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Polish teachers' conceptions related to the environment

Introduction

Wiesław Stawiński was an active member of the AEDB (Association Européenne de Didactique de la Biologie) during the nineties, an association chaired by Pierre Clément. This active collaboration led to the inclusion of a Polish team, under Elwira Samonek, in the European research project (BIOHEAD-Citizen), coordinated by Pierre Clément and two other colleagues. This project ("Biology, Health and Environmental Education for Better Citizenship") involved 19 countries, 6 of them from Europe, from 2004 to 2008. It was focused on the relations between science and society in six topics: (1) Environmental Education, (2) Health Education, (3) Human Reproduction and Sexuality Education, (4) Evolution and Human Origins, (5) Human Genetics and (6) Human Brain. Are these topics taught in the same way, with the same scientific content and the same goals, in the 19 countries?

To answer to this question, we analysed school textbooks dealing with these topics in the 19 countries, as well as teachers' conceptions.

Most of our results, presented in Brussels (Carvalho, Clément, Bogner & Caravita 2008), are not yet published as far as the data gathered in Poland are concerned. We present here the main results related to Polish teachers' conceptions on nature, environment and environmental education.

Our theoretical background is the KVP model (Clément 2004a, 2006) which analyzes conceptions as possible interactions between three poles: scientific knowledge (K), values (V) and social practices (P). As for the six topics of the project, the taught knowledge is strongly associated with values and social practices. That is particularly true for Environmental Education (Clément & Hovart 2000): its goals are not limited to the transmission of (multidisciplinary) knowledge but also relate to students' attitudes and values (Giordan & Souchon 1991, Giolitto & Clary 1994).

Nevertheless, the philosophy of Nature (Quillot 2000) and of Environment (Larrère 1997) show that several and often divergent values are associated with them (Sauvé 1994, Schultz & Zelezny 1999, Clément 2004b). From a survey of the literature, we defined several axes to analyse the teachers' conceptions related to nature and environment (Forissier & Clément 2003, Caravita et al. 2008). We designed a questionnaire taking into account the following points:

- The two poles defined by Wiseman & Bogner (2003) when analysing students' conceptions on environment: utilisation and preservation, which are not very different from the two classical types of conceptions on Environment: anthropocentred and ecocentred. Several results of the Biobead-Citizen research confirmed the importance of these two poles (Munoz et al. 2009): are we going to find these two poles in the Polish teachers' conceptions? Some other results showed three poles in the teachers' conceptions: anthropocentred (pole utilisation), ecolocentred (pole preservation) and "sentimentocentred" (see the next paragraph).
- This sentimentocentred pole focuses on the capacity of animals to feel grief or happiness. This pole was very structuring of the teachers' conceptions analysed in France, Portugal and Germany (Forissier 2003, Forissier & Clément 2003), in Lebanon (Khalil et al 2007), in Algeria (Khammar et al 2008) and in Morocco (Khzami et al 2008). What are the Polish teachers' conceptions related to this pole?
- The last point is linked to GMO, with animated debates in most of the European countries, generally structured by an opposition vs. acceptation of GMO. French teachers are mostly anti-GMO (Clément *et al.* 2007).

We will analyse the Polish teachers' conceptions and then we will briefly compare them to the 11 other European countries involved in the Biohead-Citizen project.

Methods

2-1 – Samples

In Poland, 322 teachers filled out the Biohead-Citizen questionnaire. The six samples are briefly presented in Tab. 1. Most of them were Catholic (94.1%), very few Protestant (0.6%), atheist or agnostic (1.9%). Only 3.4% ticked the item "I don't wish to answer" when answering this question on their own religion.

Tab. 1. The samples of Polish teachers who filled out the questionnaire

Samples of Polish teachers	number	Mean age (years old)	Gender (% women)
PreP = Pre-service teachers in Primary Schools	54	23	88.9 %
PreB = Pre-service Biology teachers (Secondary)	51	23	88.2 %
PreL = Pre-service Language teachers (Secondary)	48	23	85.4 %
InP = In-service teachers in Primary Schools	57	40	96.5 %
InB = In-service Biology teachers (Secondary)	51	39	92.2 %
InL = In-service Language teachers (Secondary)	61	39	90.2 %

2-2 – Questionnaire

It was designed during the first two years of the Biohead-Citizen project, taking several precautions which are described in other works (Clément & Carvalho 2007): using first a pilot test and interviews and avoiding bias in translation.

