Taking sides about an environmental issue: What do preschoolers claim for tree logging and on what grounds?

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ABSTRACT

This paper reports on two case studies concerning young children's reasoning about human actions on nature. In each study, children are presented with a different plausible scenario of tree logging, before and after a teaching intervention. The latter has to do with trees as animal-habitats and is set in the broader context of Education for Sustainable Development. We are discussing the possible impact of the teaching intervention as well as that of the probing scenarios, on children's attitudes for tree logging and on the ways they justify them.

KEYWORDS

Education for sustainable development, preschool children's environmental reasoning, attitudes about environmental issues

RÉSUMÉ

Cet article rend compte de deux études de cas concernant le raisonnement des jeunes enfants sur l'activité humaine sur la nature. Dans chaque étude, un different scénario plausible de l'exploitation forestière a été présenté aux enfants, avant et après l'enseignement. Le deuxième scénario a à voir avec les arbres comme habitats des animaux et se situe dans le cadre de l'Éducation pour le Développement Durable. Nous discutons de l'impact possible de l'enseignement et des scénarios sur les attitudes des enfants à l'égard de l'exploitation forestière et sur la façon dont ils les justifient.

MOTS-CLÉS

Éducation pour le développement durable, raisonnement sur l'environnement par des enfants d'âge préscolaire, attitudes à l'égard des questions environnementales

INTRODUCTION

Education for Sustainable Development in Early Childhood

The concept of *Sustainable Development* (in short, SD) was first introduced in the '80s (Brundtland, 1987). In fact, SD refers to the integration of economical/political, social and ecological aspects in a developmental process which is underlied by new ethics where equity and human rights are of key importance. In the '90s, the *World Conservation Union* (IUCN) offered the well-known definition of SD as a development that improves the quality of human life within the carrying capacity of the supporting ecosystems.

In 2002, the *United Nations General Assembly* (UNGA) proposed the *Decade of Education for Sustainable Development* (DESD) for 2005-2014 and developed a draft *International Implementation Scheme* (IIS) for this decade (UNESCO, 2003, 2005). It was explained that *Education for Sustainable Development* (in short, EfSD) attempts to represent "the ideal and principles of sustainable development" and focus on the problems of its three key areas: society, environment and economy, with culture being an underlying dimension. EfSD aims at providing every person with the knowledge, skills, attitudes and values that are necessary for a sustainable future for them, society and environment.

Children at preschool age develop basic values, attitudes, skills, behaviors and habits that may last for a very long time. Many stereotypes concerning race, wealth, poverty and inequity are acquired very early in life (Siraj-Blatchford, 2008). In fact, preschool education has an enormous potential in supporting children to foster values and behaviors in support of SD. Nevertheless, as it became clear in an international congress by UNESCO, held in Göteborg-Sweden in 2007, there is a significant delay of integration of EfSD in preschool education worldwide. Suggestions about having EfSD started very early in life (Pramling & Kaga, 2008), were followed by educational guidelines like the ones summarized next:

1. The notion of the child in the context of SD is the one presented in the United Nations Convention on children's rights: children are active members of the society and their views should be heard and taken into account for shaping both the didactic content and the didactic approaches.
2. Nurturing respect for and appreciation of diversity through intercultural education is essential in SD in the modern, globalizing world.
3. EfSD is broader than *Environmental Education* (in short, EE). Thus, apart from taking children out in the nature to explore and admire its beauty and learn about its complexity, we have to set focus on providing them with opportunities to get involved not just in specific actions in favor of the environment but also in an intellectual dialogue about sustainability that takes society and economy into account as well.
4. EfSD aims at helping individuals becoming able to think critically about unsustainable actions or habits and to find creative solutions. Young children should be encouraged through guided discussions to start wondering about everyday practices that have impact on their local environment.

