# Conceptions of The Baccalaureate Students of The Eastern Region of Morocco on the Environment and Sustainable Development

Abdelkader Sbai, Abdeljabbar El Mediouni, Hassan Hakim and Said Mentak

***Abstract*** **— The conceptions of the baccalaureate students of Bouarfa and Jerada are analyzed on the basis of a questionnaire relating to the environment and sustainable development. These conceptions are analyzed as interactions between scientific knowledge (K), social practices (P), and value systems (V). The multivariate analyzes used highlight two major poles or systems of conceptions. The first pole brings together people with rather anthropocentric tendencies concerned first with the use of natural resources. The second pole brings together people who tend to be more ecocentric and concerned about preserving the environment. Within these clusters appear sub-groups with different characteristics: for or against GMOs, preservation of the environment, activism in favor of the environment, actions of defense or protection of the environment. Most of the students interviewed lent feelings towards animals, but with a difference from one animal to another and from one city to another (sentiment-centered attitude). These different conceptions deserve to be taken into account in the training of trainers and teaching programs to better assume the objectives of Environmental Education.**

***Index Terms*** **— Conceptions, Environment, multivariate analysis, Oriental Region, Morocco.**

## I. INTRODUCTION

Most environmental education interventions start at schools to provide students with objective information and scientific knowledge to enable them to know and understand the different dimensions of the environment. It does also stimulate their reflection on the basis of this information and help them develop attitudes of individual, family and social responsibility.

For several years, the Ministry of National Education and Higher Education in Morocco has tried, through the programs and the various framework texts, to give a significant place to environmental issues. In fact, several elements of environmental education have been introduced into school curricula and textbooks. These programs aim to develop skills in solving environmental problems and sometimes invite students to participate concretely in conservation, environmental protection or even in the resolution of environmental problems.

The success of such an education requires taking into account the pedagogical practices of teachers who are closely related to their conceptions on environmental issues, especially since certain pedagogical practices have a positive impact on learning in this area, but that of others are ineffective. Premised this, an analysis of the conceptions of the students, in two high schools in eastern Morocco, in terms of environmental education and sustainable development is required.

## II. RESEARCH ISSUES AND HYPOTHESES

This study is primarily interested in students' conceptions as interactions between scientific knowledge (K), values (V) and social practices (P) (KVP model [1]-[4]. The analysis of these conceptions makes it possible to confront an important subject which differentiates the points of view among the students. Subsequently, we study more precisely, the conceptions of the pupils on themes related to the preservation-use of the environment, the feelings they give to animals, action - inaction, activism for the environment, pollution control and genetically modified organisms (GMOs). The link between these conceptions and personal settings is also taken into account.

We seek to test certain hypotheses such as the possible interaction between disciplinary training, standard of living, environmental protection and the use of natural resources. We also aim to have an idea whether the students' conceptions vary with gender, religious practices or other factors that come into play.

We therefore put forward two hypotheses:

Hypothesis 1: The students' conceptions testify the existence of the same value systems as other students in Morocco or elsewhere, but with local specificity.

Hypothesis 2: The value systems related to the environment and sustainable development of students of Life and Earth Sciences (LES) differ from the students of Modern Humanities (History – Geography).

To test these hypotheses, we selected several questions on personal information (such as status, age, gender), socio-cultural influences, and education... Then, we tried to see if these different variables are discriminating responses and therefore individual value systems.

## III. METHODOLOGY

### *A. Sampling*

The questionnaire targeted two high schools in the provinces (prefectures) of Bouarfa and Jerada in Eastern Morocco. In total, 118 students in the second year of the baccalaureate answered this questionnaire. The sampling was designed to represent categories of students from

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different disciplines: LES and History - Geography (Table I).

It should also be noted that the sample studied is homogeneous because the students questioned have accumulated, during their 6-year course, in middle and high school, knowledge related to the environment and sustainable development. They are roughly the same age.

TABLE I: DISTRIBUTION OF STUDENTS BY DISCIPLINE AND BY PROVINCE

| Discipline / Province | Province | | Total | Numbers of samples | |
|---|---|---|---|---|---|
| | Bouarfa: Cadi Ayad | Jerada: El Fath | Total | Bouarfa | Jerada |
| Life and Earth Sciences (LES) | 24 | 28 | 52 | 1 - 24 | 71-98 |
| Physical Sciences (PC) | 18 | | 18 | 25-42 | |
| Humanities: History-Geography | 28 | 20 | 48 | 43-70 | 99-118 |
| **Total** | **70** | **48** | **118** | **1-70** | **71-118** |

### *B. Questionnaire and Coding*

In the questionnaire, we integrated several questions (in Arabic) to analyse the conceptions of LES and HG students and more specifically their value systems related to the environment and sustainable development. We also added questions from the questionnaire developed for the ″ pilot test ″ as part of the European BIOHEAD-Citizen (Biology, Health and Environmental Education for better Citizenship) project [2], [3]. This project included 13 European and 6 non-European countries including Morocco.

