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What do Spanish 5-7 year-olds say about some Environmental issues? An Exploratory Study to Detect and Analyse their Ideas

Cruz-Guzmán, Marta[1]; Criado, Ana María[1]
Department of Experimental and Social Sciences Teaching
Faculty of Education Sciences
University of Seville, Spain.

Montilla, Sara[2].
Pío XII Primary School and Kindergarten
Seville, Spain

Abstract

Basic qualitative research is presented in order to value and compare preschool (5-6yearold) and first-year primary level(6-7yearold) children's ideas in a Spanish school about several topics: waste, biodegradability, recycling, water pollution and water saving. To obtain this information, complementary instruments were used, although here the obtained results of the first instrument are reported. The results led to identifying the children's main responses on the topic as well as establishing some differences between the two educational stages. It was possible to establish progressive levels of categories for some of the ideas studied. Some teaching suggestions are made: it is ineffective to focus on what types of materials are deposited in each type of rubbish container when they cannot yet differentiate between the types of materials and their properties. Instead, a simplified approach should be developed perhaps by way of stories. A proposal could be developed on the biodegradability of materials as a visually distinguishable property, with some hands-on activities. We would also suggest providing specific examples as specific types of contamination, such as water pollution, on the living conditions of specific forms of life.

Keywords: environmental education, education for sustainability, children´s ideas, preschool, primary school.

1. Introduction and Background

1.1. Education for Sustainability (EfS) and Environmental Education (EE)

The protection of nature is becoming one of the most important issues of the contemporary world. As many of the fundamental values of tomorrow's society are formed in early childhood, education at this level has a major role to play in achieving sustainable development (Siraj-Blatchford, 2009).

Education for sustainability (EfS) appears to overcome the limited approach of Environmental Education (EE) towards one with a sense of social transformation (Colom, 2000), even in preschool education (Chan, Choy & Lee, 2009; Kahriman-Öztürk, Olgan, & Güler, 2012).Many authors agree with this new EE perspective, which fosters action for social change (Sauvé, 2010). In this respect Somerville and Williams (2015) carried out a review of research in EfS in early childhood. Different authors refer to EfS as part of the solution to preserving natural resources and taking care of the planet (Kumar, 2004;Saylan & Blumstein, 2011; Willem, 2006). As an example, Damerell, Howe, and Milner-Gulland (2013)justify the need for EfS by noting children's high levels of consumption (gadgets with polluting batteries, their eating habits, energy use, urban noise, waste generation, urban decay, etc.) and the influence they have on their parents' behaviour.

Indeed, EE (as part of EfS) should be a priority in itself, rather than schools simply taking advantage of its cross-cutting nature to make syllabuses appear more interesting and cutting edge by providing them with a modern and progressive gloss. A positive example is Peacock (2006) who focuses on ecological literacy and the cross-cutting nature of the disciplines involved to allow for the teaching of practical values and attitudes. The author not only shows us what is the necessary content in the primary education curriculum related to ecology, but also gives different examples of how to achieve ethical, social, scientific, and environmental conceptions and implications.

In accordance with this, and specifically in Spain, we have to reflect upon how necessary it is to improve EE in schools. Edwards, Gil, Vilches, and Praia (2004),Spanish authors who studied part of the educational community (327 active teachers, 521 prospective teachers, and 138 textbooks), found that education makes very few references to numerous themes related to global environmental issues – sustainable development; they therefore recommend specific teacher education actions to overcome a reductionist vision of the global problem.

1.2. Environmental Education in the early educational stages

EfS as a focus at the preschool level have been argued persuasively in the literature for at least a decade (Davis, 2009, 2015; Elliot & Davis, 2009; Elliott, 2014; Hägglund & Pramling, 2009). Various research groups throughout the world have been studying in this field. Martínez, Ulland Aznar (2014)provide a brief recompilation.

Education for sustainability should begin in a child's early years(Davis, 2009; Taylor, Quinn, & Eames, 2015). In this regard, at the end of the twentieth century, Espinet (1995) insisted that EE in the first stages of education '*goes beyond science education, as it not only aims for an understanding of the environment, but also involves an emotional and behavioural commitment to it*' (p. 59). This author even warns of the dangers of acquiring environmentally friendly habits without reflecting on and understanding the need for those actions. Freire (2013) agrees with this view, highlighting the causal relationship between people's 'ecological sensitivity' and their contact with nature in early childhood. Mackey (2012) shows how important it is to respect the right of the child to gain knowledge about social and environmental issues, in order to be involved in conversations and possible solutions, with their ideas and contributions holding particular value.

There is an important body of literature on experiences and projects at the first levels of education. In this sense, in Spain, the vast majority of schools let their pupils interact with natural materials from their environment – logs, rocks, sticks, pine cones, and even scrap or recycled materials – with the firm intention of promoting values such as respect for the environment (Flecha, 2013).Literature (e.g., Álvarez et al., 2004) shows experiences at preschool and primary education levels (e.g., school environmental proposals to participate in the collection and sorting of waste). Here, not only scientific knowledge of the surrounding world is promoted, but also understanding how to act to preserve it. The aim is also to encourage internalization of conservationist attitudes, and an awareness and appreciation of the reasons behind conservation. In sum, this project stresses the acquisition of values as the basis for EE.