Early childhood EfSD is gradually gaining the attention it seems to deserve. Developing curricula and performing relevant research attracts the researchers' interest more and more. In many European countries, national curricula for EE were modified by taking into account EfSD principles. Scandinavian countries, U.K., Germany and recently Greece have included EfSD principles in their national curricula for early childhood. In addition, the forest-schools' movement that started from Scandinavia is now expanding in many countries of northern Europe, promoting participatory and activist approaches to nature experiences and environmental issues. Similarly, early childhood EfSD movements are present in Asiatic countries like South Korea and China. Davis (2009) refers to the "Eco-Early Childhood Education" movement in Korea and to the "Green Preschool Award" in Hong Kong's "Green School Award" Program. At the same time, in Australia and New Zealand, early childhood educators have created a community for EfSD (Davis, 2009). Moreover, the logic that underlies EfSD allows countries with different cultures (e.g. Chile, Nigeria, Kenya) to focus on alternative major themes that have special interest for them (e.g. peace, democratic rights and cultural issues) (Simonstein Fuentes, 2008; Abimbola, 2008; Otieno, 2008).

Research on Education for Sustainable Development and Environmental Education in Early Childhood

In a 2009 review paper, Davis claimed there are not many research studies concerning EE and EfSD for preschoolers. Her claim was grounded on a survey of international and Australian research journals for the years 1996-2007. She found that most of the studies published in them concern education *in* the environment, while fewer have to do with education *about* the environment. Davis pointed out that, although these are quite important, only a small number of research studies appeared to focus on young children's potential to act about sustainability, that is, on education *for* the environment.

However, environmental education journals are not the only ones that publish research studies about students & environment. And similarly, early childhood education journals are not the only ones that publish research studies concerning preschool age. In fact, many studies concerning children's reasoning about the natural environment have been performed in the domain of science education research. It seems that the ways children grasp scientific concepts related to the environment may inform environmental education programs and influence children's attitudes and actions towards the environment (Leach et al., 1995, 1996a, 1996b; Batterham, Stanisstreet & Boyes, 1996; Christidou & Koulaidis, 1996; Bonnet & Williams, 1998; Littledyke, 2004; Ergazaki & Andriotou, 2010). A common thread within this body of research is the assumption that constructing *knowledge* about the environment may be a key element for developing environment-friendly attitudes and behaviors (Kaiser & Fuhrer, 2003).

Palmer, Suggate & Matthews (1996) have reported their findings about 4-6 year-old children's emerging ecological knowledge about e.g. tropical rain forests and the associated issues of deforestation and biodiversity loss, as well as about polar lands and the associated issues of global warming and climate change. They have found that children of this age *do* recognize interactions that take place in ecosystems, as well consequences of human interventions upon them.

Palmer & Suggate (2004) have also reported their findings from a longitudinal study in UK with 4-10 year-old children. They argued that children are capable of creating simple accurate statements about the effect of major environmental changes on living things and their habitats even at the age of 4. Older students are capable of explaining the complexity of some of the relationships that exist between living organisms and their habitats, in association with significant changes in the global environment.

Young learners' understanding of basic ecological concepts has also been studied in the context of Biology Education research (Bailey & Watson, 1998; Katsiavou, Liopeta & Zogza, 2000; Leach et al., 1996a, 1996b). Such research studies concern children's understanding of the dynamic relationships of organisms with others and with their abiotic environment, as well as children's ideas about the impact of human interventions upon nature. Ergazaki, Zogza & Grekou (2009) studied young children's ideas about the biological process of decomposition, as well as about everyday waste management; they have used these ideas for shaping the objectives of a learning environment in the theoretical context of constructivism for promoting a better understanding of the topic in question and get children engaged in environmentally responsible everyday practices.

Hicks & Holden (2007) discussed children's concerns about the future of environment by drawing upon the studies of Page (2000) and Elm (2006) and they suggested that very young children (age 4-6) show a developing awareness of the negative effects of phenomena like deforestation, global warming or pollution. Ergazaki & Andriotou (2010) have explored preschoolers' views about human interventions within a forest ecosystem, as well as whether preschoolers are able to provide ecological interpretations of such

interventions. According to their findings, young children disapprove actions like forest fires and tree loggings and they justify their view by appealing to a rich set of criteria that have to do either with humans or with the animals or plants of the ecosystem.