The final questionnaire includes 82 questions which can be collocated around several themes:

1. Assessment of students' knowledge of the environment and sustainable development: questions 1-16.
2. Environmental ethics: questions 17-24; questions tested in the thesis of Forissier [5] and Alaya [6].
3. Genetically Modified Organisms (GMOs): questions 25-29.
4. Preservation – Use of the environment and nature: questions 30-38.
5. Environmental education: questions 39-43.
6. Questions corresponding to the 2-MEV model of Wiseman & Bogner [7]: questions 44-50.

Students' attitudes towards the environment and sustainable development.

This theme can be divided into several sub-themes:

- Attitudes towards the environment: differentiator of Osgood, codes from 1 to 5 between antonyms adjectives for the environment: question 51.
- Action – Inaction: questions 52-57.
- Environmental activism: questions 58-64.
- Defense of the environment: questions 65-73.
- Pollution control concerning air pollution in cities: questions 74-76.

The questionnaire ends with personal variables (age, gender, class, parents 'profession and parents' level of education) which make it possible to better qualify the sample, and study possible correlations with the different aspects of identified conceptions.

The questionnaires were filled out individually, then collected later while strictly preserving the anonymity of the responders. All the answers were processed with the Sphinx software, then transferred to Excel for the presentation of tables and graphs.

### *C. Statistical Analysis of Responses*

To test the hypotheses relating to students' value systems and their possible correlations with personal variables, we opted for Principal Component Analysis: PCA [8]. Each main component indicates a conceptual orientation that emerges from all the students' responses [9]. The analysis focuses only on quantitative variables (scales or numbers): 44 questions. The qualitative variables are analyzed by Factor Correspondence Analysis (CFA).

Personal variables are not included in this analysis. They are used in the following steps of the analysis, to identify possible correlations between some of them and the conceptual orientations highlighted by the multivariate analysis.

Discriminating analyzes allowing to differentiate groups of students from different disciplines in terms of conceptions.

## IV. RESULTS AND DISCUSSION

We highlight the first results closely linked to the personal conceptions of students, using multivariate analysis first, then cross analysis [10]-[12].

### *A. The PCA Analysis*

The PCA performed processes a table that includes 118 students in rows, and in columns the different modalities corresponding to the 44 active variables from the questionnaire. We have retained the first three axes which add up to a cumulative relative inertia of 24.76%, which is relatively important since the number of axes is equal to 44. The following table (Table II) gives the classification of the first three axes of this PCA according to their eigenvalues with the strongest in 1st position (we call it F1) and their inertias.

TABLE II: OWN VALUES, RELATIVE AND CUMULATIVE INERTIAS OF THE 44 AXES OF THE PCA

| Number axis | Own values | % relative inertia | % cumulative |
|---|---|---|---|
| 1 | 4.543 | 10.33 | 10.33 |
| 2 | 3.508 | 7.97 | 18.30 |
| 3 | 2.843 | 6.46 | 24.76 |

If the answers had been carried out at random, each of the components of the analysis would have corresponded to 100% of the variance divided by the 44 columns, or 2.27% of the total variance. This is not the case: since the histogram of the eigenvalues of these 44 components (Fig. 1) shows that the first 4 axes correspond to information, mainly the first (10.33% of the variance), the others can be neglected (<4.5% of the variance, and a regular decrease in this percentage).

The analysis of the results relates to the first three axes which have the most inertia (24.76%): I first analyse the results linked to the first two axes or components (F1 and F2), then those linked to the third axis (F3).

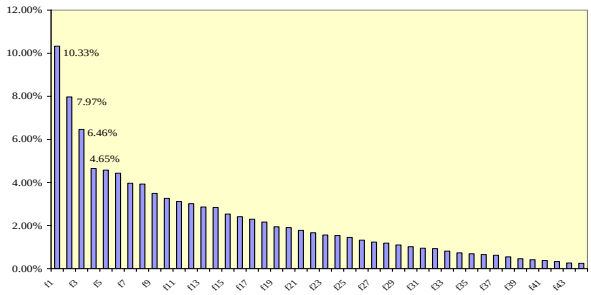


Fig. 1. Histogram of the Relative Eigenvalues or Inertias of the Axes of the PCA (expressed as percentage of variance for successive components).

### *B. Results Related to the First Two Components F1 and F2 of the CPA*

The significant modalities on the factorial plane formed by the first three axes F1, F2 and F3 are noted in Table III.

