LOOK ACADEMIC PUBLISHERS
OPEN ACCESS

INTERNATIONAL JOURNAL OF ENVIRONMENTAL & SCIENCE EDUCATION
2016 VOL. 11 NO.12, 5554-5571

Preschool Children's Understanding of Pro-Environmental Behaviours: Is It Too Hard for Them?

Marjanca Kos[a], Janez Jerman[a], Urška Anžlovar[b], Gregor Torkar[a]

[a]University of Ljubljana, Ljubljana, SLOVENIA; [b]Kindergarten Ivančna Gorica, SLOVENIA

ABSTRACT

Early childhood is a period of life in which lifelong attitudes, values and patterns of behaviour regarding nature are shaped. Environmental education is becoming a growing area of interest in early childhood education. The aim of the research study was to identify children's understanding of why and how their pro-environmental behaviours influence the environment. The sample was composed of 40 children aged 5 and 6. A quasi-experiment was conducted with control and experimental groups, each made up of 20 children. The initial semi-structured interviews sought to identify their initial ideas about the meaning of pro-environmental actions. Children from the experimental group then participated in activities in which they acquired knowledge in the natural sciences through direct experience and were becoming familiar with the meaning of the following proenvironmental behaviours: walk/cycling/using public transport instead of driving by car, turning off lights (rational use of electricity) and turning off the tap (rational use of water). At the end, the interviews in both groups were repeated. The results showed that at the beginning the great majority of children had no idea about how they influence the environment with each individual environmental behaviour. In their statements they expressed they behaved pro-environmentally because this was the socially desired behaviour. After they carried out the activities, the experimental group children's knowledge about the influence of pro-environmental behaviours was strongly improved with regard to those pro-environmental behaviours they had studied – the large majority of children had acquired a correct and precise idea about them. We find that, even in the preschool period, children are able to understand the scientific background and the impact of pro-environmental behaviours if presented to them in a way appropriate for their age. We propose that during preschool children should not only perform environmental behaviours, but should also be given the opportunity within environmental education to acquire knowledge and understanding through experiential learning about the impact of these behaviours on the environment.

KEYWORDS
Environmental education, early science, preschool children, environmental knowledge, proenvironmental behaviour

ARTICLE HISTORY
Received 13 May 2016
Revised 18 June 2016
Accepted 21 June 2016

CORRESPONDENCE Marjanca Kos ✉ Marjanca.Kos@pef.uni-lj.si

Introduction

Early childhood is a period of life in which lifelong attitudes, values and patterns of behaviour regarding nature are shaped. Environmental education is becoming a growing area of interest in early childhood education. The aim of environmental education is to help children learn and care for the environment (Palmer & Neal, 1994). It has the potential to affect a wide range of individuals and provides an opportunity to promote pro-environmental behaviour. It focuses on people's abilities to increase their understanding over the long run, affecting their attitudes, behaviour and worldviews in general (Clayton & Myers, 2009). Clayton and Myers (2009) emphasised that the success of environmental education depends particularly on cognitive development and environmental knowledge (with special attention to knowledge of biology and ecology), affective and motivational factors (especially a connection to nature and feelings about one's ability to achieve effects in the world), and actual behaviour (participating, taking action and problem-solving). Stern (2000) distinguishes between emancipatory environmental education, which seeks to engage participants in an active dialogue to establish their own objectives and plans for action, and instrumental environmental education, which seeks to change pre-determined environmental behaviours.

Understanding the way learning occurs and what stimulates environmental behaviours is as important as environmental information (Palmer, 1995). Knowledge is regarded as a precondition for successful action, as a means to overcome psychological barriers such as ignorance and misinformation, yet it often does not have the intended effect on the target behaviour (Frick, Kaiser, & Wilson, 2004). Hines, Hungerford, and Tomera (1987) found that highly educated individuals were slightly more likely to have reported engaging in responsible environmental behaviours than less educated persons. Highly educated individuals are more concerned about environmental quality and more motivated to engage in environmentally responsible behaviour because they are more aware of the potential damage (Lozano, Kevany, & Huisingh, 2006; Olli, Grenstad, & Wollebaek, 2001). There is, of course, a limit beyond which increasing knowledge has no impact, but the poorly educated may lack information about the behavioural options available and/or the environmental impact of those options (Clayton & Myers, 2009).

Orr (1992) defines knowledge about how the world works and how people can preserve and maintain the environment as environmental literacy. It includes knowledge and actions. In the education context, this means that environmental literacy consists of contents, skills and procedures, or of: what the student should be familiar with, should know how to do, and should be able to act (Krnel & Naglič, 2010). This study investigated whether preschool children are conscious of how their pro-environmental actions impact on the environment. In other words, the objective of this study was to determine if pro-environmental actions are connected to knowledge of environmental problems that particular actions try to resolve.

In previous studies, researchers investigated the environmental attitudes and pro-environmental behaviour of preschool children (e.g. Musser & Diamond, 1999; Grodzińska-Jurczak, Stępska, Nieszporek, & Bryda, 2006). Musser and Diamond (1999) created the Children's Attitudes towards Environment Scale – Preschool Version (CATES-PV). In this investigation, a set of pictures of two different model behaviours, one representing a positive attitude to the environment and the other a negative one, were shown to each child. Such a set, for example, consisted of one drawing of a child brushing his teeth beside a running tap, whereas the other picture presented a child brushing his teeth while the tap was turned off. The tested child was asked to identify which child in the picture they were most like; 42 children aged 3–4 were tested. The authors reported that children's attitudes

to the environment were generally positive. An exploration of preschool children's attitudes, using the same instrument but on a bigger scale (674 six-year-olds) was performed by Grodzińska-Jurczak et al. (2006). The results indicated that the children were able to identify improper behaviour with regard to the environment. In nine out of ten tested dimensions, the majority of children showed pro-environmental attitudes: more than 90% of the children claimed they use water and electricity rationally, are concerned about animals and plants, and are careful about their natural surroundings. In both the Musser and Diamond (1999) and Grodzińska-Jurczak et al. (2006) studies, the children were not asked about the reason they chose a certain kind of behaviour, meaning the authors were not searching for the underlying reasons for and understanding of their pro-environmental choices of the model behaviours displayed in the pictures.

