



Environmental Education in Finland – A Case Study of Environmental Education in Nature Schools

Eila Jeronen

University of Oulu, Finland

Juha Jeronen

University of Jyväskylä, Finland

Hanna Raustia

University of Oulu, Finland

Received 14 August 2008; Accepted 20 December 2008

The article aims to introduce Environmental Education (EE) in Finland and to discuss how it has been taken into account in Finnish nature schools. Firstly, we present EE models used in Finland. Thereafter we describe a qualitative case study on EE in nature schools (NS). The aim of the study was to get information for the development of EE. The research questions were: Who are the visitors to NSs? What are the educational aims in NSs? What kind of educational methods and approaches do NS teachers use? The resultant data for the questions from 1 to 3 is based on the questionnaires completed by 23 (61 %) NS teachers in 2006. The data were analysed quantitatively and qualitatively using both deductive and inductive content classification methods. The results showed that most NSs offered their services almost exclusively for children and young people and the main visitor group to the NSs were pupils from primary and lower secondary schools. The ideas on fostering a sustainable way of life and environmental responsibility mentioned in the criteria of the nature and environmental schools were expressed by most respondents. The most used educational methods were nature trips and inquiry learning methods, while the most common approaches were physical activity and learning by doing in nature. The impact of the NSs cannot be very strong when each pupil typically only visits a NS once or twice during her or his entire compulsory education. Based on the results, it seems that the teachers did not take into account the meaning of evaluation. None of them mentioned it as a part of EE.

Key Words: models in environmental education, cross-curricular theme, nature schools, environmental schools

Introduction

Much has been written over the past three decades about the many perceived purposes of Environmental Education (EE). The Tbilisi Declaration (UNESCO-UNEP, 1978) emphasized an active citizenry by suggesting, among other things, that the goal of EE was to

" help individuals and communities ... acquire the knowledge, values, attitudes, and practical skills to participate in a responsible and effective way in anticipating and solving environmental problems, and in the management of the quality of the environment."

Palmer and Neal (1994) define EE as: 1) education about the environment, which builds awareness, understanding, and the skills necessary to obtain the understanding; 2) education in (or from) the environment, where learning occurs outside of the classroom, e.g. in nature; and 3) education for the environment, which has objectives related to nature conservation and sustainable development.

Hungerford and Volk (1990) have argued that active participation is not emphasized enough in EE although environmentally responsible behaviour can be gradually developed by 1) entry level variables, including the ability to experience and enjoy nature and knowledge of ecology; 2) ownership variables, such as in-depth knowledge and personal investment in the environment; and 3) empowerment variables like internal locus of control and intention and ability to act for the environment (Hines et al., 1987; Hungerford & Volk, 1990).

The EE research conducted over the past three decades has focused on changes in the cognitive and affective attributes brought about by EE interventions. Uusitalo (1993) has argued that knowledge construction is important because, if a person knows the consequences, she or he is more aware and calls more attention to her or his behaviour. Pantzar and Siebert (1993) for their part have stated that guiding pupils to enjoy small non-material pleasures is important. According to Nykänen & Kinnunen (1992), positive nature experiences in early childhood develop nature sensitivity. Environmental awareness, attitudes and conceptions can be changed by using repeated experiences (Gilbertson, 1990; Rynning, 1993) and long-term nature education (Palmberg, 1989). It has also been noticed that an emphatic relation towards nature can be supported through nature experiences (Palmberg & Kuru, 1998; Bogner, 1998). Useful methods in this meaning are e.g. nature trips, games, and playing in nature (Vuolle, 2003; Prüter, 2003). However, Van Matre (1998) has criticized these kinds of activities and stated that they leave EE without any deeper meaning. He has argued that for this reason, people are not able to create a holistic conception of environmental phenomena.

In the near future, one of the most important challenges, at the local and global levels, is how to support a lifestyle based on sustainable development (SD). A person's knowledge level, together with values and conceptions of responsibility, has an effect on how interested he or she is in environmental questions (Bulkeley, 2000). Education is a prerequisite for promoting the behavioural changes and providing citizens with the key competencies needed to achieve SD. The educational benefits of an EE model that focuses on specific goals (Hungerford & Volk, 1990) are substantiated by Cullen and Volk (2000).

