analysis was a frequency analysis of the samples to determine if there was an approximation to a normal distribution. Likert scales are never normally distributed (therefore tests such as the Kolmogorov-Smirnov are irrelevant); however, a visual approximation allows for an assessment of whether there is clear bias, or leptokurtic distribution. Finally, a Principal Component Analysis (PCA) was performed (Torbjörnsson, Molin, & Karlberg, 2011). The same analysis divided the data set by educational level (secondary and high school).

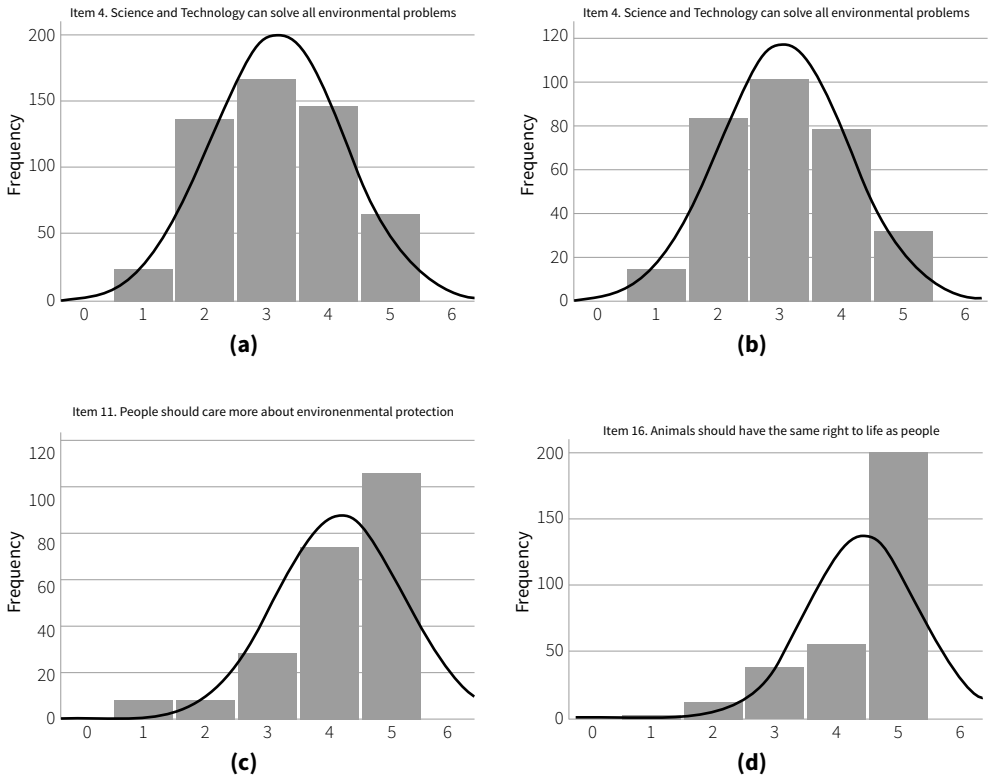
# Results

## Descriptive statistics

### *Frequency analysis*

A visual analysis helps to identify clear problems such as leptokurtic distributions or obvious bias, which would indicate an area of improvement of the question being answered by the respondents. For example, items 2, 4, 5, 8, 14 and 19 do not show any obvious problems, in contrast to items 1, 3, 6, 7, 9, 10, 11, 12, 16, 17 (Table 1). Figure 1 presents items that visually approximate a normal distribution as well as items that visually do not approximate to a normal distribution.

**Figure 1:** *Answers to items on the Likert scale that visually approximate a normal distribution (a, b) and those which do not visually approximate a normal distribution (c, d) in the general analysis as well as in the secondary and high school analysis. (a) Answers to item 4 on the Likert scale complete set N=542; (b) Answers to item 4 on the Likert scale subset analysis (secondary school) N=311; (c) Answers to item 11 on the Likert scale subset analysis (high school) N=224; (d) Answers to item 16 on the Likert scale subset analysis (secondary school) N=308.*



## Principal Components Analysis (PCA) complete set

Despite the data not being normally distributed, PCA was valid in this case, as it does not rely on the normality assumption. The PCA results of the general set of data with Varimax rotation produced a clear structure of five factors for the general poll and explained 52.19% of the variance for those five components.