The final questionnaire includes 144 questions. The 29 questions related to Environment and Environmental Education are listed below, topic by topic.

Tab. 2. The questions related to the pole "Preservation" (ecolocentric conceptions)

A1.	We must set aside areas to protect endangered species.	I agree					I don't agree
A5.	If an intensive chicken farm were going to be created near where you live, you would be against this because it may pollute the groundwater.	I agree					I don't agree
A7.	Humans will die out if we don't live in harmony with nature.	I agree					I don't agree
A11.	Industrial smoke from chimneys makes me angry.	I agree					I don't agree
A22.	I enjoy trips to the countryside.	I agree					I don't agree
A28.	It makes me sad to see the countryside taken over by building sites.	I agree					I don't agree
A40.	It is interesting to know what kinds of animals live in ponds or rivers.	I agree					I don't agree
A50.	All contemporary plant species should be preserved because they may help in the discovery of new medicines.	I agree					I don't agree

Tab. 3. The questions related to the pole "Utilisation" (anthropocentric conceptions)

A4.	Nature is always able to restore itself.	I agree					I don't agree
A8.	People worry too much about pollution.	I agree					I don't agree
A16.	Our planet has unlimited natural resources.	I agree					I don't agree
A17.	Society will continue to solve even the biggest environmental problems.	I agree					I don't agree
A18.	Human beings are more important than other living beings.	I agree					I don't agree
A23.	We need to clear forests to increase agricultural areas.	I agree					I don't agree
A32.	Humans have the right to change nature as they see fit.	I agree					I don't agree
A54.	Only plants and animals of economical importance need to be protected.	I agree					I don't agree

Tab. 4. The questions related to the GMO pole (Genetically Modified Organisms)

A12.	Genetically modified plants will help to reduce famine in the world.	I agree					I don't agree
A13.	Genetically modified organisms are contrary to nature.	I agree					I don't agree
A39.	Genetically modified plants are good for the environment because their cultivation will reduce the use of chemical pesticides (e.g. insecticides, herbicides).	I agree					I don't agree

A47.	Genetically modified plants are harmful to the environment because they will contaminate other crop plants, menacing their survival.	I agree					I don't agree
A49.	If a person eats genetically modified plants, his/her genes can be modified.	I agree					I don't agree

Tab. 5. The questions related to feelings of animals (sentimentocentred pole)

A10.	Snails are able to feel happiness.	I agree					I don't agree
A29.	Frogs are able to feel happiness.	I agree					I don't agree
A45.	Flies are able to feel happiness.	I agree					I don't agree

In the first questionnaire used for the pilot test, there were 18 questions related to the feelings of animals. Originally, there were 6 animals; for each of them was listed their ability to have feelings, to be happy and to feel grief. There was such a strong correlation between feelings, grief and happiness that we decided to use only one of these three categories. We also reduced the number of animals, because 100% of the teachers had the same answers, irrespective of animals mentioned, e.g. such as dogs or monkeys. When we know the answers in advance, it is useless to maintain the questions.

The last questions deal with practices related to the environment, as the questions A56 (below), and to Environmental education, as the question A61.

A56. There is a decision-making process in the implementation of science applications related to environment and biotechnology. Indicate, in each line, your degree of confidence in different actors to make such decisions (tick only **ONE** case for each line):

Scientists					Members of Parliament
Science experts of this specific field					Science experts of diverse fields including ethics
All the citizens (referendum)					Elected persons representing citizens at the national, regional or local levels

A61. In your opinion, the main goal of environmental education in school should be (tick only **ONE** of the four boxes)**:**

Providing knowledge | | | | | Developing responsible behaviour

2-3 – How the questionnaire was filled out

All the teachers had to individually fill out the 144 questions of the questionnaire (10 pages), with a total guarantee of anonymity. It took between 30 to 45 minutes.