Freire (2013) shows how Denmark, Germany, and Scotland are transforming their educational systems with the objective of teaching the entire curriculum at the different educational stages (preschool, primary, and secondary) in 'green spaces'. Davis (2005) showed us the positive results of educating for sustainability over years spent in an Australian kindergarten. Davis (2015) and Elliot (2014) give a framework for early learning for sustainability. Sneddon and Pettit (2016) provide materials to help embed sustainability as images of the ecological footprint and the social handprint, sustainability actions for reducing our ecological footprint worksheet, sustainability actions for increasing our social handprint worksheet and calendar of dates related to sustainability.

Ärlemalm-Hagsér (2013) illustrates how EfS can be treated in one Swedish preschool by dialogues as places for communication, participation and shared meaning-making. In the United States, Williams (2010) proposes education based on local environmental projects, in which pupils conduct team-based inquiry – collecting, synthesizing, and analysing information to then put the knowledge they have acquired into practice. Specifically, in preschool, by way of exploring their community, pupils can be introduced to such concepts as the different types of plants and animals that inhabit the Earth, the components of our planet (earth, air, and water), the identification of the Earth's resources that we use in everyday life, and the idea of conserving these resources in order to live.

Concerning the pedagogical approach, it may be inappropriate to deal with nature through solely technological media and alarmist discourses (Freire, 2013). Espinet (1995) proposes '*the environmental story*' as an important resource, especially in the first stages, as it '*allows children to imagine more distant or abstract situations related to the problems of modern society, without the need for a basis on direct experience*' (p. 60).For most children, interest in and love of nature is instinctive (Villarroel, 2013). Sabo (2010) believes that early childhood education should start with their natural interest in plants and animals. Torquati and Nernst (2013) claim that nature environments are suitable places to engage children for high quality learning experiences. Garrido (2007) stresses the importance for the pupil to appreciate the fact that living things respond to and feel the changes in their environment, since this will develop attitudes of conservation and respect.

As a means of stimulating children's concern for their close environment, various authors propose the study of living beings, in particular, of pets and livestock (Tiana, 2009). However, as these animals are housed or held in captivity by human, it is difficult to show how they relate to other living beings within an ecosystem, and the disturbance to that system caused by human (Espinet, 1995). To understand these interactions, we believe it is necessary to go beyond presenting children with natural resources in isolation, outside of their natural systems, but to instead view these systems from within allowing children to see the multiple relationships among the members where they make sense.

1.3. Studies of Children's Ideas in Environmental Education

In order to start planning any intervention, teachers need to research children's previous conceptions of environmental issues, because they bring their own ideas which they have been forming since an early age (Driver, 1985, Osborne & Freyberg, 1985). In fact, for learning, students should know, discuss and reflect on their own ideas. Knowledge is built on the foundation of the student's mind as new experiences and information interact with their misconceptions. According to Cubero, Cubero, Santamaría, Saavedra, and Yossef (2007), we need to know our students' preconceptions and worldviews before starting a learning-teaching process with them. Then it is possible to construct a shared meaning and educators are able to adjust their intervention in greater depth.

As mentioned above, the literature includes several examples of EE-related activities in preschool classrooms. Projects are shown, related to environmental protection (EscuelaI n fantilOs Campos, 2001), looking after a market-garden and farm animals (Heike, 2013), recycling (Carrasco, 2011), games related to nature (Hueso, Camina, & Monzón, 2013), and so on.

In every case, EE should be connected with the children´s environmental conceptions, in order to improve this type of education (Rodríguez, Kohen, &Delval, 2015). Reid and Scott (2013) show that it constitutes a whole field of research within EE.

Different authors have studied what preschool students think about the environment and environmental problems (Palmer & Suggate, 2004; Palmer, Suggate & Bajd, 1999; Saçkes, Flevares, & Trundle, 2010). In Table 1 we show various worldwide studies related to early-stage pupils' ideas about environmental issues. We have selected them as a wide sample of current literature on the topic. To the best of our knowledge, there has been no investigation comparing preschool children and children in the first year of primary school.

Table 1 Selection of Studies of Pupils' Preconceptions about Issues Related to Environmental Education

Education level	Authors	Years old[a]	Place	Preconceptions about
Primary education	Littledyke (2004)	6-12	UK	Environmental cognitive and moral development.
Pre-school and primary education	Barman, Stein, McNair & Barman (2006)	~ 5–13	USA	Plant growth (sun)
	Fleer (2007)	5–8	Australia	Clouds and the water cycle
	Garrido (2007)	4-7	Spain	Living beings
	Villarroel (2013)	4–7	Spain	Environmental values and their relationship to conceptions of living beings
	Burns, Chi & Hertzog (2008)	3–7	USA	Study of a meadow: plants, animals, fire, and water
	Palmer, Suggate & Bajd (1999)	4-10	UK	Reasons for and the effects of environmental change in two distant environments (rainforests and polar lands)
	Anderson, Ellis & Jones (2014)	3-7	USA	Plant structure and function
Pre-school education	Strommen (1995)	5–6	USA	Forest ecosystem
	Christidou & Hatzinikita (2006)	4-6	Greece	Plant growth and rain formation
	Tunnicliffe, Gatt, Agius, &Pizzuto (2008)	4-6	Malta	Animals
	Ergazaki & Andriotou (2010)	4–5	Greece	Consequences of human intervention
	Palmer & Suggate, 2004	4-6	England, Slovenia and Greece	tropical forests and deforestation, and polar lands and the impact of global warming
	Allen (2015)	3-5	UK	Animals classification