In order to encourage the promotion of EE and SDE (Sustainable Development Education) in Finland, a national strategy for EE (Kansallinen ympäristökasvatusstrategia, 1992) has been created, as well as a strategy for SDE (Kestävää kehitystä edistävän kasvatuksen ja koulutuksen strategia ja sen toimeenpanosuunnitelma vuosille 2006–2014, 2006). SD has also been taken into account in the national curricula for primary and secondary schools (National core curriculum for basic education, 2004; National core curriculum for upper secondary schools, 2003). In the primary and lower secondary schools (pupils aged 7–16), the theme is "Responsibility for the environment, well-being, and sustainable future". It is the objective of basic education (National core curriculum for basic education, 2004, p. 39):

“...to raise environmentally conscious citizens who are committed to a sustainable way of life. The schools must teach future-oriented thinking and building the future on ecologically, economically, socially, and culturally sustainable premises.”

The pupils should (National core curriculum for basic education, 2004, p. 39):

- understand the prerequisites for human well-being, the necessity of environmental protection, and relationships between the two;
- learn to observe changes taking place in the environment and human well-being, to clarify the causes and consequences of these changes and to act for the good of the living environment and enhanced well-being;
- learn to evaluate the impacts of their consumption and daily practices, and adopt the courses of action required by sustainable development;
- learn to promote well-being in their own communities and to understand threats to, and potential for, well-being at a global level;
- come to understand that, through their choices, individuals construct both their own futures and our common future; learn to act constructively for a sustainable future.

In the upper secondary schools (students aged 16-18), the theme is “Sustainable development”. Upper secondary schools must encourage students to pursue a sustainable lifestyle and to take action for sustainable development. In addition, the students should learn to examine the challenges of sustainable development from several points of view (National core curriculum for upper secondary schools, 2003, p. 28–29):

- exploring the effects of human activity on the environment and changes that have occurred in the way human beings adapt their environments during cultural evolution;
- analyzing global environmental hazards and their causes as well as means to correct the course of development;
- exploring problems related to population growth, poverty and hunger;
- assessing the cycles of substances and energy in the environment and production systems and learning how to save energy and raw materials;
- pondering on the characteristics of economic growth that would not be based on an increase in consumption of energy and raw materials and on the bearing of economic stability on environmental protection and people’s well-being;
- studying business enterprises and technologies that fulfill the principles of sustainable development and learning how to exercise the means of influence available to consumers;
- determining the ways in which human activities can be adjusted to their environments respecting the cultural heritage and without endangering natural diversity;
- rehearsing the practices of sustainable lifestyles and determining their structural prerequisites.

The ideas presented in the National core curricula and some EE models are quite similar and have been adapted for the teaching of EE at schools (Cantell, 2003). Some Finnish environmental educators have also presented that ethical issues should be taken into account more carefully than has been done until now at schools (e.g. Jeronen, 1995; Jeronen & Kaikkonen, 1995, 1996; Rajakorpi & Salmio, 2001; Jeronen & Kaikkonen, 2002; Rydén, 2007). Environmental philosophers for their part have emphasized that human beings should learn to be aware of their own ethical responsibility for environments (cf. Vilkkä, 1993, 1996). These issues have been considered important especially in NSs in Finland.

The first nature excursions and trips were carried out in the 1950s. At that time, they were an informal part of camp schools. They were added to the official program in the 1970s. The first nature school center was set up at Siuntio in 1986 (Kuronen, 1997). Since then, the number of nature schools has increased, but quite slowly. In 1992, there were 5, and five years later, 13 nature schools in Finland (Kajanto, 1993; Luontokoulutoiminta, 1997). Today, there are 26 nature schools (Luonto- ja ympäristökoulut Suomessa, 2008).

Nature school action can be a part of formal education on all levels from nursery school to high school, or it can be an after-school activity. The action is not bound by place, and it can be arranged by societies, municipalities or private sectors in “nature schools” or “in environmental schools” (Jääskeläinen, 1997; Luontokoulutoiminta, 1997). It is stated in the new national criteria for nature and environmental schools, accepted in the meeting of the Society for Nature and Environmental Schools in March 2008, that “the staff is full-time” (Table 1) (Luonto- ja ympäristökoulut Suomessa, 2008). However, a nature school or an environmental school usually belongs to a primary or secondary school. From one to two teachers share the responsibility to teach EE and they also act, beside their own job as a class or subject teacher, as teachers in the nature or environmental school. The Finnish nature and environmental schools do not have pupils of their own. Pupils from neighbourhood schools visit them during their school hours. The nature and environmental schools get their funding from the local municipality similarly to all primary and secondary schools in Finland.