Finally, Davis (2009) emphasized the need for research that explores the conditions under which young children may be able to act as agents for sustainability. Moreover, Davis et al. (2005) reported promising results from a study concerning the Sustainable Planet Project at Campus Kindergarten. According to these, 4-year olds initiated themselves investigations and *actions* in their daycare center and their local community about water use and waste management.

Although the line of research summarized above is underlied by the assumption that constructing environmental *knowledge* may be crucial for developing environment-friendly attitudes and behaviors, this does not seem to be the whole story. The psychological literature suggests that a person's attitudes towards environment may be based on different sources of information that come from the cognitive, affective and behavioral domains (Eiss & Harbeck, 1969; Iozzi, 1989a). Therefore, it has been suggested that in order to help children develop environmentally conscious behavior, we need to address values and attitudes through the affective domain as well (Iozzi, 1989b). Attitudes have been described as a "psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor" (Eagly & Chaiken, 1993, p. 1).

Pooley & O'Connor (2000) investigated the cognitive and affective basis of environmental attitudes. Their findings suggest that attitudes toward specific environmental issues like e.g. vehicle emissions, urban development or logging of native forests, may be predicted by both beliefs and emotions, namely by both cognitive and affective domains. The contribution of affect and cognition on shaping someone's attitude may be influenced by the kind of experience they have regarding the issue under question. It is proposed that attitudes formed through direct experiences may be mostly based on affect, whereas attitudes formed through indirect experiences may be mostly based on cognition (Millar & Millar, 1996; Pooley & O'Connor, 2000).

The importance that such findings may have for EE and EfSD is apparent. It seems that both cognitive and affective domains should be addressed when EE / EfSD programs are designed. It is important to have a clear conceptual framework concerning the attitude in question, as well as to provide learners with situations where the affective domain is also a strong source of information for shaping environment-friendly attitudes and changing everyday behavior (Pooley & O'Connor, 2000).

Educating preschoolers for Sustainable Development means that we try to support them in developing (a) knowledge about, (b) attitudes in favor of, and (c) skills to act for the environment. Attitudes and behaviors towards nature seem to be less studied than the conceptual understanding of it. The importance of obtaining research evidence on the attitudes - as well as on the actual behaviors - towards environment as a result of EfSD programs is apparent. We need to have data in order to evaluate these programs and re-design more effective versions of theirs.

Objectives & Research questions of the study

In this paper we attempt to explore preschoolers' attitudes regarding tree logging, as well as the justifications they provide for supporting them. These attitudes have been traced with two different probing scenarios that were used before and after children's participation in a learning environment. The latter - being set in the broader context of EfSD - addresses knowledge about trees as ecosystems, emotions through direct experiences with nature, as

well as discussions concerning the evaluation of human actions upon nature and decision-making about proper ways to protect it. Thus, our research questions are the following:

1. What are the attitudes of young children towards tree logging in the context of two different plausible scenarios and what kind of criteria they use for justifying them?
2. What is the possible impact of the different scenarios as well as of our learning environment about trees as animal-habitats, on children's attitudes for tree logging and the ways they justify them?

METHODOLOGICAL FRAMEWORK

The overview of the study

This paper attempts to outline young children's reasoning about human actions on nature by reporting on two exploratory case studies. More specifically, it presents and compares their findings with regard to what preschoolers think about tree logging in two different scenarios, before and after a learning environment that sets focus on trees as animal-habitats.

The informants of the two studies were 22 and 21 children, respectively. These 4-5 year-old children were attending two public kindergartens situated in urban areas of Patras and having trees in their yards. The schools were selected because their teachers volunteered to facilitate our research. Both studies took place during early spring, which means that children were already familiar with educational interactions. Moreover, they had all covered a series of relevant concepts such as plants, animals or seasons and they seemed to have a similar profile according to their teachers.