Note. [a]Pupils´ years old

1.4. Goals of this Study

This paper aims to provide some contribution towards early childhood education for sustainability being given status as a legitimate field of research endeavour (Davis, 2009). According to Malandrakis and Chatzakis (2014), we have placed more emphasis on exploring children´s pre-instructional ideas about environmental issues. This paper is focused on some of the environmental issues that we have investigated in a more extensive enquiry. The main objective of this work is to ascertain the ideas of preschool and primary school pupils about specific environmental issues: waste, biodegradability, recycling, water pollution and water saving. As can be observed in Table 1, there have been few studies of this overall type, and those that exist are only for older pupils. The line we followed was that set out by Edwards et al. (2004), adapting it to the earliest educational stages. In order to investigate the responses of children about specific environmental issues cited above, we had to design an inquiry strategy that involved the following specific objectives.

(a) To design and validate instruments to detect children´s ideas on environmental issues;
(b) To ascertain what ideas the children have on the topics;
(c) To compare preschool pupils' conceptions with those of primary-education pupils.

2. Methods

2.1. Participants

The participants were 43 children of a convenience sample, formed into two groups: twenty-one 5- and 6-year-olds in their final year of preschool education; and twenty-two 6- and 7- year-olds in their first year of primary education. Students had had no prior lessons at their school about these environmental issues (waste, biodegradability, recycling, water pollution and water saving) when we interviewed them. Both groups belonged to the same school (in Seville, Spain), in a middle-class socio-economic setting, where most of the parents have a university education.

2.2. Phases of the Research

We employed basic qualitative research methods to obtain a detailed understanding of preschool and first-year children´s ideas about the environment (Merriam, 2009). Kahriman-Öztürk et al. (2012) also employed these sorts of methods for both data collection and the data analysis procedures. The methodology is structured and can be summarized in the below plan (Table 2).

Table 2. Outline of the Phases of the Research

Phase	Sub-phase	Facts
I	Design of the first version of the data collection instruments	
	A	Interview with the usual format of questions (QFI)
	B	Interview with format adapted for young children: "complete the story" (CSFI)
II	Validation of both instruments	
	First	Apply pilot trials of (A) and (B) to individual children
	Second	Analysis of results
	Third	Amendment of (A) and (B) to give their final versions
III	Application of the final versions of (A) and (B) to children in groups of three	
IV	Recompilation of the new data, and analysis of the final results	
V	Conclusions	

Phase I. In the extensive study, the starting point was the design of the first version of the instruments used for the data collection. For purposes of triangulation, two instruments were developed to detect preconceptions: one was a question format interview (QFI); and the other a 'complete the story' format interview (CSFI). The methodological approach used was taken from the recommendations made by Cubero (1997) and Creswell (2007). Only the results of the CSFI are reported in this paper.

Phase II. The next phase of the process was the validation of the designed instruments. Once the first versions of the instruments had been prepared, they were tested in pilot trials. To this end, 6 children in the final year of preschool education (5- and 6-year-olds) were interviewed individually. They were pupils from the same school and educational level, but from a different class to that from which the final definitive data was to be acquired. We tried out both pilot trials in the lower educational level, assuming language comprehension and expression were similar or better in the higher educational level (children are one year older). These interviews were held by two of the researchers. The results of these tests were analysed by two independent researchers. They then compared their evaluations (inter-rater analysis) and this led to several changes being made to the content of the questions and the form in which they were put to the children.

With respect to changes in the form of using the instruments, it was found that the children felt self-conscious and that they were timid if they were interviewed individually, so it was decided that the definitive data would be obtained by interviewing them in groups of three. At first, we believed that beginning the conversation with the story (CSFI) would relax the atmosphere and facilitate dialogue. However, in practice, they found QFI easier, with the children relaxing and having fun as they felt more confident. It was not necessary to use visual clues in cases such as those of the 'seed' and the 'ants'. These could be evoked with the confidence that they understood the meaning of these words perfectly.

On the other hand, and with respect to changes in the content of the instruments, we should distinguish between the two types of instruments. Concerning the QFI, it was noted that sometimes it was necessary to ask for a clarifying explanation. For example: 'If we cut down all the trees on the planet we'd be sad'. 'Why?' 'We would feel that way because it wouldn't be as pretty'. The pilot tests showed the importance of adapting some terms to the pupils' level of understanding, replacing them with more everyday expressions (like 'cutting down trees' instead of 'deforestation'). In a similar vein, we found that the phrase 'saving water' meant nothing to them, because they only connect the term 'save' with money.