It was at the end of a course for the pre-service teachers, and in their school for the in-service teachers.

2-4 – Analysis of data

The Polish team fed the data into an Excel table which was then analysed by the French team and collectively discussed via e-mail and during the Meeting of Budapest (February 2008). We used multivariate analysis which is described in other works (Munoz & Clément 2007, Munoz et al 2009), mainly PCA and between analyses completed by randomization tests (Monte Carlo type): (Lebreton, Sabatier, Banco, and Bacou, 1991), Dray *et al.*, 2003; Dolédec & Chessel, 1994)

Results

3-1. PCA (Principal Components Analysis)

The main component structuring the differences of Polish teachers' conceptions is related to the feelings of animals (Component 1 = horizontal axis in Fig. 1). The teachers did not answer in the same way for the 3 animals, with important differences among the teachers, as shown in Tab. 6. About one third of them agree or rather agree that snails, flies or frogs are able to feel happiness.

Tab. 6. Answers to the 3 questions related to the feelings of animals

These animals are able to feel happiness	I agree	I rather agree	I rather don't agree	I don't agree
Snails	11.9%	23.5%	29.6%	35.0%
Frogs	11.3%	24.1%	29.3%	35.4%
Flies	10.3%	17.4%	28.0%	44.4%

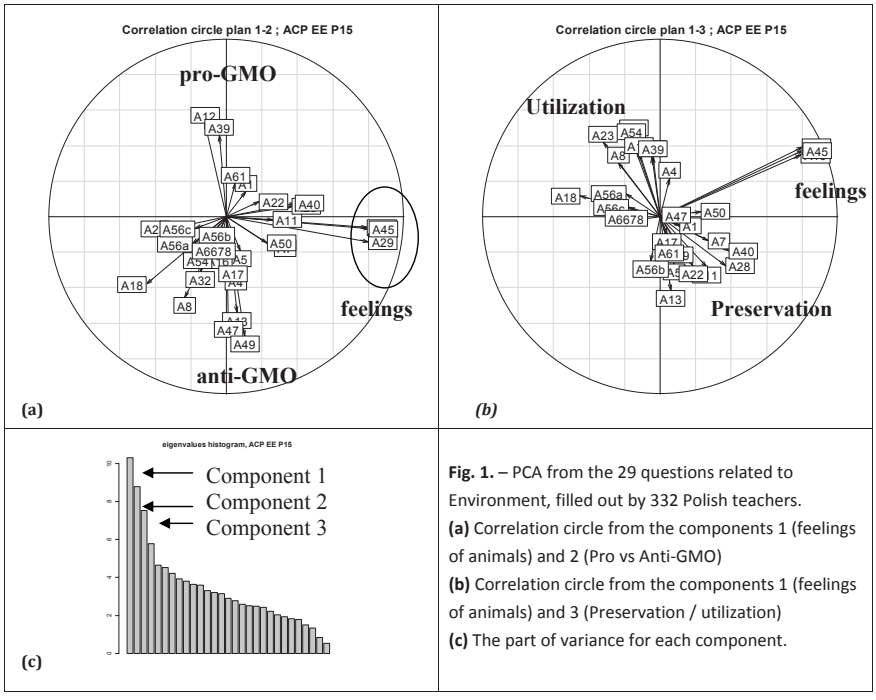

Fig. 1. – PCA from the 29 questions related to Environment, filled out by 332 Polish teachers.
(a) Correlation circle from the components 1 (feelings of animals) and 2 (Pro vs Anti-GMO)
(b) Correlation circle from the components 1 (feelings of animals) and 3 (Preservation / utilization)
(c) The part of variance for each component.

The second principal component structuring the differences among the Polish teachers' conceptions is related to GMO, with a strong opposition between pro- and anti-GMO opinions (vertical axis of Fig. 1a). Here, there is also a great coherence of the teachers' answers to these 5 questions, nevertheless with the exception of the question A13 ("Genetically modified organisms are contrary to nature"): a large part of anti-GMO answers for the other questions agrees with this proposition, which mainly deals with values (Tab. 7).

