



Evaluating the impact of the Earthkeepers Earth education program on children's ecological understandings, values and attitudes, and behaviour in Cyprus



Constantinos C. Manoli^{a,*}, Bruce Johnson^b, Andreas Ch. Hadjichambis^c,
Demetra Hadjichambi^c, Yiannis Georgiou^d, Hara Ioannou^e

^a Department of Education, University of Cyprus, P.O. Box 20537, 1678 Nicosia, Cyprus

^b Department of Teaching, Learning & Sociocultural Studies, University of Arizona, P.O. Box 210069, Tucson, AZ, USA

^c Cyprus Center for Environmental Research and Education, 8 Georgiou Anastasiou, 3070 Limassol, Cyprus

^d Department of Communication and Internet Studies, Cyprus University of Technology, P.O. Box 50329, 3603 Limassol, Cyprus

^e Cyprus Center of Environmental Research and Education, 8 Georgiou Anastasiou, 3070 Limassol, Cyprus

ARTICLE INFO

Article history:

Received 31 May 2013

Received in revised form 3 September 2013

Accepted 4 September 2013

Available online 24 October 2013

Keywords:

Sustainability

Earth education

Ecological understandings

Environmental attitudes

Environmental values

Environmental behaviour

ABSTRACT

The recent educational reform in Cyprus moved education about sustainability to the forefront of environmental learning. The present study examines the impact of an earth education program, Earthkeepers, on children's ecological understandings, environmental values and attitudes, and behaviour. The program was implemented during two consecutive years with 491 4th to 7th graders from nine different schools in Cyprus. Quantitative data were collected using individual concept, attitude and behaviour questionnaires, and a satisfaction survey. Qualitative data were collected using individual semi-structured interviews with twelve students and nine teachers from six different schools. Data analysis showed gains in students' understanding as well as significant changes towards more pro-environmental values, attitudes and behaviour. Interviews confirmed the quantitative results and verified students' behaviour.

© 2013 Elsevier Ltd. All rights reserved.

Introduction

The concept of sustainability has arisen during the past two decades and has gained increasing importance (Zandvliet & Fisher, 2007). The approach endeavours to engage people in critical reflection of current lifestyles and behaviour and enable them to make informed decisions and changes towards a more sustainable world (Fien & Tilbury, 2002). The development of children's environmental knowledge and ecological understandings (Jucker, 2002) and environmental attitudes and behaviours are essential as these youngsters will be responsible for the conservation of the natural environment in the future (Petegem & Blicke, 2006). Within this framework, many proponents of environmental sustainability consider the development of positive attitudes towards the environment to be of particular importance (Gayford, 2009). While acknowledging that there are many variables that influence behaviour, many researchers believe that one of the most

important determinants is attitude (e.g., Bogner, 1998; Boeve-de Pauw & Van Petegem, 2011a; Bogner, Dunlap, Johnson, Manoli, & Wiseman, 2009; Bogner & Wiseman, 2004, 2006; Eagles & Demare, 1999; Heimlich & Ardoin, 2008; Johnson & Manoli, 2010; Kraus, 1995; Milfont & Duckitt, 2004; Newhouse, 1990; Stern, 2000). Other researchers have not found a strong relationship between attitudes and behaviour (e.g., Ajzen, 1987; Cleveland, Kalamas, & Laroche, 2012; Guagnano, Stern, & Dietz, 1995). In at least some cases, however, the lack of relationship may be due to methodological issues such as the lack of clear theoretical framework for attitudes and poor psychometric properties of instruments used (Johnson & Manoli, 2010). In the present study, we included environmental attitudes as an important goal of the Earthkeepers program, while also evaluating the impact of the program on ecological understandings and self-reported behaviour.

Environmental learning in Europe was established by the guidelines of the declarations of the basic environmental education conferences (e.g. Stockholm, 1972; Belgrade, 1975; Tbilisi, 1977; Moscow, 1987; Thessaloniki, 1997), the declarations of the Ministers of Education of the European Community (e.g., UNECE, 2003) as well as other relevant strategies such as the Strategy for Education and Sustainability in Europe: 2005–2015 (United Nations, 2005). In Cyprus, environmental learning has been

* Corresponding author. Tel.: +357 99932948.

E-mail addresses: manoli.constantinos@ucy.ac.cy (C.C. Manoli), brucej@email.arizona.edu (B. Johnson), a.chadjihambi@cytanet.com.cy (A.Ch. Hadjichambis), demhad@ucy.ac.cy (D. Hadjichambi), ioannis.georgiou@cut.ac.cy (Y. Georgiou), hara.ioannou@gmail.com (H. Ioannou).

promoted through European Union standards (Cyprus joined EU in 2004) with a number of environmental education programs – such as the “Golden-green Leave”, “GLOBE”, “Young reporters for the environment” and “The seed of life” (Cyprus Ministry of Education and Culture, 2010) – that have found their way to classrooms. In addition, the concept of “ECO-Schools” has become the goal for many of the primary and secondary schools in Cyprus. Eco-Schools is an international program of the Foundation for Environmental Education. Its goal is to raise students’ awareness of sustainable development issues through classroom study as well as school and community action. With the emphasis placed on a democratic and participatory approach, the program encourages children and youth to take an active role in how their school can be run for the benefit of the environment, highlighting the importance of social values (Eco-Schools, 2013). Today, nearly 90% of the schools on the island have embraced this philosophy.

The effectiveness of Eco-Schools in Cyprus has not been evaluated yet, however, there is evidence of their impact in other countries. Boeve-de Pauw and Van Petegem (2011b) found that Flemish Eco-Schools mainly influenced students’ environmental knowledge and, to some extent, their environmental attitudes. Eco-School students had equal preservation attitudes but lower utilization attitudes when compared with control-school students. Furthermore, Krnel and Naglič (2009) found that the Eco-school, as a life project, raises only the level of knowledge but fails to produce the desired results in terms of raising awareness and environmentally responsible behaviour. Similar results were found in a comparative study of 13 countries (Mogensen & Mayer, 2005).

Of great importance are environmental centres which provide opportunities for free-choice learning beyond and outside of the formal education system and can contribute to the education for sustainability (Ballantyne & Packer, 2005). Subsequently, the foundation of several environmental centres around the island has strengthened environmental learning in Cyprus from multiple perspectives. Most environmental centres offer day-long thematic programs and in some occasions multiple-day residential programs. Today, there are several governmental and non-governmental environmental education centres in Cyprus.