With respect to the CSFI, we found it was advisable to present this instrument in an appropriate manner. One of the researchers told the children that she had found a story, but that it was incomplete – some pages were missing. She asked them to help us finish it, so that it could be told to other children. In particular, they were asked: 'Can you all help us to finish it and make it nice?' We deleted redundant questions that only lengthened the interview, and which only duplicated the information obtained (e.g., 'Who dumps the rubbish there?' and 'Where does the rubbish come from?'), selecting a more comprehensible question for the pupils (e.g., 'Who dumped it there?'). In certain cases, it was obvious that we would have to ask more direct questions in order to obtain the required information because the range of answers we were receiving was so broad that no real information was obtained. For instance, we changed 'From what there was, what did our friends like the least and why?' to 'Among the rubbish there, what lasted longest in the water and what lasted the least?' or 'Is it better to have some rubbish or none at all?' to 'Why were our friends sad about so much rubbish?' and 'Why didn't they like it?' As with the case of QFI, to be able to understand the answers we had to insist on their giving an explanation. For example, when they were selecting the colour of the recycling bin to put the different household waste into (the waste shown to them by the researchers), most of the time the children showed a lack of knowledge about it: 'The colour of the waste must be the same as the container', or 'If I've already used two bits of waste and two bins, the third one has to go into the container that has no waste.' It was therefore essential to ask them why they selected one container and not another for each bit of waste. With the question: 'Where does the water in the clouds come from?', we noticed that they did not always know that there is water or 'steam' in clouds. Also, certain questions were removed as they tired the children unnecessarily since they were too demanding for the children's educational levels (e.g., 'Is the water that falls always clean?').

Phase III. The next and crucial step was the application of the final instruments. The sequence followed was to firstly apply the QFI and then the CSFI, conducted by the same two researchers that performed the pilot instruments. The duration of both sessions for the 3-childgroups was about 15 minutes (5 for QFI and approximately 10 for CSFI). We selected group interviews according to Littledyke (2004), whose four child group interviews provided a greater sense of security than individual interviews. When there were some discrepancies between the children in a group interviewed at the same time, the interviewer noted down each individual response. We made that decision even though we were aware of the obstacles presented by conducting interviews with such young children. During the CSFI interviews, the characters in the story were presented to the pupils personified as soft toys, since they have been used successfully by other authors (Radler, 2009; Sarquis & Sarquis, 2005).

Concurring with Littledyke (2004) in UK, we acted as non-judgmental active listeners, since our questions were designed to simply draw out and clarify views. We encountered the same limitations (lack of confidence in speaking out, shyness, lack of attention, language limitations, etc.). The interviews were all digitally recorded and transcribed. Phase IV. Finally, we carried out the data analysis. A qualitative analysis of the data was performed by open response categorization, suitable school science responses[1].To ensure the reliability of the design of the category system and the subsequent allocation of responses to each category, we followed an inter-rater strategy of analysis (Padilla, 2002). In particular, after their independent analysis (Creswell, 2007), the researchers reached an almost unanimous agreement on all the codes (99% inter-coder reliability) and they met to form a consensus on both establishing the definitive categories and how to allocate the uncertain responses.

[1]*Suitable school science* means 'right*' science* suited for this children level of knowledge.

3. Results

3.1. Definitive Versions of the Instrument for the Diagnosis of Student Ideas

We present one of the definitive instruments, CSFI (Table 3), since we consider it has more information without being too extensive. For each question we show not only the formulation of the question, but also what we want to find out with it and the specialised literature we have used to reach its formulation. CSFI has 10 questions. As mentioned above, they are related to waste, biodegradability, recycling, water pollution and water saving.

Table 3. The Design of the "Complete the Story" Format Interview (CSFI)

Question number	Formulation of the question	What we want to determine	Based on
1	About the garbage, who dumped it there?	(a) Whether they are aware that humans are responsible for most waste, and that the waste comes from human activity.	Roman (2008)
2	What was in the garbage? And of the garbage that was there, what lasted longest in the water and what least? Why?	(a) Whether they know that there is some waste that changes and degrades, and other waste that does not.	Chamorro (2009)
3	Why were our friends sad with so much garbage? Why didn't they like it?	(a) Whether they know the reason why waste poses a problem (i.e., if they have some notion concerning water and soil pollution, the creation of foci of infection, bad smells, etc.)	Garrido (2007); Gutiérrez, Aguirre, & Aramburu (1998)
4	Do you know what recycling is?	(a) Whether they have any notion about "recycling", about the ideas of recovering used materials which then undergo a process so that they can be reused.	Carrasco (2011); Littledyke (2004)
5	Can you also teach Flop the colours of the containers in your city? Let's tell him what each one is for! (We use real examples).	(a) Whether they know the different types of containers: blue, green, yellow, and grey (or dark green). (b) Whether they know the things which you deposit in each of them – blue for paper; yellow for plastic, tins, and tetra-brik type cartons; green for glass; dark green or grey for organic waste.	Castellano (2013)
6	Could you explain to the bunny and the little frog what we mean by the water being polluted?	(a) Whether they have any notion about "water pollution" (taking as referent the idea of the "action and effect of introducing materials or forms of energy or conditions into water that, directly or indirectly, involve a harmful alteration of its quality in relation to its subsequent uses or its ecological function").	Arozarena et al. (2012); Pérez, Galache, & Camacho (1996)
7	What could they do to make their friend Flop happy?	(a) Whether they are aware of the possibility of cleaning up polluted rivers, marine spills, etc., and of some way of doing it – mechanical cleansing, removing garbage, removing oil spills, water treatment (physical, chemical, and microbiological), sedimentation, filtration, chlorination, ozone, UV rays, bioremediation….	Walker, Kremer, and Schluter (2007)
8	Ideas on how to use less water – can you think of any?	(a) Whether they know about different ways of saving water, like brushing their teeth with the tap turned off, having a shower instead of a bath, turning off the tap, use a waste-paper basket instead of the toilet to throw paper away, making the maximum use of the capacity of the washing-machine or dishwasher, etc.	Arozarena et al. (2012)