This new quality was added to the research of preschool children's attitudes to the environment in a study by Kahriman-Ozturk, Olgam, and Tuncer (2012). The study was qualitative: in addition to the CATES-PV questionnaire, the interviewed child was asked about the reason for their decision. For example, if a child identified himself with the child brushing his teeth with the tap off, the additional sub-question was posed: "Why do you turn the tap off while you are brushing your teeth?". Forty children aged 5–6 were interviewed. In the evaluation of the children's attitudes, the authors used Thompson and Barton's (1994) categorisation which defines environmental attitudes as ecocentric (valuing nature for its own sake, excluding benefits for human beings) or anthropocentric (regarding human beings as the most important component of life and valuing nature because of the material or physical benefits it can provide to humans). The findings of this research showed that most children initially appeared to have ecocentric attitudes to environmental issues in all dimensions, except recycling and reusing. The large majority of children identified themselves with those children in the picture that shows pro-environmental behaviour. In this perspective, the results were very similar to those obtained by Musser and Diamond (1999) and Grodzińska-Jurczak et al. (2006). But, when the underlying reason for the children's positive/ecocentric decisions was elicited (the children's answers to the question "Why do you… (do a certain pro-environmental behaviour))?", the great majority of the preschool children's explanations revealed an anthropocentric point of view.

Kahriman-Ozturk et al. (2012) discuss the reasons for such results and find a possible explanation in Piaget's stage theory. According to Piaget, 5- to 6-yearold children are in the pre-operational stage, characterised by the child's egocentrism. With this cognitive level, children at this stage are believed to be incapable of thinking from the perspective of the environment. Another possible explanation for the children's non-ecocentric views on the environment could be the lack of content knowledge concerning environmental issues in the preschool curriculum or syllabus. Here, they refer to Palmer's (1995) statement that, irrespective of the cognitive level children have reached, they are capable of comprehending the concepts of reusing and recycling.

In our study, we tried to shed light on possible explanations of the results of children's non-ecocentric views to environmental issues obtained in the previous research. Considering the general impression that preschool environmental education does not emphasise the natural science perspective of proenvironmental actions, the explanation that the lack of children's knowledge and understanding about how they benefit the environment by performing proenvironmental actions is the reason for such results seemed very plausible to us. Because our study focused on the children's background knowledge about proenvironmental actions, we did not ask them, for example "Do you turn the tap off when you brush your teeth?" to investigate children's attitudes to environmental issues or "Why do you

turn the tap off when you brush your teeth" to identify their ecocentric or anthropocentric perspective on environmental issues. Searching for an answer to the question of whether a lack of knowledge is the reason for children's underlying anthropocentric reasons for their pro-environmental actions, the question we asked them was "How do you save the environment when you turn the tap off while brushing your teeth? How do you do something good for the environment when you turn the tap off while brushing your teeth?". This question delved deeper into the children's ideas about environmental issues. We tried to ascertain if the children see a connection between their own actions and the positive influence of those actions on the environment. Further, we designed and carried out activities appropriate for preschool children, which provided opportunities to acquire scientific knowledge and understanding of certain environmental issues through direct experience, and investigated the extent to which they changed the children's thinking.

Methods

Research approach

A quasi-experimental study entailing a control and an experimental group was conducted. Individual interviews with children in both groups were conducted before and after the intervention.

Sample

The sample was composed of a total of 40 children, aged from 5 to 6 years. The experimental and control groups each consisted of 20 children (10 girls and 10 boys). The children were all attending preschool (in a sub-urban area in Slovenia). Carrying out environmental actions and encouraging children to perform them is a daily routine in the preschool.

Ethics

Written consent was obtained from the parents prior to conducting the research. The researcher explained the purpose of the study to the children and invited them to participate. The children were given the opportunity to refuse participation.

Procedure

At the beginning, we performed semi-structured one-to-one interviews with children from both groups to explore their initial understanding of the connection between a pro-environmental action and its positive effect on the environment. The children were asked the following questions: »How do you save the environment when you walk/ride bicycle/use public transport instead driving by car?", "How do you save the environment when you turn the tap off while brushing your teeth?", "How do you save the environment when you turn the light off when you don't need it?". Children were also asked questions with which we wanted to identify their ideas about how they protect the environment when they separate waste: "How do you save the environment when you separate waste paper/plastic bottles and tin cans/glass/organic waste, such as remains of food or peels?" – a separate question related to each type of waste. If necessary, the researcher reformulated the question for the children, for example: "How do you do something good for the environment when you turn the tap off while you are brushing your teeth?", while checking as they went whether the child understood the question and, in case they did not understand some words, the researcher gave an additional explanation. In all of the interviews all questions were asked in the same order. All interviews were recorded.