During the last decade, the Cyprus Ministry of Education and Culture completed a Strategic Action Plan for Environmental Education (2007) and almost all environmental learning decisions taken are coordinated centrally within the Ministry. In the framework of the recent educational reform, new curriculum was developed regarding environmental learning. The new curriculum introduced Environmental Education and Education for Sustainable Development as a new school subject in all grades of primary education, while in secondary education it is infused through other subjects. Even though it is based on several thematic units (e.g. water, air, soil, energy, biodiversity, sustainable consumption etc.), there are no actual proposed lessons. While teacher and student objectives, suggested learning and teaching approaches as well as evaluation methods are explicitly described, each teacher develops the material that fits to his/her student needs, abilities and the context of the school. This makes the subject more challenging for teachers, and the Cyprus Ministry of Education and Culture and the Cyprus Pedagogical Institute offer professional development seminars to enrich teachers’ pedagogical content knowledge.

The central principle of the new curriculum is to empower students to become environmentally literate citizens and therefore equip them with necessary knowledge (concepts), skills, awareness, attitudes and values. This is the most comprehensive effort the Cyprus Government has made to introduce sustainable development into the educational system, focusing especially on the transformation of schools into “sustainable schools” (Cyprus Ministry of Education and Culture, 2010).

The new curriculum focuses primarily on experiential approaches and less on knowledge-centre ones (Cyprus Ministry of Education and Culture, 2010). The class work includes current, local environmental issues, as well as global ones, and the learning process consists of action and problem-solving activities. Field work and outdoor activities in the schoolyard, nearby areas or environmental centres are also recommended. The philosophy of the new curriculum is based on interdisciplinary principles (combining natural and social sciences), a holistic and systemic approach (considering the complexity of environmental problems), activities (finding and defending different ideas, taking into account the needs of future generations), connecting real local environmental problems and global environmental issues (developing a sense of priority: local–national–global environmental problems), and playing an active role in democratic decision-making on environmental issues by combining cognitive, emotional and aesthetic aspects.

Studies evaluating the impact of environmental learning programs in Cyprus are very limited and fragmented offering very little to the body of environmental literature. Thus, there is an urgent need for more methodologically sound studies assessing the impact of educational programs on students’ conceptual understanding, attitudes and behaviour. A study by Zachariou and Katzie-Beltran (2002) concluded that the programs taught at Lemithou Environmental Centre, the very first environmental centre in Cyprus, contributed to the improvement of students’ conceptual understanding, but they did not succeed in promoting positive environmental attitudes towards the environment. That is not surprising given that the programs focused primarily on knowledge. Another study by Zachariou, Valanides, Kadji-Beltran, and Hrodotou (2003), reported that the participation of 5th graders in an environmental program in Cyprus promoted the development of environmentally responsible citizenship. There is a need for more studies of programs in Cyprus, particularly programs that are more comprehensive and adopt more holistic approaches targeting not only conceptual understanding but also positive attitudes and behaviours towards the environment.

Purpose of the study

The present study investigates the impact of an earth education program, Earthkeepers, on students’ ecological understandings, environmental values and attitudes, and behaviour based on the recent educational reform in Cyprus and the new curriculum in environmental learning. Earthkeepers was purposely selected for the reform effort because it addresses the needs of the new environmental curriculum and targets all three components of understandings, values and attitudes, and behaviours. While the Earthkeepers program has been translated and implemented into several other languages besides English (Finnish, Czech, Dutch, Chinese, Spanish, Japanese, German, Italian, etc.) with great success, it had never before been translated and taught in Greek. The Earthkeepers program, along with all the measurement instruments, were translated and piloted in Greek before the study by the Cyprus Centre for Environmental Research and Education (CY.C.E.R.E.) pedagogical team. The present study evaluates the effects of the Earthkeepers program on 4th to 7th grade students’ (a) ecological understanding of energy flow, cycling of materials, interrelationships and change; (b) environmental values and attitudes; and (c) personal environmental behaviour as a result of students’ experience of an earth education program. The purpose is to (1) inform those who offer the Earthkeepers program in Cyprus, and in other places around the world, about the impacts of the program and (2) contribute to the research literature on ecological understanding, environmental values and attitudes, and environmental behaviour.

Methods

Participants

Year one

During the first year, 196 students from six public schools in Cyprus took part in the study. The majority of the students were in 5th grade (42%), a large number in 4th (21%) and 6th (25%) grade and a few in 7th (12%). Their ages ranged from 9 to 14 years and gender distribution was almost equal with 54% females and 46% males. All students participated in the Earthkeepers program taught at the CY.C.E.R.E. between Autumn 2010 and Spring 2011.

Year two

During the second year of the study, the total number of participants increased to 295 students from five public schools in Cyprus. This year however, grade distribution was almost equal with 36% of the participants in 5th grade, 34% in 4th and 30% in 6th. Since no 7th grade students participated in the study, ages ranged between 9 and 12 years. Gender distribution was very similar with last year's sample comprised of 53% females and 47% males. Like the previous year, all students participated in the Earthkeepers program taught at the CY.C.E.R.E. between Fall 2011 and Spring 2012.

The Earthkeepers program

Earthkeepers (Van Matre & Johnson, 1988) is an earth education program designed by The Institute for Earth Education for upper elementary students. It helps participants construct ecological understandings, develop positive feelings for the natural world and make choices about their personal environmental behaviours (Johnson, 2003). Earthkeepers begins with a springboard three-day immersion experience in a natural place away from school, at the Earthkeepers Training Center, and continues back in the classroom and at home for at least one month (program follow-through). To help orchestrate participants' learning experience, the program is organized into four key components; *Knowledge, Experience, Yourself and Sharing*. Each component is represented by an actual key engraved with its initial letter, spelling the word "KEYS".

At the training centre, participants receive the first two keys, K and E, and become apprentice Earthkeepers. During the three days, hour-long activities immerse participants in the natural world (*Experience*) and teach them about four ecological concepts (*Knowledge*); energy flow, cycling of materials, interrelationships, and change. The three-day experience is used as a springboard to transfer the program back to the classroom and at home for the follow-through. The follow-through, as an integral part of the program, focuses on personal environmental behaviour. Students complete the program when they fulfil different tasks, that did not carry out before, such as: lessening their impact on the natural world by using less energy (e.g. electricity) and fewer materials (e.g. paper) and deepening their feelings and relation with the Earth by spending more time outdoors (*Yourself*), and sharing with others what they have learned during the program by teaching them some of the activities (*Sharing*). The tasks are carried out for at least one month in order to become part of the participants' lifestyles. In the classroom and at home, teachers and parents take the role of program facilitators, encouraging and helping the participants to complete their tasks. In order to confirm task completion at home, parents must send a signed confirmation letter to the teachers. Once the participants complete these tasks they receive the remaining two keys, Y and S, and become full pledged Earthkeepers.