TABLE III: SIGNIFICANT MODALITIES ON F1 AND F2 IN THE CPA

| N° | Content of the Modality | Coordinates of variables | | | Variable contributions | | |
|---|---|---|---|---|---|---|---|
| | | F1 | F2 | F3 | F1 | F2 | F3 |
| **10** | Man's power to disturb nature | -0.254 | 0.068 | -0.197 | 1.42 | 0.13 | 1.37 |
| **12** | Restoring Nature to Itself | 0.19 | -0.052 | -0.028 | 0.79 | 0.08 | 0.027 |
| **17** | Preserving plants to help discover new drugs | -0.194 | 0.063 | -0.338 | 0.83 | 0.11 | 4.009 |
| **18** | Plant preservation because each species has the right to exist | -0.06 | 0.253 | -0.306 | 0.08 | 1.83 | 3.298 |
| **19** | Protection of forests from fire to avoid economic disasters. | 0.125 | 0.145 | -0.147 | 0.35 | 0.60 | 0.763 |
| **20** | Protecting forests from fire to prevent the death of many animals and plants | -0.194 | 0.276 | -0.109 | 0.83 | 2.17 | 0.422 |
| **21** | Non-clearing of forests to protect flora and fauna | -0.079 | 0.395 | 0.1 | 0.14 | 4.46 | 0.351 |
| **22** | Non-clearing of forests to conserve cultural heritage. | 0.481 | 0.386 | -0.17 | 5.09 | 4.26 | 1.02 |
| **23** | Opposition to the installation of an industrial chicken farm because of its bad smells. | -0.189 | 0.164 | -0.246 | 0.79 | 0.77 | 2.123 |
| **24** | Opposition to the installation of an industrial chicken farm because of the pollution of the water table. | 0.214 | 0.059 | -0.211 | 1.01 | 0.10 | 1.567 |
| **26** | Genetically modified plants can reduce hunger. | 0.308 | 0.364 | -0.268 | 2.09 | 3.77 | 2.535 |
| **27** | Modification of a person's genes if they eat genetically modified products | 0.513 | 0.265 | -0.121 | 5.79 | 2.00 | 0.517 |
| **28** | Genetically modified plants will reduce the use of pesticides. | 0.444 | 0.028 | -0.321 | 4.34 | 0.02 | 3.632 |
| **29** | Genetically modified plants can contaminate wildlife, threatening their survival. | -0.083 | 0.127 | -0.043 | 0.15 | 0.46 | 0.066 |
| **25** | GMOs are unnatural. | 0.333 | 0.302 | -0.281 | 2.43 | 2.61 | 2.784 |
| **30** | Nature is always able to recover on its own. | 0.512 | 0.219 | 0.082 | 5.76 | 1.37 | 0.238 |
| **31** | Know which animals live in ponds or rivers | -0.266 | 0.334 | -0.096 | 1.55 | 3.17 | 0.321 |
| **32** | Disappearance of human beings if they do not live in harmony with nature. | 0.126 | 0.134 | -0.149 | 0.35 | 0.51 | 0.778 |
| **33** | Society will continue to solve even the biggest environmental problems. | 0.49 | 0.329 | -0.047 | 5.29 | 3.09 | 0.079 |
| **34** | People worry too much about pollution. | -0.193 | 0.289 | 0.197 | 0.82 | 2.37 | 1.364 |
| **35** | I always turn off the light when I don't need it. | -0.11 | 0.49 | -0.103 | 0.27 | 6.85 | 0.376 |
| **36** | I like to walk in the countryside. | -0.122 | 0.429 | -0.018 | 0.33 | 5.25 | 0.012 |
| **37** | Development of spaces to protect endangered species. | -0.306 | 0.604 | -0.078 | 2.06 | 10.40 | 0.212 |
| **38** | Human beings are more important than other living things. | 0.569 | 0.052 | -0.129 | 7.12 | 0.08 | 0.586 |
| **44** | Rejection of black smoke by industrial chimneys | -0.114 | 0.297 | 0.244 | 0.29 | 2.51 | 2.099 |
| **45** | The environment delays development projects. | 0.201 | 0.058 | -0.377 | 0.89 | 0.10 | 5.009 |
| **46** | Deforestation of forests to develop agriculture | 0.408 | -0.068 | -0.271 | 3.67 | 0.13 | 2.576 |
| **47** | Invasion of the countryside by buildings | 0.128 | 0.312 | 0.147 | 0.36 | 2.77 | 0.765 |
| **48** | Our planet has unlimited resources. | 0.291 | 0.387 | -0.188 | 1.86 | 4.28 | 1.243 |
| **49** | Protection of species with economic interests | 0.55 | -0.192 | -0.332 | 6.66 | 1.05 | 3.887 |
| **50** | Right of human beings to change nature as they see fit | -0.174 | -0.182 | -0.301 | 0.67 | 0.94 | 3.188 |
| **52** | If you dread illnesses, you only have to swim in the pool. | 0.263 | 0.023 | -0.225 | 1.52 | 0.02 | 1.785 |
| **53** | Nature was healthy, before Man poisoned it. | -0.421 | 0.427 | 0.159 | 3.89 | 5.19 | 0.891 |
| **54** | Fighting against those who contribute to pollution | -0.168 | 0.556 | -0.027 | 0.62 | 8.80 | 0.025 |
| **55** | Contribution to the cleanliness of the premises | -0.303 | 0.439 | 0.129 | 2.02 | 5.48 | 0.581 |
| **56** | Irresponsibility of people who frequented these places | -0.425 | 0.507 | -0.034 | 3.97 | 7.34 | 0.041 |
| **57** | Want to make no effort to pick up my trash | 0.305 | -0.025 | -0.366 | 2.04 | 0.02 | 4.722 |
| **58** | Financial support from environmental protection associations | -0.449 | -0.12 | -0.408 | 4.44 | 0.41 | 5.854 |
| **59** | Boycott of products from anti-ecological firms | -0.362 | -0.219 | -0.514 | 2.89 | 1.37 | 9.293 |
| **60** | Environmental information through reading | -0.333 | -0.188 | -0.53 | 2.44 | 1.00 | 9.892 |
| **61** | Discussion with friends on environmental issues | -0.178 | -0.038 | -0.479 | 0.69 | 0.04 | 8.064 |
| **62** | Signalling of anti-ecological behavior | 0.02 | 0.22 | -0.175 | 0.01 | 1.38 | 1.072 |
| **63** | Collection of used paper for recycling | -0.489 | -0.055 | -0.397 | 5.27 | 0.09 | 5.54 |
| **64** | Depositing empty bottles in a recycling container | -0.527 | -0.149 | -0.378 | 6.12 | 0.63 | 5.026 |