3.2. The Pupils' Conceptions about Environmental Issues, and the Categorization of the Responses

In this section, we shall present the children's ideas on specific topics: waste, biodegradability, recycling, water pollution and water saving. We have to clarify that students had had no prior lessons at their school about this environmental matter when we interviewed them. The responses were grouped into categories that progressively approach school science that is appropriate for these ages, which are meant by levels in learning progressions (Roth, 2014). In a similar way, Wilson and Bertenthal (2005) define learning progressions (LPs) as 'descriptions of the successively more sophisticated ways of thinking about an idea that follow one after the other as students learn' (p.48). Hess (2010) has identified content-specific learning progressions in the first educational stages, as have Engelhard and Sullivan (2011). According to Suzuki, Yamaguchi, and Hokayem (2015), these models begin with the prior knowledge learners already have.

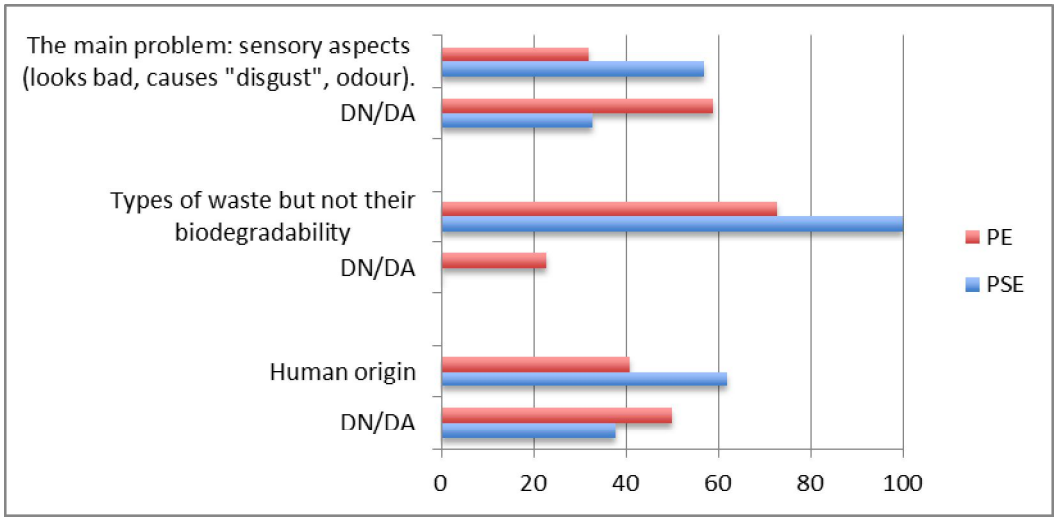
The percentages of the responses given to each question by participants from the last year of preschool education (21 children) and the first year of primary education (22 children) will be given as entries in Figures 1-4.The percentages are rounded off to the nearest unit. Thus, there may be cases in which they add up to 99% or 101%. In these figures we only show the categories with the majority of the student responses.

We will now present the different sections that analyse the responses, and compare the preschool children´s ideas with those of the primary education children. In these comparisons, it should be taken into account that, in general, a higher percentage of primary education pupils did not provide answers to some questions and therefore there was a higher overall response rate from the preschool pupils. We can only think of two aspects that can explain this fact. Firstly, it may simply be due to oscillations of the small samples used in our inquiry. Secondly, it has been reported that preschool children are more unconstrained than primary children, who feel inhibited to answer on topics they have not mastered (Delval, 2002).

Generators of waste (Question 1). The children are aware of the role of humans as the main generators of waste (62% PSE, 41% PE). In the same way, Littledyke (2004) found that first-year students were really interested in waste, such as litter. They appreciated the need to 'put rubbish in the bin' (p. 224). Anecdotally, in this latter educational stage, 9% see animals as generating waste or think that waste is generated spontaneously.

Biodegradable waste (Question 2). The vast majority do not know anything about the different periods needed for waste degradation. They can therefore not differentiate between whether waste is or is not dangerous for the environment. Generally, they do know that there are different types of waste, although 23% of the PE pupils did not answer. This is consistent with the findings of Chamorro (2009), who states that none of the pupils in that study knew about 'composting' or about the different types of plastics.

Figure 1. Majority categories for questions 1, 2 and 3 about Waste and Biodegradability