Past research on the Earthkeepers program has consistently shown gains in student understanding of ecological concepts

(e.g., Park, 1997; Martin, 2002; van Wissen, 1992). However, for another important aspect of the program, values and attitudes, the results have been mixed. Changes towards more pro-environmental values and attitudes, from pre- to post-program, have been found in several studies (e.g., Park, 1997; Black, 1998; Martin, 2002, Johnson & Manoli, 2010; Manoli, Johnson, & Dunlap, 2007), however, a few others (Bosse, 2000; Mess, 2000) found no statistically significant changes as a result of the program. One of the main reasons for the mixed results is the fact that some of these studies did not use well-developed and tested instruments (Martin, 2003), thus, failing to measure the actual impact of the program. Finally, Black (1998) found evidence of behavioural change long after taking part in the program. Based on her study, former Earthkeepers participants had more positive behaviours towards the environment compared to non-participants.

Procedure

The process followed was very similar in both years of the study. In order to measure the impact of the program, we used four assessment instruments as well as semi-structured interviews with students and teachers. All instruments used were translated into Greek and pilot tested before the program.

One to two weeks before the program, participants completed the Ecological Concept Questionnaire (ECQ) and the Model of Ecological Values (2-MEV) Scale as a pre-program test. The ECQ (Johnson, Roberts, & Manoli, 2006) is an instrument specially designed for the Earthkeepers in order to measure the program's impact on students' ecological understandings. There are 13 multiple-choice items on the questionnaire addressing the concepts of energy flow, cycling of materials, interrelationships among organisms and change over time for a total of 13 points. Some of the concepts have more facets of interest than others, so there are different numbers of items for each of the concepts: 6 for energy flow, 3 for materials cycling, 2 for interrelationships and 2 for change. A total score, the percentage of all 13 items correct, is reported, as are percentages correct of each of the four concepts.

The 2-MEV Scale (Bogner & Wiseman, 1999; Wiseman & Bogner, 2003), as it was modified for upper elementary students (Johnson & Manoli, 2010), was used to measure both values and attitudes. The 2-MEV measures two higher-order values: Preservation and Utilization. Preservation refers to the conservation and protection of the natural environment and includes items such as "I try to save water by taking shorter showers or by turning off the water when I brush my teeth". It consists of three attitudes (sub-factors): Intent of Support, Care with Resources and Enjoyment of Nature. Utilization refers to the utilization of natural resources and includes items such as "To feed people, nature must be cleared to grow food". It consists of two attitudes (sub-factors): Altering Nature and Human Dominance. The questionnaire utilizes a 5-point Likert scale with responses ranging from *Strongly Agree* (5 points) to *Strongly Disagree* (1 point) and a neutral response *Not Sure* (3 points). A mean score of 3.0 indicates no commitment. For Preservation, a mean score over 3.0 indicates pro-environmental views. However, for Utilization, a score above 3.0 indicates the opposite. The structure of the model was tested and confirmed (Confirmatory Factor Analysis) with several thousand 7th grade students from Cyprus; those results are reported in a separate manuscript in preparation.

Right after the three-day immersion experience at the centre, and before the completion of the follow-through, the participants completed the Program Satisfaction Survey (PFS). The PFS is program specific, designed to verify whether the program met the participants' expectations. The questions of the survey focus on the content of the program (activities), the program leaders and the outdoor experience.

Table 1
Students' ecological understandings before and after the program in Year 1.

Concepts	ECQ mean score (% correct)		Std. deviation		Gain	t	p	Effect size
	Pre	Post	Pre	Post				
Energy Flow	33.08	48.39	17.03	22.11	46%	-7.28	.000*	.78
Cycling	63.65	75.68	26.74	28.46	19%	-3.66	.000*	.44
Interrelationships	38.43	42.16	31.21	29.31	10%	-1.07	.288	.13
Change	43.33	58.15	33.90	36.25	34%	-3.83	.000*	.44
Total Score	42.59	55.07	12.19	17.34	29%	-7.52	.000*	.90

* $p = .05$ for Total Score; $p = .0125$ for Energy Flow, Cycling, Interrelationships and Change.

One month later, the participants were asked to complete the ECQ and 2-MEV Scale one more time as a post-program test. This allowed the comparison between pre and post-program scores in order to assess the impact of the program. The reason for the delay was that the program includes not only the three days at the centre but the follow-through back in the classroom.

Upon completion of the program, approximately two months after their visit at the centre, participants completed the Program Follow-Through Survey (PFTS) in order to determine any changes in their behaviour due to the program. The PFTS includes both closed- and open-ended items asking students about their environmental behaviours, including any specific ways they are using less energy and fewer materials. It also asks about ways they are experiencing the natural world. In addition, the PFTS includes items about their completion of the Earthkeepers program and how their experiences in the program relate to what they are studying back in the classroom.

Finally, individual semi-structured interviews with both students and teachers, during the first year of the study, helped verify the quantitative results and provide further information about the long-term effects of the program. In addition, the interviews from the two groups were compared in order to confirm whether student and teacher comments were in agreement. The interviews took place at the schools towards the end of the school year with a total of 12 students (two students from each school) and 9 of their teachers. The interview questions focused on students' ecological understandings of the four concepts taught during the program, their attitudes towards the natural world and long-term behavioural changes after attending the program.

Data analysis

All data collected, with the exception of the interviews, were entered and analysed using the SPSS statistical package. Participants with missing data (incomplete surveys), absence during the 3-day Earthkeepers program, special needs (e.g. reading disabilities) and purposefully patterned responses were excluded from the analysis in order to avoid any bias. A pair-sample t-test analysis of the ECQ and 2-MEV scores helped determine if there were any statistically significant changes in students' understanding of ecological concepts and environmental values and attitudes between pre- and post-program scores. The PSS and the PFTS were analysed in a quantitative manner examining any patterns of frequencies in students' satisfaction responses and behaviour respectively. The student and teacher interviews were transcribed and analysed separately using an open coding system.

Results

Year one

During the analysis of the first year's data, two of the eleven classes that attended the program were eliminated from the

analysis because the teachers were unable to complete the program. Both classes attended the initial three days of the program but did not continue with the last half of the program back at school. One of the teachers had health problems which required her to leave the school for several months while the other teacher had a heavy workload which left no time for doing this program. The remaining nine teachers completed the full programs after returning from the three days at the centre.