Tab. 7. Answers to the 3 questions related to the feelings of animals

	Anti-GMO	Rather anti-	Rather pro-	Pro-GMO
A49	15.8%	20.6%	30.2%	33.4%
A47	19.0%	25.7%	36.0%	19.3%
A13	43.7%	28.9%	19.9%	7.4%
Inverse of A12	14.1%	24.4%	26.4%	35.0%
Inverse of A39	13.8%	22.8%	31.5%	31.8%

Globally, about two thirds of Polish teachers are in favour of GMOs, thinking that they "will help to reduce famine in the world" (A12), that they are "good for the environment because their cultivation will reduce the use of chemical pesticides (e.g. insecticides, herbicides)" (A39), and disagreeing that "Genetically modified plants are harmful to the environment because they will contaminate other crop plants, menacing their survival" (A47). These 3 questions were dealing with an interaction between knowledge, values and the social use of GMO, showing the importance of this last aspect for the Polish teachers.

An interesting point emerges from the answers to the question A49 ("If a person eats genetically modified plants, his/her genes can be modified"). That was a question of only scientific knowledge : it is known that it is not true, even if the consequence of using GMO as human food is still today very debated. Nevertheless, the answers to this question are closely correlated with the answers to the 3 precedent questions, showing that the "knowledge" of teachers is mainly induced by their pro- or anti-GMO attitude.

The two first components are orthogonal (axes 1 and 2 in Fig. 1a), showing an independence between these two sets of conceptions. Being pro- or anti-GMO, the teachers think that animals as snails, flies and frogs can or cannot feel happiness. Thinking that these animals can (or cannot) feel happiness, the teachers can be pro- or anti-GMO.

The third component structuring the Polish teachers' conceptions is the vertical axis of Fig. 1b, opposing answers for the preservation of environment to the answers for its utilization. When only these questions are analysed (Wiseman & Bogner 2003, Munoz et al. 2009), there is an independence between the pole preservation and the pole utilization. Here, these two poles are in opposition, teachers who agree more with preservation disagree more with utilization and reciprocally, nevertheless with a little less coherence in their answers than for the first two components of their conceptions (Fig. 1b).

Nevertheless, there is a great sensitivity among Polish teachers to preserve the environment: 84.6% of them totally disagree with the proposition "We need to clear forests to increase agricultural areas" (Question A23), and 75.9% with the proposition "Only plants and animals of economical importance need to be protected" (Question A54). The same teachers admit to "enjoying trips to the countryside" (89.1% of I agree for the question A22) and most of them are concerned with construction sites effecting the countryside (45.7% agree and 33.1% rather agree with the proposition "It makes me sad to see the countryside taken over by building sites" (Question A28)), to give only some examples of answers. This relative homogeneity of Polish teachers' conceptions for the preservation of the environment explains that this topic is only the third component explaining the difference among their conceptions of the environment, the main differences coming from the two first components (animals feel or do not feel happiness, and pro- or anti-GMO).

3-2. Between analyses to differentiate groups of Polish teachers

When grouped by their gender, their age or their level of qualification, there are no significant differences between teachers

Nevertheless, there is a significant difference ($p<0.001$ Figure 2d) when we compare the six samples described in Table 1 (Fig. 2). This difference is linked to the questions dealing with GMO, contrasting the biology teachers (PreB and InB) with the other teachers (Fig. 2c and 2f). The biology teachers agree more than their colleagues with the proposition A39 ("Genetically modified plants are good for the environment because their cultivation will reduce the use of chemical pesticides (e.g. insecticides, herbicides))", and with the proposition A12 ("Genetically modified plants will help to reduce famine in the world"). They disagree more than their colleagues with the propositions A13 ("Genetically modified organisms are contrary to nature") and A49 ("If a person eats genetically modified plants, his/her genes can be modified"). That means that they are more in favour of GMO than their colleagues, knowing better than they do that our genes are not modified when eating GMO (A49). Further, their opinions differ more when it comes to values (A13: for them GMOs are less contrary to nature) and to interaction between knowledge and values for the controversial questions A39 and A12.