Table 3 depicts the underlying problem with the overall analysis and the instrument used, and therefore the need for its modification. There is no clear division of components by the theoretical attitude they should be representing. That is, component 4, for example, has items belonging to three out of five attitudes measured, and so does component 5.

**Table 3:** *General results: Distribution of the items in the components and the attitudes defined by Vazquez andManassero (2005)*

| Component 1 | Component 2 | Component 3 | Component 4 | Component 5 |
|---|---|---|---|---|
| 5 (EC) | 1 (Apa) | 9 (Apa) | 4 (St) | 2 (Pes) |
| 6 (EC) | 3 (Apa) | 16 (Nat)* | 5 (EC)* | 14 (St/Apa)* |
| 7 (EC) | 5 (EC)* | 18 (Pes) | 9 (Pes)* | 17 (Nat) |
| 11 (EC) | 8 (Apa) | 19 (Nat) | 10 (EC)* | |
| 12 (St)* | 10 (EC) | | 12 (St) | |
| 13 (EC) | 14 (St/Apa) | | | |
| 14 (St, Apa) | 15 (EC)* | | | |
| 15 (EC) | | | | |
| 16 (Nat) | | | | |
| 19 (Nat)* | | | | |

* Items that are present in more than one component indicate that there is a cross-loading greater than 0.30 between them. Those with an asterisk present the lowest value. EC=Ecocentrism, Apa=Eco-apathy, Nat=Naturalism, Pes=Pessimism, St=Scientism.

Table 4 shows the results of an exploratory factor analysis, applied to five factors (n = 548). The weights of the variables that make up each factor are shown here. For simplicity, loads below the value 0.30 are omitted, and those in bold are the highest, in absolute value. There is significant cross-loading in many of them.

**Table 4:** *General results: Exploratory Factor Analysis. PCA, Rotation Varimax with Kaiser normalisation*

| Item | Component 1 | Component 2 | Component 3 | Component 4 | Component 5 |
|---|---|---|---|---|---|
| 1 | | .611 | | | |
| 2 | | | | | .791 |
| 3 | | .570 | | | |
| 4 | | | | .778 | |

| Item | Component 1 | Component 2 | Component 3 | Component 4 | Component 5 |
|---|---|---|---|---|---|
| 5 | **.524** | .308 | | .308 | |
| 6 | .655 | | | | |
| 7 | .731 | | | | |
| 8 | | .661 | | | |
| 9 | | | **.608** | .321 | |
| 10 | | **.393** | | .363 | |
| 11 | .514 | | | | |
| 12 | .400 | | | **.403** | |
| 13 | .703 | | | | |
| 14 | **.417** | .369 | | | .319 |
| 15 | **.531** | .427 | | | |
| 16 | **.469** | | .399 | | |
| 17 | | | | | .626 |
| 18 | | | .719 | | |
| 19 | .383 | | **.598** | | |

### *Cronbach's alpha for the complete set using items with the highest values*

In accordance with previous results, Cronbach's alphas (see Table 5) were very low for components 3, 4, and 5; therefore they were excluded from further analysis. Although the Cronbach's alpha of component 2 was slightly higher than the other three components, it was also excluded. Only component 1 had an acceptable, albeit improvable, alpha.

**Table 5:** *General results: Cronbach's alpha*

| Component 1 | Component 2 | Component 3 | Component 4 | Component 5 |
|---|---|---|---|---|
| 0.743 | 0.535 | 0.452 | 0.303 | 0.393 |
| 0.752[1] | 0.557[2] | | | |

[1] Cronbach's alpha without Item 15; [2] Cronbach alpha without Item 10

### *Communalities of complete set*

The communality of a variable is the proportion of its variance that can be explained by the factorial model by which it was obtained. The acceptable values are those higher than 0.35; by acceptable we mean that although they are relevant, they are not truly measuring what they are supposed to.