Children's reasoning was traced through pre- and post- individual semi-structured interviews about certain events (Osborne & Gilbert, 1980), which lasted approximately 10-15 minutes. These - as well as the implementation of the learning environment - were conducted by two preschool-teachers under the guidelines of the researchers and were tape-recorded. The interviewers were attending the two kindergartens in the context of their research apprenticeship. Moreover, they had already got familiar with the informants and gained their own assent for taking part. Parents' informed consent was also asked.

The learning environment

Trees are quite easy to observe in urban areas. They can be found in school yards and city parks. The latter are easy to visit, unlike the forests which are usually located in distance from the Greek cities. Trees support an amazing variety of organisms. Moreover, they are quite important for humans, since they are cultivated for aesthetics, shade, shelter, timber, fruits and even medicines.

Our learning environment aimed at presenting trees as ecosystems, giving emphasis to the food relationships between the organisms that live on and around them. Thus, it covered essential concepts like food chain and food preference-based animal categories. Furthermore, being set in the broader context of Education for Sustainable Development, the learning environment was also concerned with the direct and indirect impact of human actions on trees and the related organisms.

More specifically, we used 10 educational activities, 7 of which had to do with constructing ecological knowledge while 3 had to do with developing environment-friendly attitudes. These activities were covered in a week.

1. Children were provided with a big poster of a tree and were asked to draw on it *"what does a tree need in order to grow"* (introductory activity, 20 minutes).

2. Children were told a story based on the animated story *"Who else is living here"*, which was created for preschoolers by the Environmental Education Center of Kastoria (http://kpe-kastor.kas.sch.gr/educational_material/edu_mystika.htm). The aim of this activity was to help children understand that a tree provides home and food for certain animals (e.g. squirrels and insects). The tree-animals presented in the story were grouped according to their food preferences and the on-or-around-tree-spot they lived. This was done on a big paper-sheet as a result of discussion between the teacher/researcher and the children (30 minutes).

3. Children were required to explore their school-yard in order to find what animals live on-or-around their school-tree. When coming back in the classroom, the tree-animals were grouped according to their food preferences and the spot they live on another big paper-sheet as a result of discussion between the teacher/researcher and the children (30 minutes).

4. Children were asked to compare the "story-tree" and the "school-tree" by drawing upon the two previous paper-sheets (15 minutes).

5. Children were asked to draw a tree on a paper-sheet and show clearly the on-or-around-tree spots that little animals may live and the kind of food they may get. After this, they were asked to present their tree to the whole class, whereas the teacher was recording their utterances on a big tree drawn on the board. Finally, all views were shared on a whole-class discussion (45 minutes).

6. Children were presented with animal photos and they were asked to combine them in order to create animal categories according (a) to food preferences (herbivores, carnivores, omnivores), and (b) to who-eats-whom relationships. These were recorded on a big paper-sheet (40 minutes).

7. Children were required to play a floor-game with animal categories in a simple food chain, in order to reinforce the previous learning experience (30 minutes).

8. Children took part in an interactive puppet-show that presented either forest-friendly or unfriendly human actions and were required to evaluate each of them (20 minutes).

9. Children were engaged in a role play for realizing the possible impact of environment-unfriendly human actions (e.g. littering in the forest, opening a road through it or constructing a building). Children were required to evaluate these actions in terms of their consequences for the living organisms of the forest, as well as to think how they could act themselves in order to prevent those (30 minutes).

10. Children played twice the web-of-life game that had to do with food and habitat relationships in an ecosystem. This activity aimed at promoting a respectful attitude to all the components of an ecosystem by showing their strong interdependence and the fact that the consequences of human actions against one of them can spread within the whole ecosystem (40 minutes).

The interview protocol

The interview protocol of the two studies was organized in a similar way. Children were first presented with a different, plausible scenario that had to do with a human action on nature. Then, they were asked about whether they agreed or not with the specific action and why. The probing scenarios are presented below.