Fig. 2 represents the distribution of the significant modalities on the F1 - F2 plan resulting from the PCA. The multivariate analyses used make it possible to highlight two major poles or systems of conceptions within which subgroups appear with different characteristics (Fig. 2).

The first pole brings together people who tend to be anthropocentric, concerned first of all with the use of natural resources (to the right). In anthropocentric ethics, man is the only being who has value, nature must be mastered to serve him as resources and to meet his needs (human beings are more important than other living beings; only plants and animals of economic interest deserve to be protected; nature is always able to recover on its own; society will continue to solve environmental problems, even the biggest ones; forests must be cleared to develop 'Agriculture). The resources of nature (air, water, soil, plants, minerals, etc.) are considered to be both infinite and available (our planet has unlimited resources).

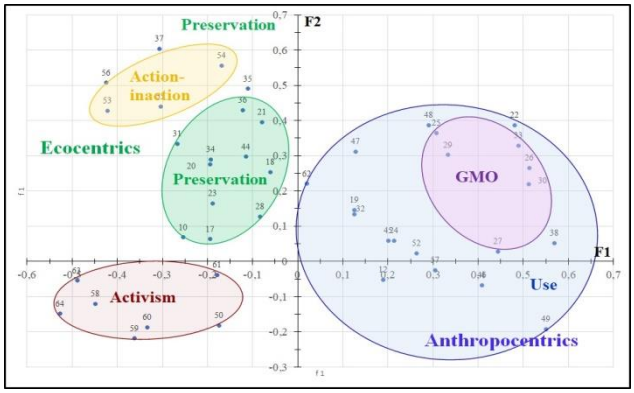


Fig. 2. Significant modalities on F1-F2.

Anthropocentres also have favorable positions for GMOs, while having more knowledge about the ecosystem (a person's genes can be modified if they eat genetically modified products; genetically modified plants are good for the environment because their cultivation will reduce the use of pesticides; genetically modified plants will help reduce world hunger; genetically modified organisms are unnatural). Anthropocentres also have favorable positions for GMOs, while having more knowledge about the ecosystem (a person's genes can be modified if he/she eats genetically modified products; genetically modified plants are good for the environment because their cultivation will reduce the use of pesticides; genetically modified plants will help reduce world hunger; genetically modified organisms are unnatural).

The second pole brings together people who tend to be more ecocentric and concerned about preserving the environment (on the left). Within this group, three subgroups can be distinguished:

- Preservation of the environment with environmentally friendly attitudes;
- Student activism in favor of the environment as is clear from (putting empty bottles in a recycling container; collection of used paper for recycling; information on environmental issues by reading; boycott of products from firms that have anti-ecological behaviour, financial support from environmental protection associations);
- Actions of defence or protection of the environment which apparent in the remarks such as (this depresses me completely and makes me regret the old times when nature was healthy, before Man poisoned his environment; I am disgusted and desperate by such behaviour which proves the irresponsibility of the people who have frequented these places and it deprives me of energy; I feel good when I help to leave them cleaner after my visit than they were when I arrived).

Axis 1 therefore opposes people who are more anthropocentric to people who are more ecocentric. Axis 2 opposes ecocentric conceptions (environment / life and "natural" nature) and anthropocentric conceptions with the actions of environmental activism.