### *Kaiser-Meyer-Olkin (KMO) analysis of complete set*

Sphericity tests (see Table 6) evaluate the applicability of factor analysis to the variables studied and define if this is statistically feasible. Although the ideal value is over 0.9, one very close to 0.8 is still acceptable in most cases.

**Table 6:** *General results: KMO and Bartlett's Analysis*

| **Bartlett's sphericity test** | |
|---|---|
| Kaiser-Meyer-Olkin measure of sampling adequacy | 0.798 |
| Approx. Chi squared | 1540.397 |
| gl | 171 |
| Sig. | .000 |

## Principal Components Analysis (PCA) Subset Results – Secondary School

The PCA with Varimax rotation produced a clear structure of five factors for the general case, which explains 49.55% of the variance for those five components.

Table 7 shows the results for secondary schools. Although there is a much clearer match between the theoretical and practical components, the other results are far from ideal, as shown in following sections.

**Table 7:** *Secondary school analysis: Distribution of the items in the components and the attitudes defined by Vazquez and Manassero (2005)*

| **Component 1** | **Component 2** | **Component 3** | **Component 4** | **Component 5** |
|---|---|---|---|---|
| 5 (EC) | 1 (Apa) | 9 (Apa) | 4 (St) | 2 (Pes) |
| 6 (EC) | 3 (Apa) | 18 (Pes) | 10 (EC) | 3 (Apa)* |
| 7 (EC) | 8 (Apa) | 19 (Nat) | 12 (St)* | 11 (EC)* |
| 11 (EC) | 12 (St) | | | 16 (Nat)* |
| 12 (St) | 14 (St/Apa)* | | | 17 (Nat) |
| 13 (EC) | 15 (EC)* | | | |
| 14 (St, Apa) | | | | |
| 15 (EC) | | | | |
| 16 (Nat) | | | | |
| 19 (Nat)* | | | | |

* Items that are present in more than one component indicate that there is a cross-loading greater than 0.30 between them. Those with an asterisk present the lowest value. EC=Ecocentrism, Apa=Eco-apathy, Nat=Naturalism, Pes=Pessimism, St=Scientism.

Table 8 presents the results of exploratory factor analysis applied to five factors (n = 314). The weights of the variables that make up each factor are shown here. For simplicity, loads

below the value 0.30 are omitted, and those in bold are the highest, in absolute value. There is significant cross-loading in many of them.

**Table 8:** *Secondary school: Exploratory Factor Analysis. PCA, Rotation Varimax with Kaiser normalisation*

| Item | Component 1 | Component 2 | Component 3 | Component 4 | Component 5 |
|---|---|---|---|---|---|
| 1 | | .641 | | | |
| 2 | | | | | .621 |
| 3 | | **.463** | | | .321 |
| 4 | | | | .733 | |
| 5 | .505 | | | | |
| 6 | .616 | | | | |
| 7 | .674 | | | | |
| 8 | | .725 | | | |
| 9 | | | .718 | | |
| 10 | | | | .565 | |
| 11 | **.355** | | | | .353 |
| 12 | **.414** | .412 | | .349 | |
| 13 | .689 | | | | |
| 14 | **.447** | .373 | | | |
| 15 | **.577** | .467 | | | |
| 16 | **.384** | | | | .322 |
| 17 | | | | | .733 |
| 18 | | | .746 | | |
| 19 | .442 | | **.487** | | |

## *Cronbach's alpha for subset results – Secondary school using items with the highest values*

Table 9 shows the Cronbach's alpha results. For components 3, 4, and 5, the values are very low, which makes them useless. Even though component 5 presents higher values, the acceptable values are above 0.6; thus component 1 is the only useful one.

**Table 9:** *General results: Cronbach's alpha*

| Component 1 | Component 2 | Component 3 | Component 4 | Component 5 |
|---|---|---|---|---|
| 0.724 | 0.546 | 0.458 | 0.418 | 0.327 |
| 0.726[1] | | | | |

[1] Cronbach's alpha without Item 15

### *Communalities of subset results – Secondary school*

Communalities for secondary schools are better than those used for the general results, as there is only one below 0.3.