Ecological understandings

Analysis of students' ecological understandings, as they were measured by the ECQ, revealed a statistically significant increase in three (Energy Flow, Cycling of Materials, Change over Time) of the four ecological concepts as well as the overall score (see Table 1). Examining the mean concept pre-scores, it is evident that students were more familiar with the concept of Cycling of Materials (63.65%). Concepts such as 'recycling' are part of the curriculum often taught in fourth grade, thus students had a better understanding of this concept before the program. The concepts of Energy Flow and Interrelationships had the lowest scores, pre and post-program, as these are more complex concepts to understand for student of this age. There was a large effect size for the change in Energy Flow as well as for the total score and moderate effect sizes for the changes in Cycling of Materials and Change. While there were gains in all four concepts, it is evident that there is still room for more score improvement especially for the concepts of Interrelationships and Cycling of Materials.

The student interviews revealed that Earthkeepers helped the participants enrich their understandings of natural processes (four ecological concepts). In response to the question "Where do plants, animals and humans get their energy?", which was related to the understanding of Energy Flow, almost all students (92%) mentioned that plants get their energy from the sun while herbivores get their energy from plants. The same number of students (92%) also mentioned that humans get energy from both plants and animals.

For Interrelationships, students were asked to place in order "Which of the following would there be the most of in a food chain (munchline)? Plants, animals that eat plants, animals that eat animals. Why is that?" The majority of the students (83%) understood that plants would be the most in a food chain because "plants should be more in order to feed animals that eat plants" or "plants are more because is the base of the food chain. The plants absorb sun and become available for food for other animals". Only 2 students (17%) mentioned that "animals that eat plants should be more because they get their energy from plants and grow faster".

Students also seemed to have a good understanding of the concept of Cycling of Materials. When asked if they could drink some of the same water or breath some of the same air another person did thousands of years ago, or even be made of something that was once part of a dinosaur, ten out of the twelve students (83%) responded positively. They explained that this could happen because "specks (molecules) are constantly being recycled" or "make

Table 2
Students' environmental attitudes before and after the program in Year 1.

	Mean scores		Std. deviation		<i>t</i>	<i>p</i>	Effect size
	Pre	Post	Pre	Post			
Preservation	4.09	4.41	.54	.46	−6.69	.000*	.64
Intent of Support	4.13	4.29	.68	.64	−2.51	.013*	.24
Care with Resources	4.04	4.45	.88	.72	−4.45	.000*	.51
Enjoyment of Nature	4.05	4.48	.74	.58	−6.14	.000*	.65
Utilization	2.26	2.08	.79	.81	2.47	.015*	.22
Altering Nature	2.42	2.16	.95	.93	2.87	.005*	.28
Human Dominance	2.13	2.03	.97	.86	1.11	.269	.11

* *p* = .05 for Preservation and Utilization; *p* = .016 for Intent of Support, Care with Resources, and Enjoyment of Nature; *p* = .025 for Altering Nature and Human Dominance.

a cycle". Only two of them (17%) were unable to provide an explanation that made sense.

Finally, it is evident that students understood the concept of Change. When asked "What would the landscape/climate/animals/plants of this area have been like in the past? Could it be very different in the future?", nine students (75%) described how "more plants, animals, fields or bare ground" were present in the past while seven students (58%) mentioned that fewer man-made elements were present in the past e.g., "fewer buildings", "no school", "fewer cars", "no electricity". Regarding the future, some students (25%) mentioned that natural elements will decrease, man-made elements will increase (50%), while some of the students (42%) made general guesses that if humans continue like this "there will be no planet", "there will be no humans" or "all will be worse".

Environmental values and attitudes

Similarly, the analysis of the 2-MEV Scale data revealed a statistically significant change in students' environmental values and attitudes (see Table 2). While students had pro-environmental values and attitudes before attending the program (Preservation > 3 and Utilization < 3), those became even more pro-environmental after program. With the exception of one sub-factor, Human Dominance (Utilization), all other factors and sub-factors experience a statistically significant change. Even though the score of the sub-factor of Human Dominance decreased, the change was not large enough to be statistically significant. However, this could be due to the fact that students scored so low on this sub-factor initially, limiting the possibility for a larger decrease in the score. Effect sizes ranged throughout the two values and five attitudes, from low (.21) to moderate (.65). However, because environmental values and attitudes are very difficult to alter (Bogner, 1998), these changes could be considered substantial for a three-day intervention program.

The interviews provided supportive evidence of students' positive change towards more pro-environmental values and attitudes as well. When asked "Do you think you care about the environment about the same amount as your friends and family members?", four students (33%) mentioned they care more than their friends because their friends didn't participate in the program e.g., "I care more than my friends because they didn't go to the program. Therefore I know more things and ways to care". In relation to their friends who participated in the Earthkeepers program, eight students (67%) mentioned they care about the same because "my friends went to the environmental center as well", while four of them (33%) stated they cared more. Regarding the students who made a comparison with their families, only one student mentioned that "I care more than my family". More than half of them (58%) could not distinguish their attitudes compared with those of their families because "my family cares and I am a member of it".

Students also demonstrated Care with Resources. When asked "Is it important to save electricity by doing things like turning off

the lights when you leave a room?", they all responded positively. Seven students (58%) referred to oil/energy saving e.g., "by this way we burn less oil", "save oil because is not a renewable resource", while seven students (58%) mentioned pollution e.g., "reduce air pollution", "protect our health from pollution", "reduce pollution of edible plants and animals", "protect environment from greenhouse effect".

A similar question regarding conservation of water, again all students responded positively. Almost everyone (93%) referred to the depletion of the natural resource but most importantly their concern regarding the survival of leaving organisms e.g., "plants, animals, human will die", "living organisms will need it". One student referred to the importance of recycling natural resources, "it's important to save water specks because will be recycled", while another student referred to the importance of water for the island, "in Cyprus amounts of water are low, like oil".

Behaviour

Approximately two months after the completion of the program, the participants were asked to complete the PFTS in order to determine the impact of the program on their behaviour. Unfortunately, not all participants completed the survey. Only six (45% of the students) of the eleven classes returned the PFTS complete.

Of the 73 students who completed the survey, all but three of them (3.4%) had earned their "Y" key. Two of those students expressed no interest in receiving the key, while one student stated that it was too difficult to carry out the necessary tasks. Four students (4.5%), the same three students and one other, did not receive their "S" key. Two of them expressed no interest in receiving the "S" key; one claimed did not have enough time to carry out the tasks, while another student was still working on the tasks.