The experimental group then proceeded with activities in which the children actively learned about the background (acquiring science knowledge) of different pro-environmental actions. The activities were performed over a 6-week period. They were designed in a way that enabled as much hands-on experience about the theme as possible. They were focused on understanding the following proenvironmental actions: walk/cycling/using public transport instead of driving by car, turning lights off (rational use of electricity), turning the tap off (rational use of water). All activities were designed so that they used the approaches of experiential and explorative learning, with an emphasis on a large degree of children's participation. Due to the wide range of activities, the theme of separate waste collection was not included in the project. The activities performed are described in Table 1. The children in the control group followed the ordinary routine of the preschool (while they also performed pro-environmental actions, they did not specifically learn about their background).

Table 1. Description of the performed activities

Title of the activity	Description of the activity
Getting to know the importance of walking/cycling /using public transport instead of driving by car	
Cars pollute the environment	We placed a piece of white fabric over the end of an exhaust pipe. We turned the car engine on and let it run for 5 minutes. Then we turned the engine off and took a look at the piece of fabric. At the point covering the exhaust pipe, it was no longer white but black due to substances generated by the combustion of fuel in the engine. We took a walk along a high traffic road and looked at the plants growing along its sides. We let our fingers run across the surface of the leaves, and the fingers turned black. The children got to know that driving with motor vehicles causes pollution of the air and the environment at the sides of roads. They concluded on their own that, for shorter distances, it was better for the environment if they walked or rode a bike.

Table 1. Description of the performed activities (Continued)

Title of the activity	Description of the activity
Getting to know the importance of walking/cycling /using public transport instead of driving by car	

If we use public transport, we contribute less to pollution than if we go by car	We prepared flat paper models of passenger cars. Each car also had a model of its own cloud of exhaust gas. We also prepared little figures of people. The children played a game where the people go for a trip by cars. The figures were put into the different cars. To be able to see how these 'people's' car rides polluted the environment, a large cloud was assembled from the models of clouds of exhaust gas that belonged to each car. Children placed the persons in the cars in different ways: one by one, two by two, up to five in each car. Each time they distributed the persons, they composed a combined cloud from all the clouds belonging to the cars they used. This is how they obtained a visual idea about how we pollute less if several people go in the same car at the same time. The children were also given a pre-prepared flat bus model with an adjacent model of exhaust gas proportional to the size of the vehicle. The children placed the people in the bus. The size of the exhaust gas cloud model was compared to the size of the cloud made up of the clouds of individual passenger cars they had put together before. They obtained a visual idea about how the transport of a certain number of persons causes much less pollution if they ride a bus compared to if they go in passenger cars. The children concluded that to travel long distances it is better for the environment if they use public transport instead of a car.
Getting to know the imp rtance of turning the tap off (when you do not need water) and the rational use of water	
What is hiding behind the tap? How and from where does water come to our preschool?	The children knew that water runs from the tap. But they mostly did not know how water comes to the tap or what is hidden in the wall behind the tap. They were shown parts of the preschool's plumbing system that could be seen (valves, pipes, shafts), and through them and pictures the concept of the plumbing system was introduced to the children.
Reserves of drinking water are limited	The children visited a local water reservoir and observed it with the assistance of a plumbing technician. They took a look at the tanks, pipes and valves in the reservoir. They saw how the water slowly flows to the reservoir. They obtained the idea that reserves of drinking water are limited.

Table 1. Description of the performed activities

Title of the activity	Description of the activity
Getting to know the importance of turning the tap off (when you do not need water) and the rational use of water	
If we leave the tap on while brushing, we use much more water than if we turn the tap off We made an experiment in which we tried to see how	much water is used when brushing teeth if the tap is turned on, and how much is used if it is turned off. Two children were brushing their teeth, while the others observed them. One child let the tap run at medium flow while he was brushing and the drain was adjusted so that the water could pour from the washbasin through the pipe into a bucket. The other child had turned the tap off while brushing and had many cups of water available to use. They were brushing their

teeth for 1 minute, and then the tap which was turned on was turned off. By using the cups, the children measured the amount of water that had collected in the	bucket while the first child was brushing his teeth. And they also counted the cups of water that had been emptied by the child who was brushing teeth with the tap turned off. The amount of water used while brushing teeth with the tap on was approximately 20 times greater than the amount used while brushing teeth while using the water from the cups. The children acquired a visual idea about how they can save a large quantity of drinking water with a small step.
Getting to know the importance of turning lights off (when we do not need them) to save the environment	
Electrical power is needed for a light bulb to glow	Children were offered to experiment with a bulb, a battery and some wires with clamps. They found out that the bulb glows if it is connected to a battery. The children also realised that the light bulb of the table lamp glows if it is plugged into the socket. They were getting to know different things that require electricity to work. We introduced the concept of electrical energy – while being aware that children will most probably only acquire an approximate idea of this very abstract concept.
What hides behind the electric socket? How and from where does electricity come to our preschool?	Most children had no idea about what hides behind the socket in the wall. Using pictures, we introduced the concept of electrical wiring. The children took a look at part of the external electrical wiring around their preschool: they observed electrical posts, wires and the electric transformer station.
How is electricity made? The production of electrical energy pollutes the environment	Watching a video recording, the children were presented with thermoelectric and hydroelectric power plants, and how they function. The children acquired an idea about how electricity is generated by burning coal or water flowing in special buildings. Children were presented with the negative influence of electrical power production on the environment. In the recording, they saw clouds of smoke that billowed from the chimneys of a thermoelectric plant. The other recording showed the influence of the hydroelectric plant on the environment: the picture of the landscape before and after the building of a dam for the hydroelectric plant. The children obtained the idea that by turning lights off and rationally using other electrical appliances they save electricity and directly help reduce power plants' negative influences on the environment.

After the experiment, we repeated the semi-structured interviews in both groups and so re-examined the children's understanding of pro-environmental actions. We compared the results with those of the previous interviews in the two groups and were able to draw conclusions about how the activities had influenced the children's knowledge.