### *Kaiser-Meyer-Olkin (KMO) analysis of subset – Secondary school*

In comparison to the general analysis, the KMO (see Table 10) is not as good as the general results. Although the value might still be acceptable, it is significantly lower than the 0.798 observed in the undivided results.

**Table 10:** *Secondary school: KMO and Bartlett's Analysis*

| **Bartlett's sphericity test** | |
|---|---|
| Kaiser-Meyer-Olkin measure of sampling adequacy | 0.745 |
| Approx. Chi squared | 869.068 |
| gl | 171 |
| Sig. | .000 |

## Principal Components Analysis (PCA) subset results – High school

Finally, results from the high schools are shown in the following sections. As for the variance, the first five factors explained 52.196%, and 57.577% for the first six, showing little improvement in comparison to the variance from the secondary school.

Table 11 shows that Ecocentrism, Eco-apathy and Naturalism can be more clearly distinguished. It could be assumed that given that there are six components when there should only be five, these results are less reliable than those obtained for secondary schools, but this would not be accurate. As previously noted, three out of five theoretical factors are better distinguished, and EFA and Cronbach's alpha analysis show better values from a statistical approach.

**Table 11:** *High School: Distribution of the items in the components and the attitudes defined by Vazquez and Manassero (2005)*

| **Component 1** | **Component 2** | **Component 3** | **Component 4** | **Component 5** | **Component 6** |
|---|---|---|---|---|---|
| 5 (EC) | 9 (Pes)* | 1 (Apa) | 4 (St) | 8 (Apa)* | 2 (Pes) |
| 6 (EC) | 13 (EC)* | 3 (Apa) | 12 (St) | 9 (Pes) | 10 (EC) |
| 7 (EC) | 16 (Nat) | 8 (Apa) | 14 (St/Apa) | 15 (EC) | |
| 8 (Apa) | 17 (Nat) | | | 18 (Pes)* | |
| 11 (EC) | 18 (Pes) | | | | |
| 13 (EC) | 19 (Nat) | | | | |
| 14 (St/Apa)* | | | | | |
| 16 (Nat)* | | | | | |

* Items that are present in more than one component indicate that there is a cross-loading greater than 0.30 between them. Those with an asterisk present the lowest value. EC=Ecocentrism, Apa=Eco-apathy, Nat=Naturalism, Pes=Pessimism, St=Scientism

Four of the six components clearly define young people's attitudes to environmental challenges.

Table 12 shows the results of exploratory factor analysis applied to six factors (n = 234). The weights of the variables that make up each factor are shown here. For simplicity, loads below the value 0.30 are omitted, and those in bold are the highest, in absolute value. There is significant cross-loading in many of them.

**Table 12:** *High school: Exploratory Factor Analysis. PCA, Rotation Varimax with Kaiser normalisation*

| Item | Component 1 | Component 2 | Component 3 | Component 4 | Component 5 | Component 6 |
|---|---|---|---|---|---|---|
| 1 | | | .752 | | | |
| 2 | | | | | | .589 |
| 3 | | | .560 | | | |
| 4 | | | | .609 | | |
| 5 | .702 | | | | | |
| 6 | .694 | | | | | |
| 7 | .731 | | | | | |
| 8 | **.507** | | .445 | | .330 | |
| 9 | | .428 | | | **.563** | |
| 10 | | | | | | .830 |
| 11 | .705 | | | | | |
| 12 | | | | .744 | | |
| 13 | **.588** | .334 | | | | |
| 14 | .407 | | | **.457** | | |
| 15 | | | | | .769 | |
| 16 | .329 | **.619** | | | | |
| 17 | | .634 | | | | |
| 18 | | **.390** | | | .307 | |
| 19 | | .784 | | | | |

## *Cronbach's alpha for subset results – High school using items with the highest values*

In Table 13, values obtained for components 1, 2 and 3 are consistent with the results shown in Table 11, making them useful to determine the attitudes of Ecocentrism, Naturalism, and Eco-apathy. The values for components 4, 5 and 6 are very low and not acceptable.