3-3. Between analyses to differentiate Polish teachers from teachers of other European countries.

The figures 3 shows that the teachers' conceptions of environment differ from country to country, the main differences being along the horizontal axis, with the opposition between Lithuania, and also Poland and Finland, to the other European countries (Romania and Cyprus being in the middle). The questions which support this opposition are, in order of importance: mostly A17 and A28, then also A54, A18 and A32. Teachers from Lithuania, and to some extent from Poland and Finland, think more than their colleagues from other countries that "Society will continue to solve even the biggest environmental problems" (A17); and think less than the others that "It makes (them) sad to see the countryside taken over by building sites" (A28). These conceptions correlate with other, more anthropocentric conceptions, agreeing with "Only plants and animals of economical importance need to be protected" (A54), "Human beings are more important than other living beings" (A18) and "Humans have the right to change nature as they see fit" (A32).

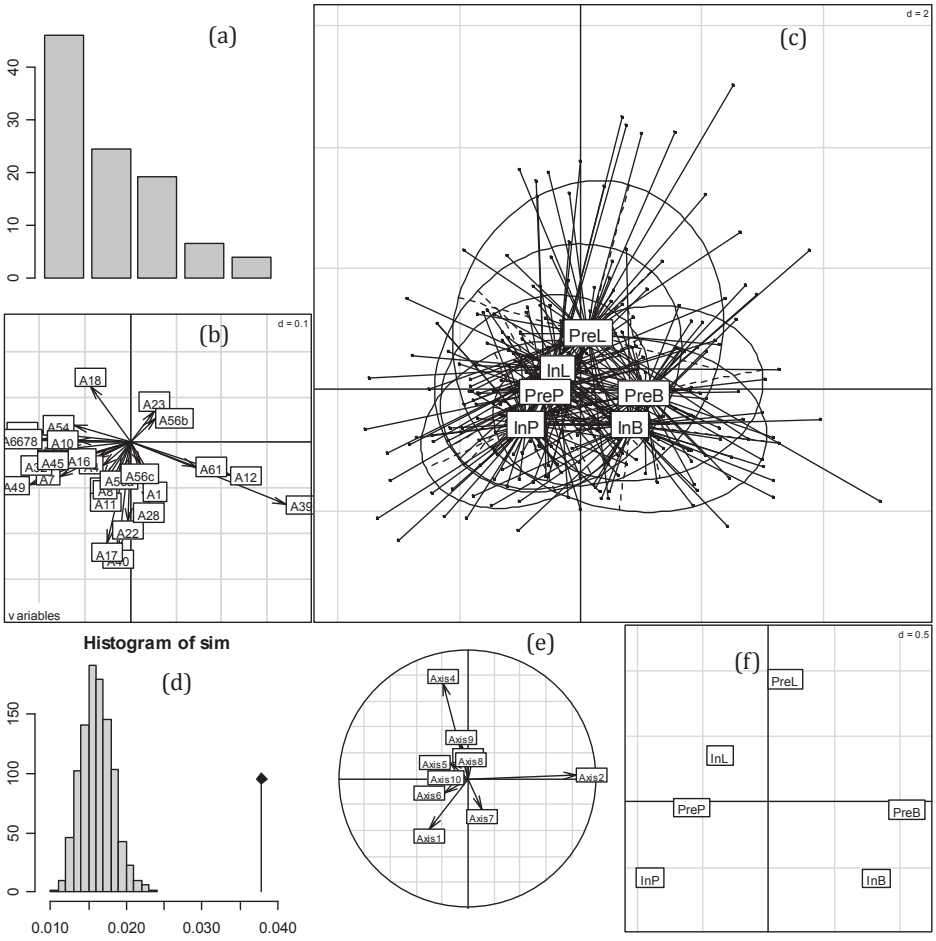

Fig. 2. Between analysis differentiating the six samples of teachers
(a) Part of variance explained by the different components. The first one is the most important.
(b) Circle of correlation showing that the questions which differentiate the 6 samples are related to GMO, mainly to the question A39.