Data analysis

The interview recordings were transcribed. After analysing the recorded interviews, we grouped the children's answers in three categories: a) the child does not have an idea about the purpose of the pro-environmental action or his/her idea is wrong; b) the child has only a superficial, imprecise conception of the purpose of the environmental action; and c) the child knows and understands precisely how a certain pro-environmental action impacts the environment.

Using the statistical analysis software IBM SPSS Statistics we computed the absolute frequency and percentage share for each answer category. Prior to

conducting the experiment, we examined the differences in answer category frequencies for the control and experimental groups by applying the MannWhitney test. After the conducted experiment, we examined the differences in answer category frequencies for both groups separately by applying the Wilcoxon signed-rank test (Field, 2013). Cohen's *r* was calculated as a measure of effect size (Coolican, 2009).

Results

Before the activities were performed (before the experiment), the MannWhitney test showed no statistically significant differences between the control and experimental groups with respect to knowledge of how each proenvironmental action affects the environment. The effect sizes were also very small ($r \leq 0.1$). The two groups were thus equal in their initial knowledge and understanding of the pro-environmental actions (Table 2).

Table 2. Results of the Mann-Whitney test between the control and experimental groups before the experiment

Pro-environmental action	Z	p	r
Reduced use of passenger car	0.000	1.000	0.000
Saving water	0.000	1.000	0.000
Saving electricity	-0.052	0.959	0.008
Separate collection of waste paper	-0.065	0.948	0.010
Separate collection of waste plastic bottles	0.000	1.000	0.000
Separate collection of glass	-0.533	0.594	0.084
Separate collection of organic waste	0.000	1.000	0.000

Children's ideas about the effect of the pro-environmental action on the environment: walk/cycling/using public transport instead of driving by car, turning lights off (rational use of electricity), turning the tap off (rational use of water)

Initial understanding of the importance of the listed pro-environmental behaviours for the environment was very poor among the children of both groups. A large majority of children did not even have an approximate idea of the importance of these particular pro-environmental behaviours (Table 3-5). Some said they did not know the answer, while others only gave a description of individual pro-environmental behaviours instead of giving an answer, while many, instead of giving the correct answer, provided answers indicating they carry out pro-environmental behaviours, because it is socially desirable. For example: we turn the light off because our parents or the teacher tell us to, or because it is the right thing to do.

In the experimental group, the children became acquainted with the meaning of these pro-environmental behaviours through different activities (walk/cycling/using public transport instead of driving by car, turning lights or the tap off). Tables 3, 4, 5 and 6 show that the environmental understanding of these behaviours had substantially improved. The large majority of children had

acquired at least a superficial idea of the meaning of the studied proenvironmental behaviours, and only very rarely did a child remain without an idea or with a wrong idea following the activities.

In the control group, knowledge concerning the meaning of proenvironmental behaviour also remained very poor in the final interviews. The large majority of children had no idea about the importance of the studied proenvironmental behaviours or they were incorrect (Table 3-6).

Table 3. The structure of answers to the question "How do you save the environment when you walk/ride bicycle/use public transport instead going by car?" before and after the practical activities for the control and experimental groups

		Control group		Experimental group	
Answers		**before**	**after**	**before**	**after**
No or wrong idea	f	17	18	17	0
	%	85.0%	90.0%	85.0%	0.0%
Superficial, imprecise conception	f	3	2	3	2
	%	15.0%	10.0%	15.0%	10.0%
Correct, precise conception	f	0	0	0	18
	%	0.0%	0.0%	0.0%	90.0%
Total	f	20	20	20	20
	%	100.0%	100.0%	100.0%	100.0%

Table 4. The structure of answers to the question "How do you save the environment when you turn the tap off while brushing your teeth?" before and after the practical activities for the control and experimental groups

		Control group		Experimental group	
Answers		**before**	**after**	**before**	**after**
No or wrong idea	f	18	20	18	1
	%	90.0%	100.0%	90.0%	5.0%
Superficial, imprecise conception	f	2	0	2	0
	%	10.0%	0.0%	10.0%	0.0%
Correct, precise conception	f	0	0	0	19
	%	0.0%	0.0%	0.0%	95.0%
Total	f	20	20	20	20
	%	100.0%	100.0%	100.0%	100.0%

Table 5. The structure of answers to the question "How do you save the environment when you turn the light off when you do not need it?" before and after the practical activities for the control and experimental groups

		Control group		Experimental group	
Answers		**Before**	**after**	**before**	**after**
No or wrong idea	f	18	20	18	1
	%	90.0%	100.0%	90.0%	5.0%
Superficial, imprecise conception	f	1	0	2	7
	%	5.0%	0.0%	10.0%	35.0%
Correct, precise conception	f	1	0	0	12
	%	5.0%	0.0%	0.0%	60.0%
Total	f	20	20	20	20
	%	100.0%	100.0%	100.0%	100.0%

The Wilcoxon signed-rank test for the control group showed no statistically significant differences in knowledge and understanding of the pro-environmental actions, as noted before and after the experiment. The effect sizes were also very small (Table 6).

On the other hand, the Wilcoxon signed-rank test for the experimental group did reveal statistically significant differences in the children's knowledge of how each pro-environmental action affects the environment, as noted before and after the experiment. The effect sizes were large ($r \geq 0.5$). The practical activities had thus substantially enhanced the children's knowledge of the pro-environmental actions (Table 6).