**Table 13:** *High school: Cronbach's alpha*

| Component 1 | Component 2 | Component 3 | Component 4 | Component 5 | Component 6 |
|---|---|---|---|---|---|
| 0.789 | 0.259 | 0.566 | 0.362 | 0.278 | 0.282 |
| | 0.604[1] | 0.625[2] | 0.417[3] | | |

[1] Cronbach's alpha without Item 18; [2] Cronbach's alpha without Item 1; [3] Cronbach alpha without Item 4

### *Kaiser-Meyer-Olkin (KMO) analysis of subset – High school*

The KMO test result (see Table 14) for high school is significantly better than the one for secondary school, with a value much closer to 0.8.

**Table 14:** *High school: MO and Bartlett's Analysis*

| Bartlett's sphericity test | |
|---|---|
| Kaiser-Meyer-Olkin measure of sampling adequacy | 0.794 |
| Approx. Chi squared | 843.543 |
| gl | 171 |
| Sig. | .000 |

## Gender analysis

The sample size (female high school students = 121) caused problems in the PCA, so this segmentation was ruled out. In a gender analysis, the results obtained showed alphas similar to the high school results, but the components are not distinguished due to the high cross-loading.

## Differences between secondary and high school

Before concluding the aforementioned results, a test was conducted to see if there was any difference between the mean value associated with secondary school and high school regarding eco-apathy. A student's t-test (see Table 15) was performed for independent samples in the eco-apathy factor between secondary and high school (assuming the representative sample of the general schools).

To perform the test, a new variable was created with the average of the values of items 1, 3 and 8, for both groups. The items were recoded, which means that the lowest value is the one with the highest rate of apathy.

Our null hypothesis was that the mean for eco-apathy in high school students is equal to that of secondary school students.

**Table 15:** *T-Student results comparing secondary and high schools*

| Bartlett's sphericity test | | |
|---|---|---|
| **Apathy** | High School | Secondary |
| **Grade** | 0 | 1 |
| **Sample size** | 234 | 314 |
| **Standard Deviation** | .72726 | .80945 |
| **Mean standard error** | 0.4754 | 0.4568 |

The bilateral significance was 0.000, which means that the null hypothesis was rejected; therefore, we can conclude that the two groups' means differ. Although the test does not establish which one is greater, it confirms that they are different, which could lead us to think that the apathy values in high school students are greater than that in secondary school students.

# Discussion

## Establishing the instrument for the Handprint Initiative

Results of the pilot project suggested what to modify to make the instrument appropriate for further use. Now that the results have been analysed, it is possible to develop a better instrument that will suit the necessities for the Handprint Initiative. In order to do this, all items were analysed based on four criteria (see Table 16), which establish: (1) if its distribution visually approached normal, (2) if it presented some degree of cross-loading, (3) if the communality was greater than 0.35, and (4) if the item was useful for determining the attitude.

**Table 16:** *Items analysis*

| Items | Defined attitude[1] | Normal distribution | Absence of cross-loading | Communality | Usefulness |
|---|---|---|---|---|---|
| 1 – Threats to the environment are not my business. | Ecoapathy | s | 1 | 1 | 1 |
| 2 – Environmental problems make the future of the world look bleak and hopeless. | Pessimism | s | 0 | 1 | 0+ |
| 3 – Environmental problems are being exaggerated. | Ecoapathy | s | 1 | 1 | 1 |
| 4 – Science and Technology can solve all environmental problems. | Scientism | N | 1 | 1 | 1 |
| 5 – I am willing to have environmental problems solved even if this means sacrificing many goods. | Ecocentrism | s | 1 | 1 | 1 |