Most encouraging, however, was the fact that almost all students (97.7%) stated that after receiving the "Y" key, they continued to use less energy and fewer materials. In addition, a large number of them (90.9%) also maintained they kept close contact with the natural world, having new experiences and reflections. This clearly indicates behavioural changes in students' lifestyle, fulfilling one of the main goals of the program. Of great importance for the purpose of this study was the fact that the Earthkeepers program seemed to be a great help for students at school. A large number of them (71.3%) stated that knowledge obtained during the program was useful and applicable, both in school assignments and tests. Hence, taking into account students responses about the program, and its impact on their lifestyles, it is not surprising that almost all of them (90.9%) would recommend the Earthkeepers program to their friends.

In order to confirm students' self-reported behaviour on the PFTS, we asked students during the interviews "Do you do anything to protect the environment or to help solve some of its problems?" Most students (83%) mentioned energy saving actions

such as “switching off electrical appliances”, “switching off the lights”, “avoid switching on the lights during the day”, “I go on foot in nearby places”, while some of them (33%) mentioned recycling actions either at home or at school. At the same time, half of the students mentioned water saving actions such as “turn off the water while I’m washing my hands and teeth” or “use a watering can instead of the hose when watering the garden”. Four students (33%) mentioned other actions such as “stop littering” or “inform other people how to save nature”. In addition, we asked teachers to report which students had earned their Y keys (based on behaviour changes). In order to earn the Y key, students had to have a form confirming the adoption of new behaviours signed by a parent.

However, in order to determine whether these behaviours were indeed because of the impact of the program, we asked students “Did you do more of these things before or after the program? Why?” The majority of the students (83%) mentioned that they do more things to protect the environment after their participation in EK program explaining that “I learned more ways how to”, “I learned so many things and now I understand why I should do that”, “because I am an Earthkeeper and as an Earthkeeper I have to protect the environment”. Only one student mentioned that she does fewer actions that before, without however explaining why.

Program contribution

Moving beyond the impact of the program on students’ ecological understandings, environmental attitudes and ecological behaviour, we used the PSS and the interviews to assess the overall impression of the program on students and whether it really fit the needs of the new curriculum. Before leaving the Earthkeepers Training Center at the end of the 3rd day, students were asked to complete the PSS in order to evaluate their three-day experience and determine whether they were satisfied, or not, with the Earthkeepers program. Similar to the PFTS, only six classes returned the PSS complete. These six classes, however, were not all the same classes that returned the PFTS.

The majority of the students (95.8%) liked everything about the program. Only two students (2.8%) stated they liked all but some things, while one student (1.4%) liked only some things. Almost everyone enjoyed being outdoors (98.6%) and did not find the activities boring (95.9%) or too long (90.4%). Consequently, they expressed their interest in doing more outdoor activities like those of the program (95.9%) and seem to get along with the activity leaders (97.3%). Most encouraging, however, was the fact that the majority of the students (95.9%), through their participation in the program, learned new things they had no knowledge of in the past and expressed the desire to return to the centre in order to attend a similar program to Earthkeepers (98.6%).

Looking at the student interview question, “What did you think of the Earthkeepers program?”, more than half of the students (58%) referred to the contribution of the learning experience, emphasizing among other things that “it was enjoyable”, “it was innovative”, “it was much better than learning in the classroom”, and “we learned so many things through playing”. Four students (33%)

referred to the connection of the program to nature e.g., “I liked it because we were outside the classroom in nature most of the time”, while six of them (50%) talked about their impressions for specific activities such as “regarding spec-trails, I didn’t believe at the beginning that I could drink the same water specs that Great Alexander drunk, after I understood that was true”, “I liked that I have to share the things I learned with other people”.

When students were asked “What would you tell a friend about the Earthkeepers program?”, many of them (75%) said they would highly recommend it to other students e.g., “I liked it, it’s nice to go too. Tell your teacher about it.”, “many schools should go if we want to make a change” while half of the participants (50%) referred to specific characteristics of the program and activities e.g., “this way we will help the earth by recycling, saving energy and water”, “it was enjoyable and learned so many things important to save our planet”.

In response to a similar question, the teachers spoke even more highly of the program. The majority of them (89%) referred to the contribution of the learning experience, mentioning between others that “the scenario was motivating”, “the program was innovative”, “the program helped students understand many concepts through playing”, “the program created many experiences in nature”. They also talked about the fact that “the program continued at school and at home and did not end at the center” and how valuable was the “infusion of the program in students’ families”. Finally, some teachers (33%) emphasized the fact that the program contributed to their class work and the requirements of the new curriculum e.g., “the program was helpful in general aspects of communication and collaboration”, “students participation in the program contributed to the understanding of several other environmental issues”, “the Earthkeepers program helped me organize several environmental activities at school”.

Year two

The second year of the study was susceptible to weather conditions as the island received an unusual amount of precipitation during the winter and spring season. Unfortunately, two of the eight Earthkeepers sessions (a total of four classes from the same school) had to be postponed due to severe rainfall, thus interrupting the flow of the program. Despite the efforts of the staff to complete the remaining activities later on, there was simply not enough time. For this reason, the four classes were eliminated from the data analysis in order to avoid jeopardizing the impact of the program and the results of the study.

Ecological understandings

During the second year of the study, ecological understandings yielded better results than the first years’ data. All four concepts, and the overall score, increased significantly (statistical) after the intervention of the program (see Table 3). Similar with the results of the first year, participants scored higher on the concept of Cycling of Materials, before and after the program. However, the high pre-score allowed less room for gain (41%) than the remaining

Table 3
Students’ ecological understandings before and after the program in Year 2.

Concepts	ECQ mean score (% correct)		Std. deviation		Gain	t	p	Effect size
	Pre	Post	Pre	Post				
Energy Flow	27.94	57.94	17.45	25.72	111%	-14.11	.000*	1.46
Cycling	52.94	74.90	27.28	30.94	41%	-7.59	.000*	.75
Interrelationships	31.76	61.47	33.39	37.30	93%	-8.54	.000*	.84
Change	37.06	71.47	33.22	34.75	93%	-9.57	.000*	1.01
Total Score	35.70	64.48	13.61	23.52	81%	-14.76	.000*	1.50

* p = .05 for Total Score; p = .0125 for Energy Flow, Cycling, Interrelationships and Change.

Table 4
Students' environmental attitudes before and after the program in Year 2.