1ˢᵗ case study probing scenario (city-park scenario)

"This morning, on my way to school, I heard some people talking about a loud noise that was coming from the nearby park earlier. They said that the noise was so loud that they had to run to the park to see what was happening. When they got there, they saw three men cutting some

trees with their saws. They asked them why they were doing this and the men said that they were ordered to do so, because these trees were too big". How do you feel about this action? Do you think that cutting these trees was right or wrong? Why do you think so?

2ⁿᵈ case study probing scenario (forest scenario)
"I know a family that their dream was to have a big house in the forest, just in the middle of the trees. Since the trees were close to each other and there was not enough area to build the big house they were dreaming of, they decided to cut some trees. On the other hand, they could have built a smaller house in order to use a smaller area and leave the trees as they were". How do you feel about this action? Do you think that cutting these trees was right or wrong? Why do you think so?

The overview of the analytic procedure
The tape-recorded interviews were transcribed and analyzed with regard to (a) children's claims about the actions in question, and (b) children's justifications for their claims. The latter were categorized on the basis of the coding scheme developed by Ergazaki & Andriotou (2010). Thus, the criteria children used for grounding their disagreement or agreement with tree logging were categorized as (a) *flora-centric* (the focus was set on the directly-affected trees), (b) *anthropo-centric* (the focus was set on human beings), and (c) *fauna-centric* (the focus was set on the non-directly affected tree-animals). Following the scheme of Ergazaki & Andriotou (2010), we coded for a series of sub-categories of criteria within each of the three main categories.

Thus, the *flora-centric* criteria were *biological-ethical, anthropomorphic* or *naturalistic*. More specifically:
- Criteria that emphasized the property of trees as living entities and the respect they deserve from us due to this property, were coded as *biological-ethical*: tree logging is wrong, because *"trees can grow like us, have roots… for this we must let them grow"*.
- Criteria that considered trees as having human characteristics or even reactions were coded as *anthropomorphic*: tree logging is wrong, because *"trees will cry afterwards"*.
- Criteria that considered trees as part of nature's order and harmony which needs to be preserved were coded as *naturalistic*: tree logging is wrong, because *"plants must always be there"*, *"it will destroy the environment"*.

Similarly, the *anthropocentric* criteria were *utilitarian, aesthetic, personal-sentimental* and *human risk-based*. More specifically:
- *Utilitarian* criteria had to do with the idea that trees are useful to human beings by providing essential products: tree logging is wrong because *"trees give us fruits and oxygen to breath"*. On the other hand, when applied for *supporting* the action of tree logging, the criteria of this type focused on tree logging as an essential requirement for something that would be nice to people: tree logging is right because *"children will have more space to play around the house"*.
- *Aesthetic* criteria concerned the destruction of natural beauty: tree logging is wrong, because *"the forest will not be nice"*.

- *Personal-sentimental* criteria were associated with personal emotions and empathy for the natural environment that suffered from the human action in question: tree logging is wrong, because *"it makes me sad…those trees were trying to make apples"*.
- *Human risk-based* criteria focused upon the threat that tree logging poses on human health and life: tree logging is wrong, because *"people will not have air to breathe"*, *"they pollute the city with their saws…they pollute the air"*.

Finally, the *fauna-centric* criteria referred to the *destruction of (a) food relationships*, and (b) *habitat*. More specifically:

- *Destruction of food relationships* criteria had to do with the deriving shortage of food resources for the animals: tree logging is wrong because *"there will be no fruits and nuts for the animals to eat"*.
- *Habitat destruction* criteria drew upon the idea of *tree-as-a-home-for-animals*: tree logging is wrong, because *"the birds will lose their nests"*.

RESULTS

1st case study (probe: city-park scenario)

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In the pre-interviews, all 22 children expressed the attitude that tree logging in a city-park is wrong, while 19/22 (86.4%) were able to justify their attitude by invoking certain criteria in favor of it. In the post-interviews, everyone was able to provide a justified attitude (Table 1). The set of criteria invoked by our informants was rich. Moreover, there was a worth noticing shift of focus between the pre- and post-interviews.