| Items | Defined attitude[1] | Normal distribution | Absence of cross-loading | Communality | Usefulness |
|---|---|---|---|---|---|
| 6 – I can personally influence what happens with the environment. | Ecocentrism | S | 1 | 1 | 1 |
| 7 – We can still find solutions to our environmental problems. | Ecocentrism | S | 1 | 1 | 1 |
| 8 – People worry too much about environmental problems. | Ecoapathy | N | 1 | 1 | 1 |
| 9 – I hate humanity for what it has done to Nature. | Pessimism | S | 0 | 1 | 0+[2] |
| 10 – Environmental problems can be solved without big changes in our way of living | Ecocentrism | N | 0 | 1 | 0-[3] |
| 11 – People should care more about environmental protection. | Ecocentrism | S | 0 | 1 | 0- |
| 12 – It is responsibility of the rich countries to solve the environmental problems of the world. | Scientism | s | 0 | 1 | 1 |
| 13 – I think each of us can make a significant contribution to environmental protection. | Ecocentrism | S | 1 | 1 | 1 |
| 14 – Environmental problems should be left to the experts. | Scientism/ Ecoapathy | s | 0 | 1 | 0-[4] |
| 15 – I am optimistic about the future. | Ecocentrism | N | 0 | 1 | 1 |
| 16 – Animals should have the same right to life as people. | Naturalism | X | 0 | 1 | 1 |
| 17 – It is right to use animals in medical experiments if this can save human lives. | Naturalism | N | 1 | 1 | 1 |
| 18 – Nearly all human activity is damaging for the environment. | Pessimism | N | 0 | 0 | 0+ |
| 19 – Nature is sacred and should be left in peace. | Naturalism | s | 0 | 1 | 1 |

For communalities: 1 means the item has a communality of over 0.3, 0 that it does not. For normal distribution: X=the item does not visually approach normal distribution, either for notable bias or for being unmistakably leptokurtic. S=more than moderate bias. s=moderate bias. N=the item visually approaches normal distribution. For cross-loading: 0 means the item present cross-loading (over 0.3 in more than one component). 1 means the item does not present cross-loading (meaning there is no weight greater than 0.3 in more than one component).

[1] According to Vazquez and Manassero (2005); [2] Constantly presented in components other than Ecocentrism; [3] Presented a distribution with a lot of bias, an important cross-loading and the writing caused confusion among the participants (using the original Spanish questionnaire from Spain); [4] Because it marks two different attitudes, causes an important cross-loading.

None of the Pessimism items worked as they were expected to, due to very high cross-loading, and a constant mix with Naturalism items. The best explanation is that Pessimism, as a concept, is not well defined in this instrument.

## Adaptation of the items for further use

After having analysed the results, the main problems encountered were the following, which were also evident given the outcomes of previous research papers:

- Heavy cross-loadings indicate a lack of understanding on the students' side of what the items are meant to measure; or, rather, a non-correct formulation of the items. In fact, no item should be used to measure more than one theoretical concept, since this leads to a lack of clarity of such concepts. This was visible from the very beginning, as some items were theoretically approached in the original questionnaire by ROSE as measuring more than one attitude.
- Low Cronbach's alphas indicate a low reliability as to the measurement made by the Likert scale. All values, however, were much higher than most of those published in previous studies, most likely due to changing from a 4- to a 5-point Likert scale.
- Items with extreme bias are ineffective since they are unable to discriminate attitudes. Again, this was visible from the very beginning, and was proved by the results already analysed.
- Some items, particularly those related to pessimism, were stated in such a way that participants were unable to understand the impact they were going to suffer due to their environmental attitudes.

Items corresponding to the pessimistic attitudes (items 2 [*Environmental problems make the future of the world look bleak and hopeless*], 9 [*I hate humanity for what it has done to Nature*], and 18 [*Nearly all human activity is damaging for the environment*]) were modified because what the original literature was measuring did not fit the scope here. To define each of the items, they were rewritten based on the perspective of the present and future quality of life of the participant.

Item 2 [*Environmental problems make the future of the world look bleak and hopeless*] was modified in order to make the statement clearer and more personal, from "the world" to "my world".

Item 9 [*I hate humanity for what it has done to Nature*], in all cases (general and by educational levels) presented a leptokurtic distribution, which indicates a bias towards indifference due to a lack of commitment on the part of participants to take a positive or negative position. Therefore, it was modified to avoid its evident leptokurtic distribution by changing the term "hate" to "despise". Claiming to "hate" something or someone is too strong a statement, albeit not morally so, for people to take a stand. That is, students were forced to choose what was right, and seeing no evident answer to the dilemma, they went for the neutral option.

Item 18 [*Nearly all human activity is damaging for the environment*] was adjusted from a more general statement and linked to the direct impact of human activities on the environment.