### *C. Meaning of the F3 component*

The F3 axis also deserves to be interpreted, since it represents 6.46% of the variance. The two axes F1 and F3 have a cumulative relative inertia of 16.76% (10.33% and 6.46%): these two axes are almost as important as F1 and F2 whose cumulative inertia is 18.3%. What additional information does the F3 component provide?

Fig. 3 represents the distribution of the significant modalities on the F1-F3 plan of the PCA and reveals the characteristics of the different conceptions of the students concerned by this analysis.

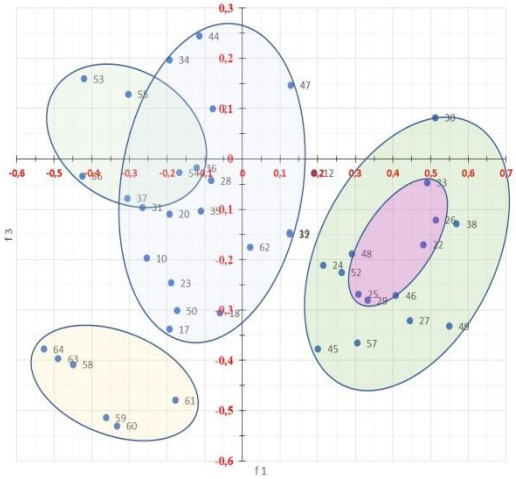


Fig. 3. Significant modalities on F1-F3 axis.

The F3 axis opposes, for the most part, attitudes respectful of the environment as the following testimonies show (the forest should not be razed to protect flora and fauna; people worry too much about pollution; I am angry when I see chimneys of industries emitting black smoke) and action - inaction in the face of pollution problems (this depresses me completely and makes me regret the old days when nature was healthy, before Man does not poison his environment. I feel good when I help to leave the picnic areas cleaner after my visit than they were when I arrived). It corresponds to the ecocentric conceptions of the F1-F2 plan.

The negative side of the axis corresponds more to the desire to preserve the environment and to transmit knowledge. It corresponds to the anthropocentric conceptions of the F1-F2 plan defined here by: anthropized nature, leaving the houses in place and channelling the wadi securely. The bottom of the axis (F3 negative) favours more the development of attitudes of use and preservation of the environment (anthropocentric and ecocentric). Pro or anti GMO conceptions and environmental activism are also located in this pole because they are always defined by F1.

For the qualitative variables (closed single or multiple), we used the Factorial Analysis of Correspondences: FAC [13]. This analysis highlights a third pole called "sentimentocentric" (Fig. 4).

F1 opposes those who lend feelings to animals: pigeon, bird, dog, snail, monkey (negative side) to those who have less feeling for animals (frog, fly, snake) or do not lend feelings at all (positive side).

F3 opposes people who have no feelings at all for animals (positive side) to people who lend them feelings but with a difference from one animal to another (negative side).

Fig. 5 shows the distribution of the 118 students on the F1-F2 plane: the students of Life and Earth Sciences (LES) correspond with green dots and History-Geography (HG) students with blue dots.

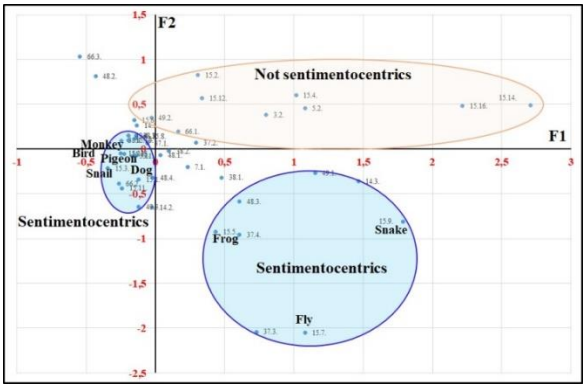


Fig. 4. Significant modalities on F1-F2 of FAC.

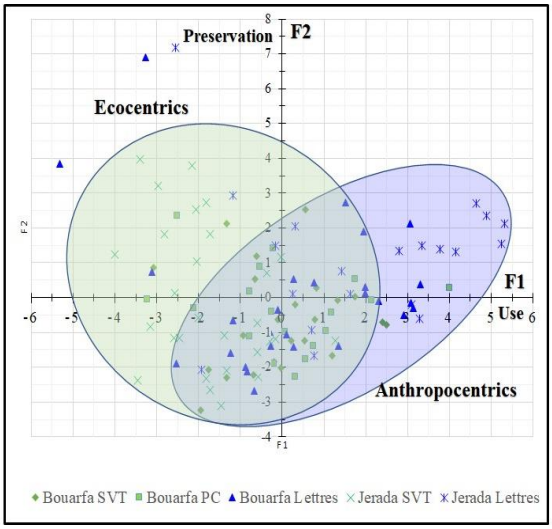


Fig. 5. Distribution of students on F1-F2 in the CPA.