	Mean scores		Std. deviation		<i>t</i>	<i>p</i>	Effect size
	Pre	Post	Pre	Post			
Preservation	3.96	4.29	.60	.61	−6.49	.000*	.55
Intent of Support	4.04	4.16	.72	.74	−1.77	.078	.16
Care with Resources	3.96	4.43	.90	.77	−6.20	.000*	.56
Enjoyment of Nature	3.88	4.34	.84	.72	−7.05	.000*	.59
Utilization	2.51	2.14	.70	.76	6.19	.000*	.51
Altering Nature	2.66	2.19	.95	.93	5.95	.000*	.50
Human Dominance	2.33	2.09	.75	.83	3.22	.002*	.30

* *p* = .05 for Preservation and Utilization; *p* = .016 for Intent of Support, Care with Resources, and Enjoyment of Nature; *p* = .025 for Altering Nature and Human Dominance.

three concepts. The concepts of Interrelationships and Change experienced gains of 93% while the concept of Energy Flow had a 111% gain. Over all, the total score of all four concepts experienced an 81% gain. However, while the effect sizes for the gains for all four concepts were large, the mean scores did not exceed 75%, indicating once again that there is still room for improvement. Resembling the first year's results, the more complex concepts, Energy Flow and Interrelationships, had the lowest scores, before and after the program.

Environmental values and attitudes

Participants' environmental values and attitudes experienced a statistically significant change during the second year as well (see Table 4). Like the first year of the study, students began with environmentally oriented scores before the program and became more environmentally oriented after the program for both factors of Preservation and Utilization. Only the sub-factor of Intent of Support (Preservation) did not experience a statistically significant change. While there was a score increase in this sub-factor, from pre- to post-program, it was not large enough to be statistically significant. Taking into consideration the pre-program results, it is evident that students had already scored very high on this sub-factor with a possibility for a "ceiling" effect. Comparing the results of the two years of the study, it is evident that the post-program scores from year one (see Table 2) were slightly more pro-environmental than the second year's results. However, it is important to note that last year's pre-program score were also more pro-environmental, compensating for the difference. Finally, the second year's effect sizes were of moderate values and to some extent better than those of the first year.

Behaviours

The response rates for the PFTS were much better in year two. Only 10.1% of the participants did not return the surveys. Over all, the vast majority of the students carried out all the required Y and S tasks and became full Earthkeepers.

A total of 198 students (95.2%) fulfilled all requirements for the *Yourself* tasks and earned their Y key. However, 10 others (4.8%) failed to do so. Of those, four students stated they did not have enough time, three were still working on their tasks, two forgot all about the tasks, and finally, one student expressed no interest in completing the program. Likewise, the majority of the students (82.89%) completed the *Sharing* tasks and received the S key, while the remaining 17.11% (35 students) were unsuccessful. Main reasons for failing to do so included the lack of time (15 students) and forgetting about the tasks (11 students). Seven other students were still working on their tasks, while the last two stated they simply didn't care for the program.

As in year one, the majority of the students (93.3%) continued to use less energy and fewer materials after completing the program. Similarly, a great number of them (85.6%) continued to have new experiences and reflections in the natural world. In addition, the

knowledge obtained during the program was very useful for many students (74.2%) in school assignments as well as tests. Finally, the positive impact of the program reflects on students' positive response (93.2%) to recommend the Earthkeepers program to their friends.

Program contribution

The PSS had similar return rates to the PFTS. The results revealed another year of satisfied participants. Like in year one, the majority of the students (88.3%) had a great experience and liked everything about the program while only two students (1%) were unsatisfied and liked just a few things. A small portion of the students (10.7%) liked all but some things, however, considering the bad weather conditions, it was expected a few of them to be negatively affected.

Over all, the majority of the students (95.7%) loved being outdoors. They did not seem to find the activities boring (89.9%) or too long (84.1%), and they were very positive to the idea of doing more outdoor activities like these (86.4%). Most of them liked the program and the program leaders (95.2%) and would like to come back and do another program like the Earthkeepers (89.9%). Finally, when asked if they learned anything new due to their participation in the program, the majority of them (93.7%) said yes.

Discussion

From the results of the study, it is evident that students who participated in the Earthkeepers program have shown gains in understanding of ecological concepts as well as changes towards more pro-environmental values and attitudes and behaviour. In particular, students (a) became more competent understanding ecological concepts related to Energy Flow, Cycling of Materials, Interrelationships and Change; (b) experienced statistically significant increase in pro-environmental values and attitudes; and (c) demonstrated longitudinal behavioural changes by lessening their impact on the natural world, deepening their feelings with the Earth and sharing their knowledge with others.

The results suggest that the holistic approach addressing all three components of educational pedagogy – conceptual understanding, values and attitudes, and behaviour – was very successful addressing the needs of the recent educational reform and the new environmental curriculum. It is our belief that a well designed, long-term approach such as that of earth education programs (Van Matre, 1990) is required in order to have a substantial impact on these components, some of which (values and attitudes) are very resistant to change (Bogner, 1998). Results obtained in the study support the contribution of the Earthkeepers program to developing affective components of environmental literacy, since the program seemed to generate a sense of wonder, interest, enthusiasm, motivation, and eagerness to learn, which are much neglected in traditional formal school science.

Findings of the study have broader implications with regards to developing and implementing non-formal environmental learning programs in schools as extracurricular programs supplementing the school curriculum, as well as contributing to teachers' everyday practice. The successful pedagogical practices of the current learning intervention could constitute exemplary practices that could be implemented in the frame of innovative approaches of education for sustainability. Future research could investigate other components of the program that could highlight directions for education for sustainability are: learning through playing, providing experiences in environment, expanding actions at school and home, enhancing communication and collaboration, approaching the environment in a holistic view, promoting sharing of knowledge, experiences and behaviours.

The Earthkeepers program seems to contribute also to the educational reform since it is in accordance to the revised curriculum which aims to "help students develop into active citizens, to enhance their critical thinking and research capabilities". Furthermore, the program could support teachers "to include a variety of teaching methodologies and introduce flexibility in the school program, so that they may use the most appropriate approach for the particular class" (Cyprus Ministry of Education and Culture, 2010, p. 257). Johnson (2007) proposes the implementation of earth education programs in order to make decisions and take action for sustainable life, for understanding the natural systems of the world and for grasping the big picture of how life works. The results of the present study support the integration of such programs into the Cyprus curriculum under the European Union standards.

The Earthkeepers program had a tremendous impact on the students in Cyprus, despite its initial stage of translation and implementation. Very encouraging is the fact that similar results were found in studies of the Earthkeepers program in other countries where the program is currently taught (Martin, 2003). Despite the analogous results of previous studies, in no other occasion were all components – understanding, values and attitudes, and behaviour – assessed in a single study successfully.