(c) Each point corresponds to one teacher's answers, joined to the centre of gravity of its group (the 6 samples described in Tab. 1). Each ellipse encompasses 2/3 of each sample.
(d) The randomization test (Monte Carlo) shows that the observed difference is outside the histogram coming from 1000 essays by random: the difference between the 6 samples is significant ($p<0.001$).
(e) Correspondence between the axes of the initial PCA (Fig. 1) and the axes of this between analysis: its horizontal axis corresponds to the axis 2 of the PCA, dealing with GMO.
(f) Enlargement of the graph (c), with only the centres of gravity of the 6 samples.

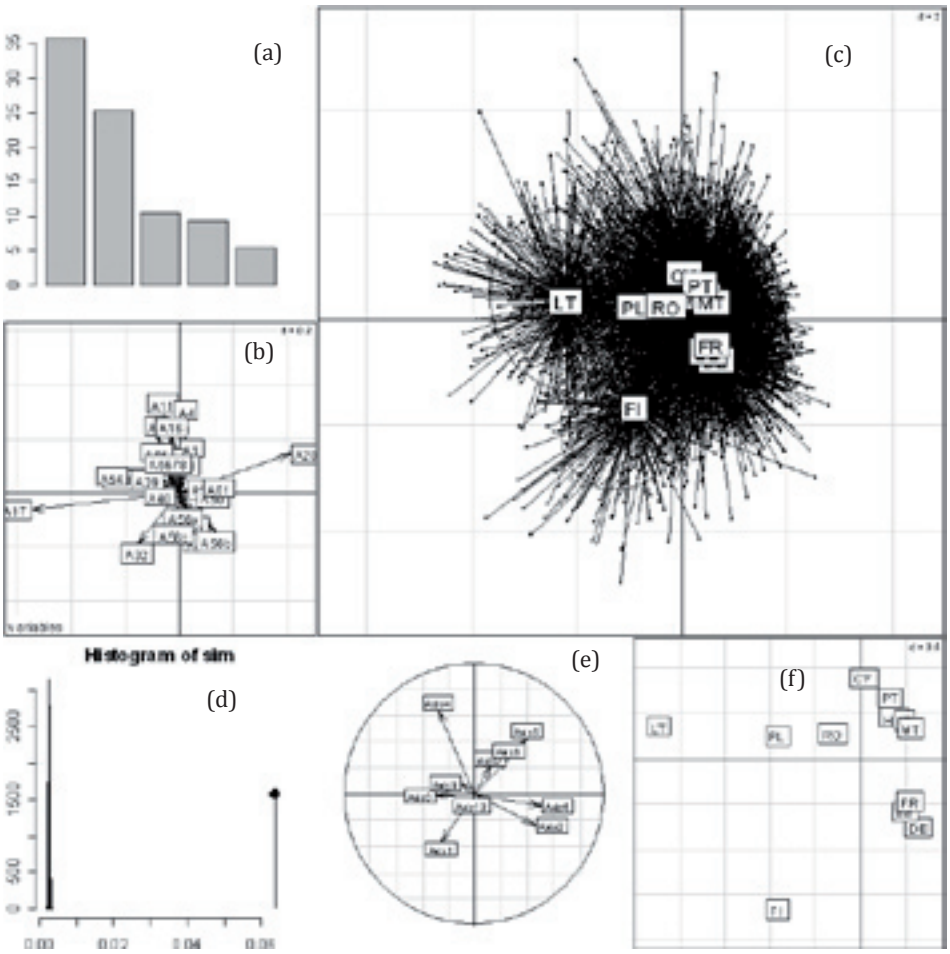

Fig. 3. Between analysis differentiating the Polish teachers from teachers from other European countries: (from left to right of the horizontal axis) LT = Lithuania, FI = Finland, RO = Romania, CY = Cyprus, PT = Portugal, HU = Hungary, IT (hidden by MT) = Italy, MT = Malta, EE (hidden by FR) = Estonia, FR = France, DE = Germany

(a) Part of variance explained by the different components. (b) Circle of correlation showing the questions which differentiate the 13 countries. (c) Each point corresponds to one teacher's answers, joined to the centre of gravity of its country. Each ellipse encompasses 2/3 of each country. (d) The randomization test (Monte Carlo) shows that the observed difference is outside the histogram coming from 1000 essays by random ($p<0.001$).