Fig. 5 identifies 2 trends:

- an anthropocentric trend (on the right): the students of History-Geography (HG).
- an ecocentric trend (on the left): students of Life and Earth Sciences and physical sciences.

The two poles have a wider distribution, corresponding to the negative values on the two axes F1 and F2.

### *D. Meaning of Student Environmental Components and Trends*

Table IV summarizes the meaning of the first three components of the PCA.

TABLE IV: MEANING OF THE THREE COMPONENTS OF THE PCA

| | **Axis 1: + 10.32%** | | **Axis 2: + 7.97%** | | **Axis 3: + 6.46%** | |
|---|---|---|---|---|---|---|
| | positive | negative | positive | negative | positive | negative |
| Use of the environment | 27 | -1 | 8 | -1 | 14 | |
| Preservation | 6 | -2 | 41 | | 9 | -3 |
| GMOs | 13 | | 6 | | 7 | |
| Action-inaction | 3 | -7 | 25 | | 5 | |
| Activism | | -19 | 1 | -1 | 31 | |

Table V gives the main significant variables and their percentages on the three axes F1, F2 and F3 of the CPA classified into groups and subgroups.

TABLE V: THE MAIN SIGNIFICANT VARIABLES ON THE THREE AXES OF PCA

| | **Axis 1: + 10.32%** | | | | **Axis 2: + 7.97%** | | | | **Axis 3: + 6.46%** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | positive | | negative | | positive | | negative | | positive | | negative | |
| | Variable | % | Variable | % | Variable | % | Variable | % | Variable | % | Variable | % |
| | 38 | 7 | 10 | -1 | 48 | 4 | 49 | -1 | 45 | 5 | | |
| **Use** | 49 | 6 | | | 33 | 3 | | | 49 | 3 | | |
| **Anthropo-** | 30 | 5 | | | 30 | 1 | | | 50 | 3 | | |
| **centrics** | 33 | 5 | | | | | | | 46 | 2 | | |
| | 46 | 3 | | | | | | | 48 | 1 | | |
| | 48 | 1 | | | | | | | | | | |
| | 22 | 5 | 31 | -1 | 37 | 10 | | | 17 | 3 | 44 | -2 |
| | 24 | 1 | 37 | -1 | 35 | 6 | | | 18 | 3 | 34 | -1 |
| | | | | | 36 | 5 | | | 23 | 2 | | |
| | | | | | 21 | 4 | | | 24 | 1 | | |
| | | | | | 22 | 4 | | | | | | |
| **Preservation** | | | | | 31 | 3 | | | | | | |
| **Eco-** | | | | | 19 | 2 | | | | | | |
| **centrics** | | | | | 34 | 2 | | | | | | |
| | | | | | 44 | 2 | | | | | | |
| | | | | | 47 | 2 | | | | | | |
| | | | | | 18 | 1 | | | | | | |
| | 27 | 5 | | | 26 | 3 | | | 28 | 3 | | |
| | 28 | 4 | | | 25 | 2 | | | 26 | 2 | | |
| **GMOs** | 26 | 2 | | | 27 | 1 | | | 25 | 2 | | |
| | 25 | 2 | | | | | | | | | | |
| | 57 | 2 | 53 | -3 | 54 | 8 | | | 57 | 4 | | |
| **Action-** | 52 | 1 | 56 | -3 | 56 | 7 | | | 52 | 1 | | |
| **Inaction** | | | 55 | -1 | 53 | 5 | | | | | | |
| | | | | | 55 | 5 | | | | | | |
| | | | 64 | -6 | 62 | 1 | 59 | -1 | 59 | | 9 | |
| | | | 63 | -5 | | | | | 60 | | 9 | |
| **Activism** | | | 58 | -4 | | | | | 61 | | 8 | |
| | | | 59 | -2 | | | | | 58 | | 5 | |
| | | | 60 | -2 | | | | | | | | |

### *E. Discriminant Analysis on the Theme "Use - Preservation"*

The analysis in this case relates to the variables "Use - Preservation", ie 24 criteria (Fig. 6). It makes it possible to seek the conceptions which most differentiate the students according to their disciplines. This differentiation between the disciplines of the respondents is very significant. The two tendencies: anthropocentric (History-Geography students); and ecocentric (respondents of Life and Earth Sciences and physical sciences) appear clearly.