Table 6. Results of the Wilcoxon signed-rank tests for the control and experimental groups after the experiment

Pro-environmental action	**Control group**			**Experimental group**		
	Z	**p**	**r**	**Z**	**p**	**r**
Reduced use of passenger car	-0.447	0.655	0.071	-4.134	0.000	0.654
Saving water	-1.414	0.157	0.224	-4.185	0.000	0.662
Saving electricity	-1.342	0.180	0.212	-3.938	0.000	0.623

Here are some examples of children's wrong initial ideas about this group of pro-environmental actions:

When I brush my teeth I turn the tap off so that there isn't a flood. (C 31)

I turn off the tap because...because dad says we need to save. Because it is expensive. (C 35)

Walking or riding a bike is better than going by car because with a car you can run over an animal or a snail or grass. (C 32)

If you go by bicycle, then the car does not use your petrol. (C 12)

It is good for your muscles if you walk or ride a bike. (C 17)

I don't know why it is good for nature when I turn the light off. I do it because mummy always turns the light off. And my sisters, too. (C 32)

If you don't turn the light off, the bulb breaks. (C 30)

A majority of the children from the experimental group acquired a correct and precise conception of the studied pro-environmental actions, as can be seen from the examples below:

I turn the tap off because then I don't use too much water. And then it doesn't fall short where the water reservoir is, and in the stream underground that goes there. (C 16)

Everything will be cleaner if we go by bike or walk. Because smoke comes out from cars and the air is dirty and then we breathe it. And the plants are dirty. (C 2)

If the light is on too much, there is too much smoke from the plant where they make electricity. And we breathe this, and nature does. (C 15)

I turn the light off to save electricity. So we use less electricity. If we used more electricity, more smoke would come from the plant and the air would be dirty. (C 4)

Some of the children's answers were classified in the category of superficial, imprecise conceptions. While they indicated a weak connection between the child's idea and their pro-environmental behaviour, they showed the absence of a more concrete idea about this connection. Two examples of such answers are:

If you do not turn the tap off when you are brushing your teeth, the water can run out. (After being asked additional questions, the child answered that it also runs short in the stream that flows in the tap.) (C 2)

If you leave the light on for too long, you use too much electricity. Then a lot of smoke comes from the chimney. (When asked additional questions, the child could not tell any more about how electricity and the smoke are connected, and from which chimney the smoke comes). (C 10).

Children's ideas about the effect of the pro-environmental action on the environment: separate collection of waste paper, plastic bottles and tin cans, glass and organic waste

The initial interviews regarding the importance of these actions brought similar results as the initial interviews about the importance of the proenvironmental actions of reduced use of passenger cars and rational use of water and electricity. A large majority of children, in both the control and experimental groups, did not know the connection between the environmental action and its effect on the environment. Instead of providing an answer to the question of how they protect the environment by separating waste, most often the children gave reasons for why they do this. Their answers reveal that many do this because it is socially desirable. Only exceptionally did children have correct and precise ideas about the importance of the separate collection of waste (Table 6-10).

Since the pro-environmental actions of separate waste collection were not included in the contents of the activities that were carried out, it would be

expected that the experimental and control groups would not differentiate from each another in their final results. After the activities were conducted, the knowledge of the experimental group about the meaning of separate waste collection was improved, but the progress was much smaller than the progress related to the behaviours whose meaning the children came to know through the activity and with direct experience. Only rarely were precise ideas acquired about the meaning of these behaviours, while the share of children with superficial ideas increased (Table 6-11).

The results of the final interviews in the control group were not essentially different from the results in their initial interviews. Their knowledge about the environmental meaning of separate waste collection remained poor. The large majority of children had no idea about this or their ideas were wrong (Table 6-11).

Table 7. The structure of answers to the question "How do you save the environment when you separately collect waste paper?" before and after the practical activities for the control and experimental groups

		Control group		Experimental group	
Answers		**before**	**after**	**before**	**after**
No or wrong idea	f	17	19	17	12
	%	85.0%	95.0%	85.0%	60.0%
Superficial, imprecise conception	f	2	1	3	5
	%	10.0%	5.0%	15.0%	25.0%
Correct, precise conception	f	1	0	0	3
	%	5.0%	0.0%	0.0%	15.0%
Total	f	20	20	20	20
	%	100.0%	100.0%	100.0%	100.0%

Table 8. The structure of answers to the question "How do you save the environment when you separately collect waste plastic bottles and tin cans?" before and after the practical activities for the control and experimental groups

		Control group		Experimental group	
Answers		**before**	**after**	**before**	**after**
No or wrong idea	f	20	20	20	15
	%	100.0%	100.0%	100.0%	75.0%
Superficial, imprecise conception	f	0	0	0	4
	%	0.0%	0.0%	0.0%	20.0%
Correct, precise conception	f	0	0	0	1
	%	0.0%	0.0%	0.0%	5.0%
Total	f	20	20	20	20

	%	100.0%	100.0%	100.0%	100.0%

Table 9. The structure of answers to the question "How do you save the environment when you separately collect waste glass?" before and after the practical activities for the control and experimental groups

		Control group		Experimental group	
Answers		**before**	**after**	**before**	**after**
No or wrong idea	f	19	20	18	13
	%	95.0%	100.0%	90.0%	65.0%
Superficial, imprecise conception	f	0	0	2	6
	%	0.0%	0.0%	10.0%	30.0%
Correct, precise conception	f	1	0	0	1
	%	5.0%	0.0%	0.0%	5.0%
Total	f	20	20	20	20
	%	100.0%	100.0%	100.0%	100.0%

Table 10. The structure of answers to the question "How do you save the environment when you separately collect organic waste?" before and after the practical activities for the control and experimental groups

		Control group		Experimental group	
Answers		**before**	**after**	**before**	**after**
No or wrong idea	f	19	19	20	15
	%	95.0%	95.0%	100.0%	75.0%
Superficial, imprecise conception	f	0	0	0	5
	%	0.0%	0.0%	0.0%	25.0%
Correct, precise conception	f	1	1	0	0
	%	5.0%	5.0%	0.0%	0.0%
Total	f	20	20	20	20
	%	100.0%	100.0%	100.0%	100.0%

The Wilcoxon signed-rank test for the control group showed no statistically significant differences in the knowledge and understanding of the proenvironmental actions of separate waste collection, as noted before and after the experiment. The effect sizes were also very small (Table 11).