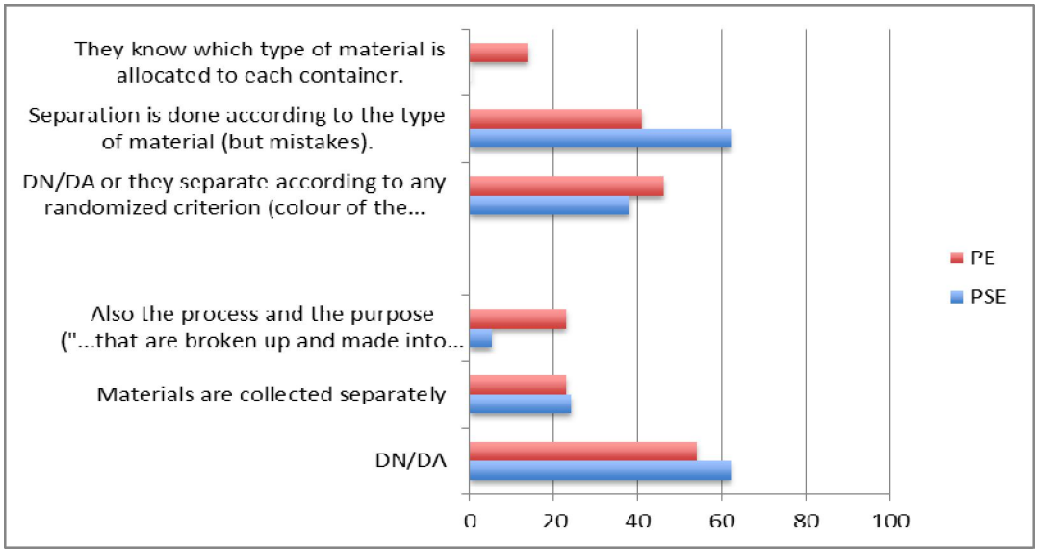


Consequences of waste accumulation (Question 3). In general, PSE students relate the problems arising from the existence of excess waste on the planet with sensory issues (57%) or with people's quality of life (9%). But it is worth noting that no pupil realizes that waste can bring about a change in animals' environmental conditions and, as a result, limit their development. It is striking that most PE children either do not know or do not answer (59%). Among the respondents, 32% only note sensory problems, as was also the case in PSE – this issimilar to the result obtained by Littledyke (2004) for first-year students, 'Waste, as litter, was usually seen as a problem because it is unsightly' (p. 224). However, in PE there is now a small percentage (9%) who takes into account the limitation in the growth and development of different species that may be caused by the accumulation of waste. This is consistent with the opinion of Garrido (2007) that the acquisition of this concept occurs during primary education.

The concept of recycling (Question 4). Most PSE pupils (62%) do not know what recycling is. Only 5% are aware of the process and its purpose, although they start to have somewhat fuzzy concepts such as it somehow being associated with waste (9%), or with selective waste collection without asking themselves what it is for (24%). The same as with PSE, most PE pupils do not know what recycling is, although the percentage is lower (54%). There is a slight evolution of the concepts with respect to PSE, with the proportion of pupils who are aware of the process and its purpose rising to 23%. The remaining 23% hold fuzzy, unclear concepts.

Our results agree with Littledyke (2004), who noted that first-year students knew about recycling activities at home, but most of them did not connect the need for recycling with concepts such as pollution and waste, energy use, consumption. Kahriman-Öztürket al. (2012) observed that only a few (n= 9) five- and six-year-old children out of 36 considered recycling to save nature, while a larger amount of them (n= 23) thought about reducing water, paper and electricity consumption for the same purpose.

Figure 2. Majority categories for questions 4 and 5 about Recycling



Waste materials and their association with the colour of the container (Question 5). While 76% of the PSE pupils are aware of the different colours of the containers; none of them are sure what type of waste is put into each. Thus, 62% get the waste materials that go into each container wrong, and 14% separate them according to other characteristics, such as the label colour, size, etc. In PE there is again a slight conceptual breakthrough. 14% of pupils know what type of waste is put into each container, although 41% still confuse the material that should go into each container, and 32% continue to separate waste according to various characteristics other than the type of material.

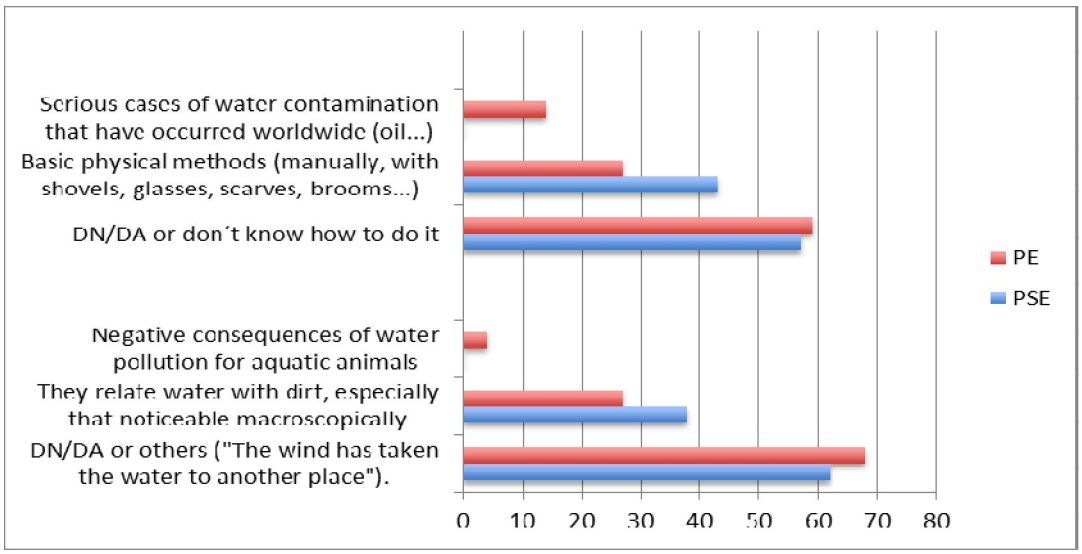
Water pollution (Question 6). The vast majority of the pupils (62% PSE, 68% PE) do not know about water pollution, and 38% PSE, 27% PE relate it to macroscopic dirt and rubbish that might be found in rivers or seas. In the same sense, Littledyke (2004) concluded that many primary children identified pollution as litter, visible items, and few had a clear concept of chemical pollution: 'When my dad is out fishing and they throw litter in the water, we could poison the fish and kill them' (p.228). Also he showed that pollution issues became more significant among older children.