More specifically, before the teaching intervention, the most frequent criteria for rejecting tree logging were anthropo-centric and flora-centric: each type was invoked by 36.4% of the children. The most frequent anthropo-centric criteria were the utilitarian, which set focus on what people can get from trees. On the contrary, the most frequent flora-centric criteria were the biological-ethical which focus on the living nature of trees and the human respect this nature calls for. Appealing to this as well as to the preservation of the natural order and harmony (naturalistic criteria), may be considered as a sign of environmental sensitivity on behalf of the children. Nevertheless, the fauna-centric criteria, that seem to imply ecological reasoning more clearly, were used only by 13.6% of the children at the outset of the study.

On the contrary, after the teaching intervention, the fauna-centric criteria became dominant. 77.3% of the informants seemed to recognize the destruction of food relationships as well as the destruction of habitat as good reasons for not supporting the action of tree logging in the city-park scenario. Moreover, children seemed to change their minds about whether reasons that have to do with humans are the best for such an attitude. In fact, the frequency of the anthropo-centric criteria was reduced by half. This, combined with the increase of the frequency of the fauna-centric criteria, implies the effectiveness of the teaching intervention in promoting ecological reasoning. On the other hand, the significant decrease of the frequency of the flora-centric criteria may be attributed to the emphasis of the teaching intervention on trees as animal-habitats and not as living organisms themselves.

TABLE 1

Types of criteria against tree logging in the city-park scenario

Types of criteria *against* tree logging in the city-park		Pre-interviews		Post-interviews	
Anthropo-centric	Utilitarian	6/22	**36.4%**	4/22	**18.2%**
	Aesthetic	1/22		-	
	Human Risk - based	1/22		-	
	Personal-sentimental	-		-	
Flora-centric	Biological - Ethical	4/22	**36.4%**	-	**4.5%**
	Anthropomorphic	2/22		1/22	
	Naturalistic	2/22		-	
Fauna-centric	Destruction of food relationships	2/22	**13.6%**	9/22	**77.3%**
	Habitat destruction	1/22		8/22	
None	No Justification	3/22 **13.6%**		-	

2nd case study (probe: forest scenario)

2nd case study (probe: forest scenario)

When asked to reason about tree logging in the context of the construction of a family house in the middle of the woods, preschoolers were not so keen on considering it as a bad thing. In fact, in the pre-interviews 66.7% of the children were in favor of tree logging, while only 33.3% were against it (Table 2). This indicates a strong anthropo-centric way of thinking, probably invoked by the probing scenario itself. The idea of having a nice, big house in the forest where play would be absolute fun may be too attractive for leaving enough space for environmental sensitivity. Nevertheless, most of the children appeared to express different views after the teaching intervention: 85.7% claimed that the action of cutting trees is wrong even in this appealing context.

TABLE 2

Children's attitudes about tree logging in the forest scenario

Attitudes	Frequencies	
	Pre-interviews	**Post-interviews**
In favor	14/21 **66.7 %**	3/21 **14.3 %**
Against	7/21 **33.3 %**	18/21 **85.7 %**

Moving to the criteria that guided children through taking sides on the tree logging issue, we note that the dominant criteria for being *in favor* of tree logging were the *anthropo-centric, utilitarian* criteria: these were activated by almost all of the children who were in favor of tree logging in the pre-interviews (13/14) and by all three children who did so in the post-interviews (Table 3). In other words, children focused on tree logging as pre-requisite for something that would be nice to people in order to claim *for* it.