(e) Correspondence between the axes of the initial PCA from these countries and the axes of this between analysis (f) Enlargement of the graph (c), with only the centres of gravity of the 13 countries.

Tab. 8 shows the differences between 4 of the 12 countries for the question A17. At the one pole (more ecolocentric and for preservation) there is Germany, France being very near. At the other pole (anthropocentric, more for utilization) there is Lithuania and, in the middle, Poland. In Lithuania and in Poland, teachers are more optimistic than most of their colleagues from other European countries, believing more that our society will be able to solve the biggest environmental problems. We hope they will be right, and that our research on teachers' conceptions related to the environment will help to improve scientific education to take decisions in this direction.

Tab. 8. Answers to the questions A17 in Poland and in France

Question A17	I agree	Rather agree	Rather don't agree	I don't agree
Lithuania (n = 316)	83.9%	13.0%	1.6%	1.6%
Poland (n = 322)	**31.8%**	**33.1%**	**23.2%**	**11.9%**
France (n = 732)	6.4%	18.9%	40.3%	34.4%
Germany (n = 365)	1.9%	6.8%	40.3%	51.0%

A17 : "Society will continue to solve even the biggest environmental problems"

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References

Caravita S., Valente A., Luzi D., Pace P., Khalil I., Berthou G., Valanides N., Kozan-Naumescu A., Clément P. (2008). Construction and validation of textbook analysis grids for ecology and environmental education. *Science Education International*, 19, 2, 97–116.

Carvalho G.S., Clément P., Bogner F. & Caravita S. (2008). Biology, health and environmental education for better citizenship: CITC-CT-2004-506015. Final Report E.C Brussels, 103 pp + 30 pp Annex.

Clément P., Munoz F. & Castéra J. (2007). Environment and GMO (Genetically Modified Organisms): Conceptions of teachers from 16 countries. *Environmental Psychology Conference 2007*, University of Bayreuth (Germany).

Clément P. (2004a). Science et idéologie : exemples en didactique et épistémologie de la biologie. Actes du Colloque *Sciences, médias et société*. ENS-LSH, (pp. 53–69) http://sciences-medias.ens-lsh.fr

Clément P. (2004b). Construction des umwelts et philosophies de la nature. *Soc. Linéenne Lyon* (co-éd. Univ. Catholique Lyon : Fac. Sc. & Fac. Philo : J.M. Exbrayat & P. Moreau, *L'homme méditerranéen et son environnement*) (pp. 93–106).

Clément P. (2006). Didactic transposition and the KVP model : conceptions as interactions between scientific knowledge, values and social practices. *Proceedings of ESERA Summer School 2006*, IEC, Braga (Portugal), (pp. 9–18).

Clément P., Carvalho G. (2007). Biology, Health and Environmental Education for better Citizenship: teachers' conceptions and textbook analysis in 19 countries. *WCCES XIII (World Council of Comparative Education Societies*, Sarajevo, CD-Rom, 15 pp.

Clément P., Hovart S. (2000). Environmental Education: analysis of the didactic transposition and of the conceptions of teachers. In: H. Bayerhuber & J.Mayer (Eds.), *State of the Art of Empirical Research on Environmental Education* (pp.77–90). Münster: Waxmann Verlag.

Dolédec S. & Chessel, D. (1994). Co-inertia analysis: an alternative method for studying species–environment relationships. *Freshwater Biology*, 31, 277–294.