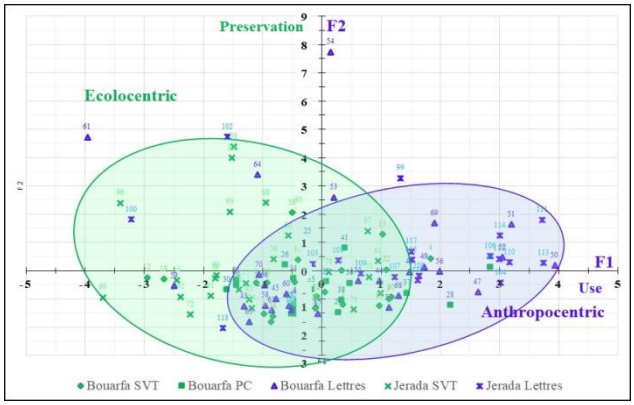


Fig. 6. Distribution of students on F1-F2 in the PCA (24 criteria).

### *F. Discussion*

The multivariate statistical analysis reveals trends in the conceptions of the students of Bouarfa and Jerada. These conceptions are structured in two poles: the anthropocentrics and the ecocentrics. A third pole is highlighted by the Factor Analysis of Correspondences. These are sentimentocentrics. Most students attribute feelings to animals, but with differences from animal to animal. These conceptions also differ according to the disciplines. The History - Geography students are more anthropocentric while the Life and Earth Sciences and Physical Sciences students are more ecocentrics. However, these significant trends deserve to be confirmed with larger samples.

These conceptions testify to value systems close to those of their Maghreb, Lebanese or European counterparts. In Lebanon, reference [14], in their analysis of the conceptions of (future) Lebanese teachers on Environmental Education, and their variations according to the language and the subject taught, highlighted three value systems: ecocentrics, sentimentocentrics and anthropocentrics. In Tunisia, the conceptual tendencies of Tunisian teachers are divided into three poles [6]. The same conceptions have been identified in French, German and Portuguese teachers [15]-[18]. In Algeria, the sentimentocentric conceptions have also been described as differentiating teachers' conceptions [19].

In another study on the value systems on the environment of teachers in four Mediterranean countries (France, Algeria, Lebanon and Morocco), references [20] and [21] were also able to identify three systems of conceptions which can be expressed by the same way in the four countries: anthropocentrics, ecocentrics and sentimentocentrics. By studying the conceptions of African and European teachers, reference [22] showed that African teachers have a very strong tendency to anchor themselves in anthropocentric values, unlike European countries. These differences, the meaning of which is disputed, deserve to be taken into account in the training of teachers in order to better assume the objectives of Environmental Education.

### *G. Cross analysis*

Multivariate statistical analysis revealed trends in student conceptions. But the reality is much more complicated. Cross-analysis provides more detail on the students' conceptions. We have tried to cross the questions specific to the problem studied with questions associated with social factors which are deemed to be "determining" such as sex, specialty and socio-professional category (SPC). The first review of the data collected shows that most of the students interviewed lent feelings towards animals, but with a difference from one animal to another and from one city to another: 55.5% in Jerada; 52.1% in Bouarfa. The cross-analysis gives more details on the different correlations tested.

#### *a. Variable 1: Gender*

We can then wonder if there is a significant difference between boys and girls. The assumption, which is based on gender stereotypes, might be that animals may be more likely to please women. After cross-sorting, our hypothesis seems to be invalidated since we obtain 56% for boys and 53% for girls. The percentage differences between boys and girls appear to be too small to be interpreted. At first glance, therefore, the gender difference does not appear significant in terms of the appreciation that one is inclined to bring to animal feelings. But to get to the bottom of it, I have conducted further statistical tests (Table VI). The dependence is not significant: Chi2 = 20.94; dof (Degrees of freedom) = 15; 1-p = 86.14% The Chi2 is calculated on the citations table (marginal numbers equal to the sum of the row / column numbers). The percentage of variance explained is 17.75%, Cramer's V= 0.11.

$$\text{Cramer's V} = \sqrt{X^2} / N * \text{Min.dof}$$

Where $X^2$: Khi2.
N: Number of samples. Min.dof: Degrees of freedom [23].

TABLE VI: MEANING OF THE DEPENDENCE OF THE VARIABLES BY BIVARIATE ANALYSIS

| | Khi2 | Sample | dof | Cramer's V | % Variance | Dépendance |
|---|---|---|---|---|---|---|
| Kind and feelings to animals | 20.94 | 118 | 15 | 0.11 | 17.75 | little significant |
| Gender and pollution | 3.13 | 118 | 3 | 0.09 | 2.65 | not significant |
| Gender and GMOs | 11.54 | 118 | 3 | 0.18 | 9.78 | very significant |
| Specialty and feelings | 31.25 | 118 | 15 | 0.13 | 17.75 | very significant |
| Specialty and GMOs | 4.64 | 118 | 3 | 0.11 | 3.93 | not significant |
| Specialty and pollution | 22.66 | 118 | 3 | 0.25 | 18.35 | very significant |
| SPC and Environmental Protection | 48.52 | 118 | 30 | 0.12 | 13.71 | significant |
| SPC and financial support | 42.08 | 118 | 30 | 0.11 | 11.89 | little significant |
| SPC and support of associations | 64.36 | 118 | 40 | 0.12 | 13.64 | very significant |