Rodríguez et al. (2015) found that 9- and10-year-old students knew three predominant epistemic structures about the pollution process: 1) pollution as innocuous; 2) dirt and apparent features; and 3) local, direct and immediate impacts. In our case, PSE students knew about only two of them, and first-year students were beginning to acquire the third one, because only 4% of the PE pupils are aware of the chemical pollution of water which can render it impossible for certain aquatic animals to inhabit. In this sense, Garrido (2007) places PE as being the period in which students learn that every kind of living being adapts to life under certain specific conditions, and that their development can be limited by a change such as pollution. As a chemical general wide concept (its causes and consequences), pollution is too abstract for them (Rodríguez et al., 2015). However, children can understand some specific and evident examples, as dead birds or fishes while been covered by a black film of thick fuel dumped in the sea. In fact, Evans et al. (2007) found there was high concern (82%) in first- and second-year students about the water pollution from industrial dumping.

Remediation of water pollution (Question7). In keeping with the above responses**,** the majority of the PSE pupils (57%) do not know how water is decontaminated or cleaned. The others (43%) would clean the water with very rudimentary, physical means: with shovels, brooms, glasses, etc. The percentage of PE pupils who did not know how water is cleaned is similar to the PSE case (59%). Some 27% would do it domestically using physical means. However, 14% of the pupils stood out for having heard about severe cases of pollution, such as oil spills, and were aware of the need to clean them up. Kahn (1997) found that the majority of the 2nd grade students understood that oil spills negatively affected the local environment.

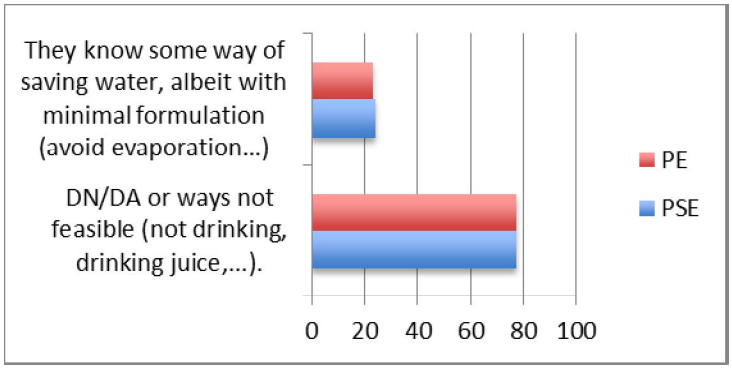
It is important to appreciate that the majority of the students do not care about water pollution and its remediation. Similarly, Lea and Hilmo (1998) observed that 'Clean drinking water is taken for granted by children in Norway, but for children in many countries, polluted water will be the first environmental issue young children are concerned with' (p.54).

Figure 3. Majority categories for questions 6 and 7 about Water pollution



Reducing water consumption (Question 8). Although children aged 9 may know some ways of saving water (Arozarena et al. 2012), most of our pupils (76% in PSE and 77% in PE) ignore this aspect. The others (24% in PSE and 23% in PE) describe just a single way (turning the tap off, washing things less). According to Kruse (2010), the situation becomes real for preschool children when they personally experience it. In order to develop water saving habits, Siguraardottir (1998) proposes that one day all the water should be turned off in the preschool, so that it were not possible to have water to drink or for washing hands.

Figure 4. Majority categories for questions 8 about Saving water



4. Discussion

In general, results are in concordance with what is expected from theirdevelopmental growth in conceptual understanding. In general, children are not able to think of 'non-perceptible-phenomena', they have 'evident-focused thinking' (Delval, 2002). In the next paragraphs we discuss these features in relation to the specific ideas investigated. When speaking about waste and biodegradability, we see children are not able to appreciate that waste is dangerous for the environment. This could be due to the fact that transformations after slow process of degradation can be perceived only along large periods of time. Adults do 'believe' on degradation process even though it cannot 'be seen', because environmental education tell us it is happening due the slowness of this short of change. It is not surprising that so little children: i) have not still heard about degradation of waste; and ii) have inability to understand no perceptible transformations in real time.

Also no pupils realize that waste can bring influence in the animal´s environment conditions. This agrees with these children thinking features: i) not being able to think of no perceptible phenomena, and ii) having simple mono causal reasoning. If there are students (9%) who can think of one aspect, such as the influence of waste on human life, these children cannot simultaneously consider a second effect from the same factor on animals, on the environment, and so on. They do not assign multiple consequences to one problem, they just infer a single consequence. When they are taught about recycling, most children ignore what it is. Only 5% are aware of recycling and its purpose. Firstly, family behavior can influence in knowing or not about separating litter. Secondly, children that see it daily at home may ignore of the real purpose of this separation if no explanation has been given to them. For example, if bottles are collected together, then the glass can be re-used to make new bottles.