The Wilcoxon signed-rank test for the experimental group did reveal statistically significant differences in the children's knowledge of how each proenvironmental action affects the environment, as noted before and after the experiment. The effect sizes were medium ($r \geq 0.3$). The project activities had an

effect on the children's knowledge and understanding of this group of proenvironmental actions (Table 11).

Table 11. Results of the Wilcoxon signed-rank tests of the control and the experimental groups after the experiment

Pro-environmental action	Control group			Experimental group		
	Z	p	r	Z	p	r
Separate collection of waste paper	-1.342	0.180	0.212	-1.903	0.029	0.301
Separate collection of waste plastic bottles	0.000	1.000	0.000	-2.121	0.017	0.335
Separate collection of waste glass	-1.000	0.317	0.158	-1.897	0.029	0.300
Separate collection of organic waste	0.000	1.000	0.000	-2.236	0.013	0.354

Here are some of the children's responses obtained in the initial interviews. The examples given show the children's answers to the questions they were asked. Some did not give an answer to the question of how they protect the environment with a certain pro-environmental behaviour, and instead gave reasons as to why they do certain pro-environmental behaviours. Their answers indicate numerous erroneous ideas about separate waste collection:

You put paper in a special bin because that's the right thing to do. (C 28)

We put plastic bottles and tin cans in a special bin. Or else policemen come, and you get fined. (C 25)

If you do not put different things separately, the waste collectors have everything mixed up, and they become angry. (C 38)

Glass things are put separately because somebody might get cut if they are put together with other things. (C 31)

Food waste is given in a separate bin because it stinks. (C 8)

Only a small number of children had correct and precise ideas about the proenvironmental actions of this group in the initial and final interviews. Two examples of their answers are:

The bin with plastic bottles is taken to the factory and they make plastic from them and they can make new plastic bottles again. If you throw these on the ground, they pollute there. (C 12)

Things that rot are put separately. My grand-grandma needs that. It rots and she puts it in the garden so that vegetables grow better. (C 31)

That some children only have a superficial idea of the importance of the proenvironmental action of separate waste collection was concluded from their answers in which only a weak connection between their understanding of the proenvironmental action and its effect was perceived. One example of such an answer is:

We put each waste in a separate bin. So that they can make something else from them in the factory. (When asked additional questions of what and how they can make something from them, it turned out that the child does not have a concrete idea about it.) (C 2)

Discussion

The Our study addresses the area of environmental education in early childhood. This area of education is becoming an increasingly important area in early childhood education (Pearson & Degotardi, 2009; Prince, 2010; Duhn, 2012). The research by Liefländer and Bogner (2014) indicated that the effect of environmental education which aims at enhancing pro-environmental attitudes may be more effective with younger children and may become less effective and more difficult to implement with increasing age. Therefore, it is suggested that environmental education should begin in the very earliest years of life.

Many studies have shown that pro-environmental concern and behaviour are influenced by different factors. Beside childhood experiences, knowledge and education are some of the most important factors (Gifford & Nilsson, 2014). Correct knowledge about environmental issues has been shown to predict behaviour (Levine & Strube, 2012). Knowledge is a often necessary but not a sufficient condition for salutary decision-making (Gifford & Nilsson, 2014; Jensen 2002; Kollmuss & Agyeman, 2002). The importance of education has been shown in many research studies, for example Meyer (2015), Hines, Hungerford, and Tomera (1987), Olli, Grenstad, and Wollebaek (2001), Lozano, Kevany, and Huisingh (2006), Clayton and Myers (2009). In general, individuals with greater education are more concerned about the environment. These facts support the idea that within environmental education during early childhood attention should also be paid to acquiring scientific knowledge about environmental problems.

Our results bring new findings to the investigation of the underlying, nonecocentric reasons for preschool children's views on pro-environmental actions established in previous research by Kahriman-Ozturk et al. (2012). The results do not support the idea, discussed by those authors, that preschool children's egocentrism, characteristic of children in the pre-operational stage, could prevent them from thinking and acting in an ecocentric way. How can a child who has not been given an opportunity to become familiar with how their pro-environmental actions influence the environment have developed ecocentric reasoning? Our results confirm the idea, as stated by Palmer (1995), that the cognitive level of children at ages 5–6 is not an obstacle to knowing and understanding proenvironmental actions.

The question remains of which approaches are most suitable for preschool children, and what is the practice of achieving the aims of environmental education. The results of our study indicate that, in general, preschool children have very poor knowledge and understanding of pro-environmental behaviours. Although these are included in the environmental activities of the preschool through children regularly carrying out pro-environmental actions themselves, they actually do not know the direct effect of their efforts – they do not know the connection between their action and its effect on the environment. In our study, many children who did not know the answer to the question of how they protect

the environment with a certain environmental behaviour instead told us they engage in these actions because it is the socially desirable behaviour (because their teacher or parents want it, because it is the right thing to do). This gives the impression that preschool education largely emphasises the carrying out of proenvironmental behaviours but, while doing so, children are not encouraged to think about the direct effects of their behaviours on the environment, nor given opportunities to be able to come to know these effects through their own experience.