Despite the encouraging results of the study, we urge researchers to use the findings with caution. The sample size of the study is limited and the results cannot be generalized for the whole student population of Cyprus. While several grades (4th to 7th) took part in the Earthkeepers program, it is not evident which grades were impacted the most due to the small sample of students in each grade. Thus, more students from each grade are required in order to strengthen our findings and to further investigate if some grades are more impacted than others. In addition, the results of the interviews with individual participants about their behaviours should be treated with caution. There is clearly a possibility that participants felt some pressure to please the interviewer.

Further investigations of the Earthkeepers program in Cyprus, and in other places around the world, could inform us what it is about the program that contributes to the changes seen in this study. Are there program practices that seem to be especially beneficial to impacting student understandings, values and attitudes, and behaviours? Longitudinal examination of the program's impacts is also important to investigate. How persistent are the changes, particularly in environmental behaviour? What can be done to encourage not only the maintenance but the expansion of pre-environmental behaviours developed as a result of Earthkeepers? There are also interesting questions about the relationships between understandings, values and attitudes, and behaviours. In what ways and how strongly are they linked? Are changes in understandings and in values and attitudes prerequisites to changes in behaviours, or are they all developed at the same time? To what extent do changes in behaviour lead to further changes in understandings or in values and attitudes? It is clear

that there is a wealth of future evaluation and research that could build on the results of this study.

References

- Ajzen, I. (1987). Attitudes, traits, and actions: Dispositional prediction of behavior in personality and social psychology. *Advances in Experimental Social Psychology*, 20(1), 63.
- Ballantyne, R., & Packer, J. (2005). Promoting environmentally sustainable attitudes and behaviour through free-choice learning experiences: What is the state of the game? *Environmental Education Research*, 11(3), 281–295.
- Black, R. S. (Unpublished results). *The use of qualitative methods in environmental education evaluation: A pilot study with the Earthkeepers program*. New South Wales, Australia: Unpublished master's thesis, University of New England.
- Boeve-de Pauw, J., & Van Petegem, P. (2011a). A cross-cultural study of environmental values and their effect on the environmental behavior of children. *Environment and Behavior*, 20(1), 1–33.
- Boeve-de Pauw, J., & Van Petegem, P. (2011b). The effect of Flemish Eco-Schools on student environmental knowledge, attitudes, and affect. *International Journal of Science Education*, 33(11), 1513–1538.
- Bogner, F. X. (1998). The influence of short-term outdoor ecology education on long-term variables of environmental perspective. *Journal of Environmental Education*, 29(4), 17–29.
- Bogner, F. X., & Wiseman, M. (1999). Toward measuring adolescent environmental perception. *European Psychologist*, 4, 139–151.
- Bogner, F. X., & Wiseman, M. (2004). Outdoor ecology education and pupils' environmental perception in preservation and utilization. *Science Education International*, 15(1), 27–48.
- Bogner, F. X., & Wiseman, M. (2006). Adolescents' attitudes towards nature and environment: Quantifying the 2-MEV model. *Environmentalist*, 26, 247–254.
- Bogner, F. X., Dunlap, R. E., Johnson, B., Manoli, C., & Wiseman, M. (2009). Views of the environment – Theory, measurement, and results. Presented at the annual meeting of the National Association for Research in Science Teaching.
- Bosse, S. (Unpublished results). *The Earth Education program Earthkeepers – Qualitative evaluation and reflection from the perspective of a constructivist (environmental) education*. Germany: Unpublished master's thesis, University of Luneburg/Institute for Environmental Communication.
- Cleveland, M., Kalamas, M., & Laroche, M. (2012). "It's not easy being green": Exploring green creeds, green deeds, and internal environmental locus of control. *Psychology and Marketing*, 29(5), 293–305.
- Cyprus Ministry of Education and Culture. (2007). *The strategic action plan for environmental education and education for sustainable development*. Nicosia: Cyprus Pedagogical Institute.
- Cyprus Ministry of Education and Culture. (2010). *Curriculums of preprimary, primary and secondary education, Volume A. Curriculum of environmental education/education for sustainable development*. Nicosia: Cyprus Pedagogical Institute – Program Development Service.
- Eco-Schools (2013, August 18). *What is Eco-Schools?* Retrieved from: <http://www.eco-schools.org/menu/about/eco-schools-2>.
- Eagles, P. F. J., & Demare, R. (1999). Factors influencing children's environmental attitudes. *Journal of Environmental Education*, 30(4), 33–37.
- Fien, J., & Tilbury, D. (2002). The global challenge of sustainability. In D. Tilbury, R. B. Stevenson, J. Fien, & D. Schreuder (Eds.), *Education and sustainability: Responding to the global challenge* (pp. 1–12). Gland: Commission on Education and Communication, IUCN.
- Gayford, D. (2009). *Learning for sustainability: From the pupils' perspective*. UK: WWF Research Report.
- Guagnano, G. A., Stern, P. C., & Dietz, T. (1995). Influences on attitude-behavior relationships a natural experiment with curbside recycling. *Environment and Behavior*, 27(5), 699–718.
- Heimlich, J., & Ardoin, N. (2008). Understanding behavior to understand behavior change: A literature review. *Environmental Education Research*, 14(3), 215–237.
- Johnson, B. (2003). The role of experience in understanding, feeling, and processing. *Zeitschrift Für Erlebnispädagogik*, 23(5/6), 5–13.
- Johnson, B. (2007). Education and research for sustainable living. In D. B. Zandvliet & D. L. Fisher (Eds.), *Sustainable communities, sustainable environments* (pp. 85–96). Rotterdam: Sense Publishers.
- Johnson, B., & Manoli, C. C. (2010). The 2-MEV scale in the United States: A measure of children's environmental attitudes based on the theory of ecological attitude. *The Journal of Environmental Education*, 42(2), 84–97.
- Johnson, B., Roberts, E., & Manoli, C. (2006). The impact of earth education programs on students' understandings of ecological concepts. Paper presented at the annual meeting of the National Association for Research in Science Teaching.
- Jucker, R. (2002). Sustainability? Never heard of it. *International Journal of Sustainability in Higher Education*, 3(1), 8–18.
- Kraus, S. J. (1995). Attitudes and the prediction of behavior: A meta-analysis of the empirical literature. *Personality and Social Psychology Bulletin*, 21, 58–75.
- Krnjel, D., & Naglič, S. (2009). Environmental literacy comparison between eco-schools and ordinary schools in Slovenia. *Science Education International*, 20(1), 5–24.
- Manoli, C. C., Johnson, B., & Dunlap, R. E. (2007). Assessing children's environmental worldviews: Modifying and validating the New Ecological Paradigm Scale for use with children. *Journal of Environmental Education*, 38(4), 3–13.
- Martin, D. (Unpublished results). *An evaluation of the Earthkeepers program at Ardroy Outdoor Center*. Liverpool, U.K.: Unpublished report commissioned by Ardroy Outdoor Center and Scottish Natural Heritage, Liverpool John Moores University.