Dray S., Chessel D. & Thioulouse J. (2003). Co-inertia analysis and the linking of ecological tables. *Ecology*, 84, 3078–3089.

Forissier, T. (2003). *Les valeurs implicites dans l'Éducation à l'Environnement. Analyse de la formation de SVT (Sciences de la Vie et de la Terre) et des conceptions de futurs enseignants français, allemands et portugais*. Unpublished doctorate dissertation, Université Claude Bernard Lyon 1, France.

Forissier T. & Clément P. (2003). Les systèmes de valeurs d'enseignants du secondaire sur la nature et sur l'environnement. Une analyse comparative en France, Allemagne et Portugal. In: A. Giordan, J.L. Martinand and Raichwarg, D (Eds.) *Proceedings of XXV Journées Internationales d'Education Scientifique* (pp. 393–398), Paris: Université Paris Sud Press.

Giolitto P. & Clary M. (1994). *Éduquer à l'environnement*. Paris: Hachette Éducation.

Giordan A. & Souchon C. (1991). *Une Education pour l'Environnement*. Nice: Z'éditions.

Khalil I., Clément P. & Laurent C. (2007). Anthropocentrées, écolocentrées ou sentimentocentrées : Les conceptions d'enseignants et futurs enseignants libanais sur la nature et l'environnement. *Feuilles Libanaises (Ligue des Professeurs de l'Université Libanaise),* 29, 67–92.

Khammar F., Clément P., Laurent C. & Remki L. (2008). Les conceptions d'enseignants algériens sur la nature et l'éducation à l'environnement. In: I. Khalil, *Enjeux dans la rénovation de l'éducation à l'environnement et à la biologie*, Alexandrie : presses Université Senghor, sous presse, 10 pp.

Khzami S., Agorram A., Selmaoui S., Elabboudi T. & Clément P. (2008). Les systèmes de valeurs d'enseignants et de futurs enseignants marocains des sciences de la vie et d'arabe sur l'environnement. In: I. Khalil, *Enjeux dans la rénovation de l'éducation à l'environnement et à la biologie,* Alexandrie: presses Université Senghor, sous presse, 10 pp.

Larrère C. (1997). *Les philosophies de l'environnement*. Paris: P.U.F.

Lebreton, J. D., Sabatier, R., Banco, G. & Bacou, A. M. (1991). Principal component and correspondence analyses with respect to instrumental variables: an overview of their role in studies of structure-activity and species- environment relationships. In: Devillers, J. and Karcher, W. (Eds.), *Applied Multivariate Analysis in SAR and Environmental Studies* (pp. 85–114). Kluwer Academic Publishers.

Munoz F., BognerF., Clément P., and Carvalho G.S. (2009). Teachers' conceptions of nature and environment in 16 countries. *Journal of Environmental Psychology,* 29: 407–413.

Quillot R. (2000). Crise et retour de l'idée de la nature. In R. Quillot, *La Nature*. (pp. 3–38), Paris: Ellipses, coll. Philo.

Sauvé L. (1991). La clarification des valeurs. *L'Enjeu, la revue de l'éducation relative à l'environnement,* 11 (3).

Schultz P.W., & Zelezny L. (1999). Values as predictors of environmental attitudes: evidence for consistency across 14 countries. *Journal of Environmental Psychology*, 19, 255–265.

Wiseman M. & Bogner F.X. (2003). A higher-order model of ecological values and its relationship to personality. *Personality and Individual Differences, 34*, 783–794.

Polish teachers' conceptions related to the environment

Abstract

We analyse conceptions of 322 Polish teachers, related to the environment. These differ mainly in the way some teachers think that animals such as snails, flies or frogs can or cannot feel happiness and, independently, in their pro- or anti-GMO approach. The six samples (primary school teachers, secondary school teachers of biology or of Polish, with pre-service and in-service teachers) show different conceptions, the biology teachers being more pro-GMO. Most of the Polish conceptions are for the preservation of the environment, but, when compared to 12 other countries (the same teachers' samples), they are more anthropocentric than most of the observed conceptions in 12 other European countries (except for Lithuania and Finland).

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