Results converge with those of Buck and Meduna (2001). Even though children show association between a caring environment and recycling, they would explain this relation in a descriptive, not well-founded, manner. Although we think this type of learning is a success for such little children, the environment-recycling relation requires too much information at the same time (physical and chemical concepts, such as energy transformations, and natural resource consumption). It also demands too much 'inference' from ' non-evident clues'. In general, the children are aware of the types of waste materials and their association with the colour of the container. This can be influenced, not only by family behaviour (whether they separate rubbish or not), but also classification of waste may be quite abstract for these children. They perhaps may easily identify glass bottles, but they may have problems with the concept of 'packages' (tetra brick packs, cans, but not cardboard boxes), suitable for the yellow container. When water pollution and its treatment are addressed, again their unawareness can be explained by their aforementioned 'evident-focused thinking'. Harlen (2008) claims that for children it is difficult to understand abstract concepts like the pollution influence on the environment if they do not have prior perceptible experiences with concrete cases in their lives. For instance, pupils can dirty the water in a goldfish bowl and compare how fishes live there and in a clean one (although we think it could have ethical concerns, because we are injuring animals). According to our results, older pupils were not able to define 'pollution', although they could describe certain contaminating actions (Pérez, Galache, &Camacho, 1996). At last, most of our pupils ignore any viable ways of saving water. Ching-YuanandPei-Yu (2016) reported a similar case.They develop effective activities for 5 and 6 years old children that did not know how to use less water in Taiwan, in fact they often did not know how to cherish water resources.

In comparing the two educational levels, we found that a greater proportion of PE pupils did not answer compared to the PSE pupils. This relatively greater inhibition of children one year older may be due to a particular feature of the sample, as it has been explained. Beyond this, many of the items studied showed the same trends in the two levels. There were also other cases that presented better levels of formulation of knowledge in the higher level of education. For instance, there were greater percentages of pupils who are aware of the process of recycling and its purpose. In the higher level, a small percentage also appear who take into account the impact of the accumulation of waste on the growth of living beings, who are able to distinguish what type of waste goes into each type of bin, who know about the chemical contamination of water and its impact on the lives of certain aquatic animals, and who recall severe cases of contamination of water such as oil spills and are conscious of the need to clean them up.

5. Conclusions

This study shows the children's formulation of environmental topics at the earliest stages of education, which were identified through an instrument, CSFI. We were able to observe differences between the two educational levels, preschool and primary education.-In synthesis, we could describe the common conceptual features that we found as follows: (a) they recognize humans as being primarily responsible for the generation of waste, even though they do not recognise specific effects on animal environments. Perhaps this has to do with the children´s inability of having into account more than one variable affecting a phenomenon. It can also be due to their anthropocentric thinking; (b) they do not know about the different rates at which wastes degrade, and therefore they do not recognize their danger for the environment; (c) they usually do not know what recycling is. Sometimes they are able to relate it to a separate collection of materials, but only a few older children know which type of material is allocated to each container. Only a minority of the older children know its process and purpose; (d) they are not often aware about water pollution, and if they are, they use to relate it with macroscopically dirt, which could be eliminated with basic physical methods; (e) In general, they do not express any viable ways to save water.

This work seems novel to us because: i) the designed instrument shows the way the questions have been worded and why (and this reflects the thorough piloting, when changes were made to adapt the interviewing techniques to PSE children); ii) The acquired results compare children´s ideas about specific environmental issues of preschool and first-year primary children and report that general features of preoperational thinking likely lie behind these responses. From the analysis, we are able to establish a number of proposals for the improvement of the teaching of these topics. Therefore, we think that activities for humans taking care of nature should continue to be insisted upon, but through showing pupils their chance to choose not to participate in harmful activities. Fostering autonomy and responsibility in their decision-making will make their involvement more effective and help them assimilate the worthiness of their acts.

Furthermore, it is ineffective at these ages to focus on what types of materials are deposited in each type of rubbish container. This focus has become widespread as mere rote learning, which makes no sense when they cannot yet differentiate between the types of materials and their properties. Instead, an approach should be developed towards understanding the consequences of the accumulation of waste for environmental health and to resource depletion, perhaps by way of stories, to begin to present the importance of such complex concepts as recycling, reusing, and reducing the consumption of materials. Additionally, an approach could be developed on the biodegradability of materials as a visually distinguishable property, without going into details of categorization. Hands-on activities may perhaps be used to this end.

We would also suggest providing specific examples (e.g., the consequences of specific types of contamination, such as water pollution, on the living conditions of specific forms of life). This should constitute the backbone of the teaching and learning process. In this sense, water consumption in pupils' households is very present in their lives; so ways to avoid wasting and polluting water at home should be highlighted. This implies that tasks in which the children can be made aware that water used at home 'travels to natural surroundings' should be included. Activities of inquiry (Peterson, 2008) could be encouraged in which they would be guided to discover how humans contaminate and waste this resource. This could help them to value our natural resources.

This study has the limitation of the small sample of children. Although two complementary instruments were used (here we have reported only the results of one of them), and both of them were piloted previously, several improvements can be made. For example, suggestions based in Payne (2010, 2014, 2015):i) Qualitative (and descriptive only) data can be collected ethnographically from young children via 'philosophical' conversations (in classroom) and art works (outside in the playground) about a range of topics freely chosen by the children about children's conceptions of (local and experiential/existential) nature and environment. ii) It can be highlighted how young children experience and investigate highly local/proximal-temporal environmental problems. iii) It can be investigated how the 'social ecology' of families/homes has an intergenerational impact on how young children and teenagers behave themselves. Taking appropriate data can help to understand and discuss better the results we have obtained.

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