Since Ecocentrism has a greater number of items, and item 10 [*Environmental problems can be solved without big changes in our way of living*] consistently presented a higher load on apathy components, it was defined as a new item to determine apathy in adolescents.

Although Spanish is the learners' main language, there are slight differences between Spanish spoken in Mexico (as used by the students) and Spain (where the questionnaire was originally developed). The relevance of these differences became evident in the results of item 11 [*People should care more about environmental protection*], as well as in certain comments made by the teachers who applied the questionnaire in the schools (see Table 17). As a consequence, item 11 was rewritten in a way that was more clear, and that could accurately determine an attitude of Ecocentrism.

Previously, item 14 [*Environmental problems should be left to the experts*] presented two challenges; on the one side it was set to determine two different attitudes (Scientism and Eco-apathy), causing an important cross-loading, and on the other, the concept of "expert" in the statement was too general. For these reasons it was edited to be more specific and to determine only one attitude (Scientism).

**Table 17:** *Items adapted after the data analysis*

| **Me and environmental challenges** | |
|---|---|
| **Item** | **Sentence** |
| 1 | Threats to the environment are not my business. |
| 2 | **Environmental problems make my future look bleak and hopeless.** |
| 3 | Environmental problems are being exaggerated. |
| 4 | Science and Technology can solve all environmental problems. |
| 5 | I am willing to have environmental problems solved even if this means sacrificing many goods. |
| 6 | I can personally influence what happens with the environment. |
| 7 | We can still find solutions to our environmental problems. |
| 8 | People worry too much about environmental problems. |
| 9 | **I despise human activities for the damage that has been done to the environment.** |
| 10 | **Environmental problems can be solved without affecting my quality of life.** |
| 11 | **We should make more sacrifices to protect the environment.** |
| 12 | It is the responsibility of the rich countries to solve the environmental problems of the world. |
| 13 | I think each of us can make a significant contribution to environmental protection. |
| 14 | **Scientists have the knowledge to solve environmental problems.** |
| 15 | I am optimistic about the future. |
| 16 | Animals should have the same right to life as people. |
| 17 | It is right to use animals in medical experiments if this can save human lives. |
| 18 | **All activities that humans do negatively impact the environment.** |
| 19 | Nature is sacred and should be left in peace. |

## Conclusions

The Handprint Initiative was in need of an instrument capable of measuring the critical attitudes that we are addressing. With the suggested modifications, the newly created instrument will prove to be a valuable resource for assessing attitudes of participants.

The original questionnaire allowed for a segmentation of the students into two clear sets according to the identification of their attitudes. On this basis, the students in high school were defined as the best target group for implementing the initiative.

Originally, this instrument was designed as part of a larger research project (ROSE study) aimed at identifying the aspects that influence science and technology school learning. In the framework of this research, Vázquez and Manassero (2005) assessed attitudes towards the environment, defining ecocentrism, eco-apathy, pessimism, naturalism, and scientism attitudes. The term 'naturalism' proposed by the authors created some confusion, for their study refers to the rights of nature. However, its better-known definition in philosophy can make it difficult to understand. We recommend that future application define a different term that relates closely to the attitude described.

Having established the statistical basis to defining the attitudes towards the environment in young people and convinced of the need of a different perspective in education for the formation of change-makers, the impact of the Handprint Initiative on the way environmental teaching and learning is done throughout the world can now be assessed. In addition, it should be possible to show how and why such a goal is possible.

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## Percentage contribution

| Areas of contribution | Author | % Contribution per area, per author (each area = 100%) |
|---|---|---|
| Conception or design of the paper, theory or key argument | Morel Schramm | 40% |
| | Ruz Salmones | 40% |
| | Robischon | 20% |
| Data collection | Morel Schramm | 80% |
| | Ruz Salmones | 10% |
| | Robischon | 10% |
| Analysis and interpretation | Morel Schramm | 30% |
| | Ruz Salmones | 60 % |
| | Robischon | 10% |
| Drafting the paper | Morel Schramm | 40% |
| | Ruz Salmones | 40% |
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| Critical review of paper | Morel Schramm | 15% |
| | Ruz Salmones | 15% |
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