The Chi-square test confirms what we sensed when reading the table: the differences are not significant enough to be interpreted as being the expression of one variable - sex - acting on another - the feeling of animals. In fact, this is not very surprising, considering that the variables in general, and the difference between men and women in particular, refer to a whole set of meanings. Also, the difference between men and women is not only biological in nature, but also affects the role and status of a man or a woman in society, which themselves vary according to age or profession... and various other forms of social assignments. For instance, pollution is perceived differently by respondents: 88.4% of girls worry too much about pollution and oppose any project that could pollute the groundwater, for example, against 82.6% of boys. The dependence is not significant: Chi2 = 3.13; dof = 3; 1-p = 62.76%. The percentage of variance explained (Cramer's test) is equal to 2.65%. As far as genetically modified organisms are concerned, it is questionable whether there is a significant difference between boys and girls. In fact, 73.9% of boys say they are unnatural, compared to 52.6% of girls. The dependence is very significant: Chi2 = 11.54; dof = 3; 1-p = 99.09%. % of variance explained: 9.78%; Cramer's V = 0.18.

*b. Variable 2: The specialty*

If we take a look at the variable "specialty" (Life and Earth Sciences and History-Geography), and if this variable is likely to influence the feelings one feels towards animals, the assumption is that the more you study the life and earth sciences, the more likely you are to endorse feelings about flora and fauna. Yet when cross-referenced, we observe the opposite: 85% of the students of History-Geography have feelings for dogs, snails, monkeys, pigeons and birds in general, against 74.4% of Life and Earth Sciences students. But 15.7% of the latter approve of feelings for the other animals: frogs, flies and snakes, against 12.5%. This tends to reject our hypothesis. What can we deduce from the statistical tests?

Regarding the Chi-square test, the dependency is very significant: Chi2=31.25; dof=15; 1-p=99.19%. Concerning Cramer's test, the % of variance explained is equal to 17.75%.

With regard to pollution, 93.8% of the students of History-Geography think that people worry too much about pollution, compared to 82.9% for Life and Earth Sciences students. The dependence is not significant: Chi2=4.64; dof=3; 1-p=79.95%. The percentage of variance explained (Cramer's test) is equal to 3.93%.

Students are more likely to be anti-GMOs: 74.3% of them in Bouarfa and 58.3% in Jerada consider them unnatural. 68.6% of Life and Earth Sciences students say that genetically modified organisms are unnatural, compared to 39.6% of History-Geography students. The strength of the relationship between the students' specialty and their response to the question on GMOs is very significant: Chi2 = 21.66; dof = 3; 1-p = 99.99%. The % of variance explained (V of Cramer) is equal to 18.35%.

*c. Variable 3: The Socio-Professional Category (SPC)*

If we take a look at the variable "socio-professional category" (CSP), and if this variable is likely to affect the level of satisfaction of the other variables, it looks well correlated with the spaces planning to protect endangered species. The dependence is significant: Chi2=48.52; dof=30; 1-p=98.24%. The % of variance explained is equal to 13.71%, and Cramer's V is equal to 0.12. It is also well correlated with the financial support of environmental protection associations. Chi2=64.36; dof=40; 1-p = 99.14%. The % of variance explained is equal to 13.64%, and Cramer's V is equal to 0.12. Finally, it has little correlation with deforestation of forests for the development of agriculture. Chi2 = 42.08; dof=30; 1-p = 92.96%. The % of variance explained is equal to 11.89%, and Cramer's V is equal to 0.11.Several tests have conducted on the feelings for animals, pollution, GMOs but the dependencies are not significant.

## V. Conclusion

The trends in the conceptions of students in Bouarfa and Jerada high schools with regard to the environment and sustainable development fall into two main areas. Axis 1 of the PCA represents the largest part of the variance, with anthropocentric attitudes opposed to attitudes respectful of the environment. These conceptions clearly differ according to the disciplines. History - Geography students are more anthropocentric, while students of Life and Earth Sciences and physical sciences are more eco-centered.

The students interviewed are sensitive to pollution and GMOs and worry about anthropogenic impacts on the environment. They also lend feelings to animals but with a difference from one animal to another (sentimental attitude).

The cross-analysis provides more detail on the students' conceptions. Gender and GMOs, specialty (Life and Earth Sciences or History-Geography) and feelings as well as socio-professional categories and financial support for associations are well correlated. On the other hand, gender and pollution, gender and feelings for animals as well as specialty and GMOs are not correlated.

These conceptions bear witness to value systems close to those of their counterparts in Algeria, Tunisia, Lebanon and some European countries. They deserve to be taken into account in school curricula and in the training of trainers in the Regional Centers for Education and Training (CRMEF) to better meet the objectives of Environmental Education.

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