TABLE 3

Types of criteria in favor of tree logging in the forest scenario

Types of criteria *for* tree logging in the forest		Pre-interviews		Post-interviews	
Anthropo-centric	Utilitarian	13/14		3/3	
	Aesthetic	-	**92.9%**	-	**100%**
	Human Risk - based	-		-	
	Personal-sentimental	-			
Flora-centric	Biological - Ethical	-		-	
	Anthropomorphic	-	**0%**	-	**0%**
	Naturalistic	-		-	
Fauna-centric	Destruction of food relationships	-	**0%**	-	**0%**
	Habitat destruction	-		-	
None	No Justification	1/14	**7.1%**	-	**0%**

The *anthropo-centric, utilitarian* criteria were also the most frequent for being against tree-logging, in both pre- and post-interviews: 57.1% and 44.4% of the children respectively, rejected tree logging by appealing to criteria that focus on humans. Nevertheless, it is probably worth noticing that children who apply *utilitarian* criteria *against* tree logging may be considered as "more informed" than those who apply them *in favor* of it. The reason is that the former seem to recognize that trees are actually beneficial to human beings, while the latter are engaged in a rather uninformed and even more selfish reasoning based just on the convenient consequences of having a house in the woods no matter what the pre-requisite is. In the pre-interviews, *flora-centric* criteria and specifically the *naturalistic* ones that consider plants as part of the natural harmony that needs to be preserved were activated by 14.3% of the children who were against cutting the trees (1/7). Finally, 28.6% of the children with a negative attitude were not able to come up with a justification for it (2/7), while no child activated *fauna-centric* criteria of any type (Table 4).

TABLE 4

Types of criteria against tree logging in the forest scenario

Types of criteria *against* tree logging in the forest		Pre-interviews		Post-interviews	
Anthropo-centric	Utilitarian	3/ 7		3/18	
	Aesthetic	1/7	**57.1%**	4/18	**44.4%**
	Human Risk - based	-		-	
	Personal-sentimental	-		1/18	
Flora-centric	Biological - Ethical	-		1/18	
	Anthropomorphic	-	**14.3%**	-	**16.7%**
	Naturalistic	1/7		2/18	
Fauna-centric	Destruction of food relationships	-	**0%**	-	**22.2%**
	Habitat destruction	-		4/18	
None	No Justification	**2/7**	**28.6%**	3/18	**16.7%**

In the post-interviews, although the *anthropo-centric* criteria against tree logging remained dominant as already mentioned, there was an increase of the *flora-centric* criteria and specifically those sub-types that imply biological knowledge (*biological - ethical*) and environmental sensitivity *(naturalistic).* More importantly, the *fauna-centric* criterion that has to do with the *destruction of habitat* did emerge: 22.2% of the children drew on this in order to argue for the preservation of trees (4/18). This change seems to indicate an ecological reasoning, probably built in the teaching intervention. This finding is rather important, although it is not as promising as the one of the first case study where 77.3% of the children drew upon the destruction of food relationships and habitat for rejecting tree logging after the teaching intervention.

DISCUSSION

We have already presented our findings with regard to the 1st research question that has to do with children's reasoning *(attitudes & justifications)* about tree logging in the context of two different scenarios, before as well as after their participation in our learning environment. What follows here is a discussion about our 2nd research question that has to do with the possible impact of (a) the learning environment, and (b) the probing scenarios we used, on children's reasoning.

The impact of our learning environment on children's attitudes & justifications
In the 1st case study, all children were against the action of tree logging from the beginning, but some of them were not able to ground their environment-friendly attitude. After taking part in the learning environment, all children came up with *justified* claims. Moreover, their justifications were based on more ecologically-informed criteria. In fact, there was a spectacular move from the mainly *utilitarian*, *anthropo-centric* criteria to the *fauna-centric* ones. The percentage of children, who recognized the destruction of food relationships or animal-habitat as critical tree logging consequences for making up their minds *after* the teaching intervention, was almost six fold. On the other hand, children that appealed to *flora-centric* criteria for rejecting tree logging were reduced by eight times.

The reduction of the frequency of the *flora-centric* criteria may be attributed to the emphasis of the teaching intervention on trees as *animal*-habitats and not as living organisms *themselves*. This may be considered as a drawback of the teaching intervention which should be tackled in a new version of it. On the contrary, the shift towards the *fauna-centric* criteria was rather promising. This may be attributed to the educational activities 2-5 where the focus was set on the animals that live on and around trees. The story *"Who else is living here?"* introduces the idea of the inter-dependence of animals and tree parts in detail. In addition, the real observations of the trees and the related animals in the school yard, as well as the drawings and discussions guided by them, were probably critical in shaping children's reasoning.