- Martin, D. (2003 May/June). *Research in earth education*. *Zeitschrift für Erlebnispädagogik*.
- Milfont, T., & Duckitt, J. (2004). The structure of environmental attitudes: A first- and second-order confirmatory factor analysis. *Journal of Environmental Psychology*, 24, 289–303.
- Mess, R. (Unpublished results). *Possibilities and limitations of earth education demonstrated with Earthkeepers*. Germany: Unpublished master's thesis, University of Luneburg/Institute for Environmental Communication.
- Mogensen, F., & Mayer, M. (2005). *Eco-schools – Trends and divergences*. Vienna: Austrian Federal Ministry of Education, Science and Culture.
- Newhouse, N. (1990). Implications of attitude and behavior research for environmental conservation. *Journal of Environmental Education*, 22(1), 26–32.
- Park, E. (Unpublished results). *The effectiveness of the Earthkeepers 3-day residential program at McKeever Environmental Learning Center on students ecological knowledge and environmental attitudes*. Pennsylvania: Unpublished master's thesis, Slippery Rock University, Slippery Rock.
- Petegem, V. P., & Blicek, A. (2006). The environmental worldview of children: A cross-cultural perspective. *Environmental Education Research*, 12(5), 625–635.
- Stern, P. C. (2000). Toward a coherent theory of environmentally significant behavior. *Journal of Social Issues*, 56(3), 407–424.
- United Nations. (2005). *UNECE strategy for education for sustainable development; CEP/AC.13/2005/3/rev 1. High level meeting of Environment and Education Ministers, 17–18 March 2005*.
- UNECE. (2003). *Statement on education for sustainable development; ECE/CEP/102/Rev.1. Fifth ministerial conference "Environment for Europe", Kiev, 21–23 May 2003*.
- Van Matre, S. (1990). *Earth education: A new beginning*. Greenville, WV: The Institute for Earth Education.
- Van Matre, S., & Johnson, B. (1988). *Earthkeepers: Four keys for helping young people live in harmony with the earth*. Greenville, WV: The Institute for Earth Education.
- van Wissen, F. A. (1992). *Promoting responsible environmental behavior through earth education camps: Sunship Earth and Earthkeepers*. Halifax, Nova Scotia, Canada: Unpublished master's thesis, Dalhousie University.
- Zachariou, A., & Katzie-Beltran, C. (2002 November). *The contribution of Environmental Education Centres in the achievement of environmental education goals in Cyprus. 2nd international conference on Science Education, Pedagogical Institute of Cyprus*.
- Zachariou, A., Valanides, N., Kadji-Beltran, C., & Hrodotou, H. (2003). The social critical character of environmental education and environmental education centers: A case of Cyprus. *International Symposium "Environment 2010: Situation and perspectives for the European Union"*.
- Zandvliet, D. B., & Fisher, D. L. (2007). *Sustainable communities, sustainable environments*. Rotterdam: Sense Publishers.
- Wiseman, M., & Bogner, F. X. (2003). A higher-order model of ecological values and its relationship to personality. *Personality and Individual Differences*, 34, 783–794.

Constantinos C. Manoli holds a BS in wildlife management and a master's and PhD in environmental learning and his research focuses on children's environmental attitudes and behaviour. Currently, he is an associate researcher in the department of education at the University of Cyprus and a University of Arizona affiliate with the Earth Education Research and Evaluation Team (EERET) in the department of teaching, learning and sociocultural studies. In addition, he is the pilot coordinator of Earthkeepers program at

the Cyprus Centre for Environmental Research and Education (CYCERE) where the program is being translated and implemented.

Bruce Johnson is a professor of environmental learning & science education at the University of Arizona, where he also serves as director of the Earth Education Research and Evaluation Team; head of the department of teaching, learning & sociocultural studies; and as co-director of the UA STEM Learning Center. He is also international program coordinator for The Institute for Earth Education, an international, non-profit organization. His research focuses on the teaching and learning of ecological concepts, development of environmental perceptions and actions, curriculum development, and teacher preparation.

Andreas Ch. Hadjichambis holds a BS in biology, a master's on educational sciences and a master's on environmental conservation management. His PhD is in conservation biology of threatened coastal habitats of Cyprus. He works at the Ministry of Education and Culture as Counselor of Biology and as coordinator of an Environmental Education program. He deals with the New Curriculum of Biology and with the development of learning material. He is also the scientific director of the Cyprus Center for Environmental Research and Education (CYCERE) and he has taught at the Cyprus University of Technology in the past.

Demetra Hadjichambi is a biologist and she has a master's in environmental conservation management and a PhD in didactics of biology. She worked as a member of special educational personnel in Science at the University of Cyprus (2005–2012). She is currently working in secondary education. She has been a member of Biology Curriculum Committee in the framework of Cyprus Educational Reform since 2008. Her research interests include the design and evaluation of curriculum materials enhancing students' conceptual understanding, values and attitudes. She also coordinated the development and evaluation of learning materials for the enrichment of Primary Science Curriculum of Cyprus (2007–2010).

Yiannis Georgiou holds a master's degree in "Learning in Science" and a BA in primary education. He is pursuing several interests in research including new technologies that support teaching and learning in science as well as science education teachers' professional development. Currently, he is a PhD student investigating game-based learning in science while at the same time he works as a research assistant at the Cyprus University of Technology. In addition, he is a member of the research group of the Cyprus Center for Environmental Research and Education (CYCERE) where the Earthkeepers program is being translated and implemented.

Hara Ioannou holds a bachelor's degree in Primary Education and currently is a master student in "Communications and Internet Studies". In the past, she taught evening courses at three different primary schools (2008–2010). Since 2007 she has also been an environmental educator at the Cyprus Center of Environmental Research and Education (CY.C.E.R.E.) and has contributed to the development of educational material for students of primary and secondary education. In addition, as a member of the research group of CY.C.E.R.E., she has participated in the translation and implementation of the Earthkeepers program in Cyprus.