The findings of the study show that preschool children are able to understand the scientific background and meaning of different pro-environmental behaviours. This understanding is easier with some actions than with others. For example, children can more easily acquire the idea of why it is important to separately collect some types of waste and recycle them because this can be more easily made familiar to them through concrete experience. The practice of children making new paper from old newspaper or burying different waste and monitoring how it degrades is not rare in preschools. On the other hand, understanding of why they should turn lights off and save electricity requires a large degree of abstract thinking, making it more difficult to find a way to bring it closer to preschool children. As a challenge, we chose this very category of environmental actions in our study. The results show that children aged 5–6 can acquire precise ideas about the importance of pro-environmental actions, even when the connection between their action and its effect on the environment is complex and difficult to grasp, provided the activities are adequately selected, presented and carried out. In our study, a large majority of children obtained an understanding of the importance of saving electricity and water, and reducing the use of passenger cars.

Activities conducted with the children were based on the well-known fact that young children mainly learn through direct experience (Bredekamp & Copple, 2009). Based on these experiences, they construct their own concepts via interaction with the physical and social environment surrounding them (Labinowicz, 2010; Fosnot, 1996). In our study, the significance of direct experience was reflected as progress made in the understanding the experimental group children showed regarding those environmental behaviours they came to know through direct experience. Interestingly, the experimental group children improved their knowledge and understanding to a certain extent also for the environmental actions of separate waste collection. While the progress was less than with the pro-environmental actions the children were getting to know experientially, it was statistically significant. While the number of children with precise and correct conceptions about the meaning of their actions still remains very small, the share of those having superficial conceptions increased. These changes in the experimental group can be explained as the result of the described activities that were conducted which encouraged children to more widely reflect on the meaning of their pro-environmental activities they perform daily.

Adult interaction and support is necessary to bridge the gap between experience and the construction of actual knowledge and understanding in early years (Siraj-Blatchford, 2007; Cutter-MacKenzie & Edwards, 2013). Although the activities that were carried out were largely planned and guided by an adult, their execution was flexible and the children's initiatives were also considered. Children

connected the acquired knowledge with their own experiences, and were additionally encouraged to think more deeply about their pro-environmental actions while carrying them out.

Learning about sustainability in early childhood education should focus on participation, communication, problem-solving and critical thinking. In new ways of environmental education, children are acknowledged as environmental stakeholders with a right to meaningfully participate in environmental issues (Davis, 2010; Pramling Samuelsson, 2011; Ärlemalm-Hagsér, 2013). An analysis of environmental education practices of Slovenian preschool and primary school teachers revealed that they under-emphasise the meaning of recruiting young children in pro-environmental actions taking place in the school and preschool (Torkar 2014). Based on the results of the present study, we suggest that children should not only be passive receivers of instructions on how to behave proenvironmentally and how to put it into practice. By giving young children frequent opportunities to gain scientific knowledge that will enable them to understand the influences of their own actions on the environment, we can help ensure children play an active role in saving the environment.

Conclusions

In conclusion, this study revealed that preschool children possessed a low initial understanding of the pro-environmental behaviour they regularly practise. This result supports previous findings. Kahriman-Ozturk et al. (2012) discussed how, according to their stage of cognitive development, these children (5- to –6years-old) should not be capable of thinking from the perspective of the environment. However, our findings do not support this idea. On the contrary, the results clearly show preschool children's progress in understanding proenvironmental behaviour after having actively performed activities in which they gained background information about different pro-environmental behaviours.

Therefore, we find that even in the preschool period children are able to understand the scientific background and the influence of their environmental behaviours if they are appropriately presented to them. We propose that during preschool period children should not only carry out pro-environmental behaviours, but also be given the opportunity to acquire, within environmental education, experiential knowledge and understanding on how their behaviour influences the environment. This is what gives their actions more sense, and, last but not least, motivation.

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes on contributors

Marjanca Kos holds a PhD in science education and now is an associate professor at Faculty of Education, University of Ljubljana, Ljubljana, Slovenia.

Janez Jerman holds a PhD in science education and now is an associate professor at Faculty of Education, University of Ljubljana, Ljubljana, Slovenia.

Urška Anžlovar holds a PhD in science education and now is an associate professor at Kindergarten Ivančna Gorica, Ljubljana, Slovenia.

Gregor Torkar holds a PhD in science education and now is an associate professor at Faculty of Education, University of Ljubljana, Ljubljana, Slovenia.

References

Ärlemalm-Hagsér, E. (2013). Respect for Nature – A prescription for developing environmental awareness in preschool. *CEPS Journal, 3* (1), 25-44.

Bredekamp, S. & Copple, C. (2009). *Developmentally appropriate practice in early childhood programs serving children from birth to age 8* (3rd ed.). Washington, DC: National Association for the Education of Young Children.

Coolican, H. (2014). *Research methods and statistics in psychology* (6th ed.). New York: Psychology Press.

Clayton, S., & Myers, G. (2009). *Conservation Psychology: Understanding and promoting human care for nature.* Chichester: Wiley-Blackwell.

Cutter-MacKenzie, A. & Edwards, S. (2013). Toward a model for early childhood environmental education: Foregrounding, developing, and connecting knowledge through play-based learning. *The Journal of Environmental Education, 44* (3), 195-213. doi: 10.1080/00958964.2012.751892

Davis, J. (2010). Revealing the research »hole« of early childhood education for sustainability: A preliminary survey of the literature. *Environmental Education Research, 15* (2), 227-241. doi: 10.1080/13504620802710607

Duhn, I. (2012). Making "place" for ecological sustainability in early childhood education. *Environmental Education Research, 18* (1), 19-29. doi: 10.1080/13504622.2011.572162

Field, A. (2013), *Discovering statistics using IBM SPSS statistics* (4th ed.). London: Sage Publications.