Finally, the opportunities for critical thinking may also have contributed in the increase of the *fauna-centric* criteria in children's warrants. Such opportunities were given to children in educational activities 8-10 and more specifically in (a) the interactive puppet-show that required children to evaluate several human actions within a forest, (b) the role play that engaged children in examining in more detail the possible impact of human actions within a forest and required them to think of possible ways of action for its protection, and (c) web-of-life game about food and habitat relationships as a context for developing a respectful attitude to all the creatures of it.

The teaching intervention seemed to help children advance their reasoning about tree logging in the 2nd case study as well. In the beginning of the study, most of the children were *in favor* of tree logging. Nevertheless, a significant shift was carried out when the teaching intervention was over. More specifically, very few children remained in favor of tree logging, whereas the most *did* change their minds and adopted a negative attitude. In addition, this target-attitude was grounded less on *anthropo-centric*, similarly on *flora-centric* and for the first time on *fauna-centric* criteria. The teaching intervention seemed to help at least *some* of the participants of the 2nd case study to recognize the destruction of the animal-habitat as a key consequence of tree logging for deciding for or against it. The not so high percentage of children that reached this understanding, as well as the fact that *no* child drew upon the destruction of food relationships to reject tree logging, seems to imply that in the 2nd case study the teaching intervention was not as effective as in the 1st with regard to children's justifications.

In summary, although even in the 2nd case study the impact of the teaching intervention was clear, it seems purposeful to reconsider some of its aspects. First, to deal with plants as living organisms that worth to be preserved, in order not discourage children from using *flora-centric* criteria. And second, to provide children with more opportunities to practice the development of argumentative reasoning strands like those required from them in the probing scenarios. One way would be to integrate educational activities of finding or evaluating alternative solutions to environmental issues which are familiar to them and thus have children more engaged in decision-making.

The impact of the probing scenarios on children's attitudes & justifications

According to our findings, in the 1st case study where the probe was the city-park scenario, all children were against tree logging before and after the teaching intervention. On the contrary, in the 2nd case study where the probe was the forest scenario, a high percentage of children were in favor of tree logging before the teaching intervention, whereas a few of them *did* hold their attitude even after it. It seems that the idea of cutting forest trees in order to build a house in the middle of the woods is approved by the children, although the approval drops significantly after the intervention. However, cutting trees from a city-park is considered as unacceptable from the beginning.

This difference may be attributed to the different impact of tree logging on human life. The things that humans are supposed to gain from cutting trees in the forest scenario are more attractive than those they are supposed to loose. Human needs come first and the protection of the forest seems as distant as the forest itself. On the contrary, in the city-park scenario the things to be lost are clearer: the park is nearby and humans won't be able to enjoy it so much if tree logging is carried out. Although this interpretation may be plausible, it should be noted that the participants of the two case studies are not identical: they do have similar profile as pupils, but they are different people as well.

Moving our discussion to the impact of the probing scenario on the criteria children used in their justifications, the absence of anything else except the *anthropo-centric* criteria in the 2nd case study before the intervention is impressive. The dominant use of *utilitarian* criteria probably indicates the strong anthropo-centric way of thinking that this scenario seems to promote.

Coda

Children's attitudes as well as the criteria that may underlie them appeared to be influenced by *both* the context in which they have been probed *and* the learning environment that aimed at modifying them by addressing knowledge, emotions and discussions about human actions

regarding environment. Nevertheless, in order to strengthen this argument, we would probably need to perform a third case study with a larger number of participants who would be asked to reason within *both* the probing scenarios. Moreover, the teaching intervention could be further elaborated. It seems that inducing pro-environmental attitudes may be facilitated by providing children with environmentally problematic situations which are familiar to them and call for inventing alternative solutions that take into account both humans and nature. Being engaged in critical thinking in order to recognize that the welfare of society and environment can be pursued in parallel seems to be a valuable educational goal.

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