Fosnot, C. (1996). Constructivism: A psychological theory of learning. In C. Fosnot (Ed.) *Constructivism: Theory, Perspectives and Practice,* (pp. 8-33). New York: Teachers College Press.

Frick, J., Kaiser, F.G. and Wilson, M. (2004). Environmental knowledge and conservation behaviour: Exploring prevalence and structure in a representative sample. *Personality and Individual Differences, 37* (8), 1597-1613. doi: 10.1080/13504620220145401

Gifford, R. & Nilsson, A. (2014). Personal and social factors that influence pro-environmental concern and behaviour: A review. *International Journal of Psychology, 49* (3), 141-157. doi: 10.1002/ijop.12034

Grodzińska-Jurczak, M., Stępska, A., Nieszporek, K. & Bryda, G. (2006). Perception of environmental problems among pre-school children in Poland. *International Research in Geographical and Environmental Education, 15* (1), 62-76. doi: 10.2167/irgee187.0

Hines, J. M., Hungerford, H. R., & Tomera, A. N. (1987). Analysis and synthesis of research on responsible environmental behaviour: A meta-analysis. *Journal of Environmental Education, 18*, 1–8. doi: 10.1080/00958964.1987.9943482

Jensen, B. B. (2002). Knowledge, action and pro-environmental behaviour. *Environmental Education Research, 8* (3), 325-334. doi: 10.1080/13504620220145474

Kahriman-Ozturk D., Olgam, R. & Tuncer, G. (2012). A qualitative study of Turkish preschool children's environmental attitudes through ecocentrism and anthropocentrism. *International Journal of Science Education, 34* (4), 629-650. doi: 10.1080/09500693.2011.596228

Kolmuss, A. & Agyeman, J. (2002). Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research, 8* (3), 239-260. doi: 10.1080/13504620220145401

Krnel, D. & Naglič, S. (2010). Okoljska pismenost – ali kako uspešne so eko-šole. [Environmental literacy – or how successful are ecoschools]. *Gospodarjenje z okoljem*, *76*, 2-10.

Labinowicz, E. (2010). *Izvirni Piaget [The Piaget Primer]*. Ljubljana: DZS.

Levine, D. S. & Strube, M. J. (2012). Environmental attitudes, knowledge, intentions and behaviors among college students. *Journal of Social Psychology, 152*, 308-326. doi: 10.1080/00224545.2011.604363

Liefländer, A. K. & Bogner, F. X. (2014). The effects of children's age and sex on acquiring proenvironmental attitudes through environmental education. *The Journal of Environmental Education, 45* (2), 105-117. doi: 10.1080/00958964.2013.875511

Lozano, G. F., Kevany, K & Huisingh, D. (2006). Sustainability in higher education: What is happening? *Journal of Cleaner Production 14* (9), 757-760. doi: 10.1016/j.jclepro.2005.12.006

Meyer, A. (2015). Does education increase pro-environmental behavior? Evidence from Europe. *Ecological Economics, 116,* 108-121. doi: 10.1016/j.ecolecon.2015.04.018

Milton, K. (1993). Introduction: environmentalism and anthropology. In: Milton, K. (Ed.) *Environmentalism: The View from Anthropology*, (pp. 1-17). London: Routledge.

Musser, L. M. & Diamond, K. E. (1999). The children's attitudes toward the environmental scale for preschool children. *The Journal of Environmental Education, 30* (2), 23-30.

Olli, E., Grendstad, G. & Wollebaek, D. (2001). Correlates of environmental behaviors. *Environment & Behavior, 33* (2), 181-209. doi: 10.1177/0013916501332002

Orr, D. W. 1992. *Ecological Literacy: Education and the Transition to a Postmodern World*. Albany: State University of New York Press.

O'Riordan, T. (1981). *Environmentalism* (2nd edition). London: Pion.

Palmer, J. (1995). Environmental thinking in the early years: Understanding and misunderstanding of concepts related to waste management. *Environmental Education Research, 1* (1), 35-45. doi: 10.1080/1350462950010103

Palmer, J., & Neal, P. 1994. *The Handbook of Environmental Education.* London: Routledge.

Pearson, E. & Degotardi, S. (2009). Education for sustainable development in early childhood education: A global solution to local concerns? *International Journal of Early Childhood, 41* (2), 97-111.

Pramling Samuelsson, I. (2011). Why we should begin early with ESD: The role of early childhood education. *International Journal of Early Childhood, 43* (2), 103-118. doi: 10.1007/s13158-0110034-x

Prince, C. (2010). Sowing the seeds: Education for sustainability within the early years curriculum. *European Early Childhood Education Research Journal, 18* (3), 423-434. doi: 10.1080/1350293X.2010.500082

Siraj-Blatchford, I. (2007). Creativity, communication and collaboration: The identification of pedagogic progression in sustained shared thinking. *Asia-Pacific Journal of Research in Early Childhood Education, 1* (2), 3-23.

Stern, P. C. (2000). Toward a coherent theory of environmentally significant behavior. *Journal of Social Issues,* 56, 407-424. doi: 10.1111/0022-4537.00175

Thompson, S. C. G. & Barton, M. A. (1994). Ecocentric and anthropocentric attitudes toward the environment. *Journal of Environmental Psychology, 14*, 149-157.

Torkar, G. (2014). Learning experiences that produce environmentally active and informed minds. *NJAS - Wageningen Journal of Life Sciences, 69,* 49–55. doi: 10.1016/j.njas.2014.03.002