In the programs of both school types, the principles of Agenda 21 (see Documents, 2007) have been taken into account. Their common educational idea focuses on the knowledge of nature, nature exercises, acquiring nature information, and study skills. Both school types foster a sustainable way of life and environmental responsibility (Luonto- ja ympäristökoulut Suomessa, 2008). The purpose is for the pupils to understand that human beings are a part of nature.

Furthermore, an important aim is to foster environmental sensitivity and interest in nature, and to promote a responsible lifestyle. The main ideas of teaching and learning methods are also similar. The pupils are active participants and learn by doing. They acquire information through their own senses via investigation, traveling and playing, and solving problems based on their own age level. The educational emphasis for teachers is on strengthening environmental values and increasing environmental knowledge (Luontokoulutoiminta, 1997).

This article aims to introduce EE in Finland. First, we present the EE models used in Finland followed by a description of a qualitative case study of EE in Finnish nature schools and environmental schools. In the study, the term nature school (NS) is used to describe both nature schools and environmental schools, because the descriptions of the educational approaches of the Finnish nature and environmental schools do not feature any crucial differences (cf. Luonto- ja ympäristökoulut Suomessa, 2008). Based on our results, we present at the end of the article observations and questions for the development of EE in NSs and other schools.

Table 1. Criteria for nature and environmental schools in Finland (Luonto- ja ympäristökoulut Suomessa, 2008).

Criterion	Nature school	Environmental school
Objectives	fosters sustainable way of life, environmental responsibility, and nature knowledge; strengthens interaction skills; supports the belief that an individual can influence and participate.	fosters sustainable way of life, environmental responsibility, and life-long learning; supports the belief that an individual can participate and influence on the solution of environmental problems.
Tasks	supports early childhood and basic education to achieve the objectives presented in the curricula.	supports early childhood and basic education to achieve the objectives presented in the curricula.
Target groups	pupils, teachers and educators in early childhood and basic education.	the rising generation and educators.
Type of action	continuous, concerning the whole area.	continuous, concerning the whole area.
Staff	full-time, professional and informed on EE.	full-time, professional and informed on EE.
Learning environment	mainly nature	practical action in living environments.
Main content	nature and effects of human beings on their environment	relationships between human beings and environments; local and global environmental problems
Methods	knowledge-based and experiential action to create positive environmental attitudes; practical action taking into account needs of learners	knowledge-based and experiential action taking into account the needs of learners
Teaching	integrative and holistic	integrative and holistic
Evaluation	gathers feedback and evaluates and develops effectiveness of its activities	gathers feedback and evaluates and develops effectiveness its activities

Models in Environmental Education Used in Finland

The background of educational models lies in teaching and learning the conceptions of educators and the educational culture (Robottom & Hart, 1993). In Finland, the basis of education is provided by constructivist pedagogy. This means that the role of pupils as constructors of their own knowledge is emphasized. In this process, the teacher acts as a guide, and her or his main task is to support the learning processes of the pupils. Future orientation is also important, because the pupils in school now will become active members of society for a number of years into the future.

The most widely known and used EE models in Finland are (Cantell & Koskinen, 2004; Willamo, 2005) the Environmental behaviour model (Hungerford & Volk, 1990), the Onion model (Käpylä, 1995), the Tree model (Palmer, 1998), the House model (Jeronen &

Kaikkonen, 2002) and the Model of Education for Sustainable Development (Åhlberg, 2005).

In the *Environmental behaviour model* (Figure 1), Hungerford and Volk (1990) describe the development of an environmentally responsible citizen with three variables linked to each other. The most important variable at the entry level is environmental sensitivity, which means an emphatic attitude toward nature. It develops based on experiences of nature in childhood. Knowledge of ecology, androgyny, and attitudes toward pollution, technology and economy occupy minor roles. Knowledge of ecology includes knowledge about the basic processes in nature, such as population ecology and material cycle. Androgyny means behavioural qualifications, e.g. great sensitivity, empathy, and self-confidence. Ownership variables are the most important for the development of responsible behaviour. In-depth knowledge of environmental issues and the ecological and social consequences of human action promotes environmentally responsible behaviour.

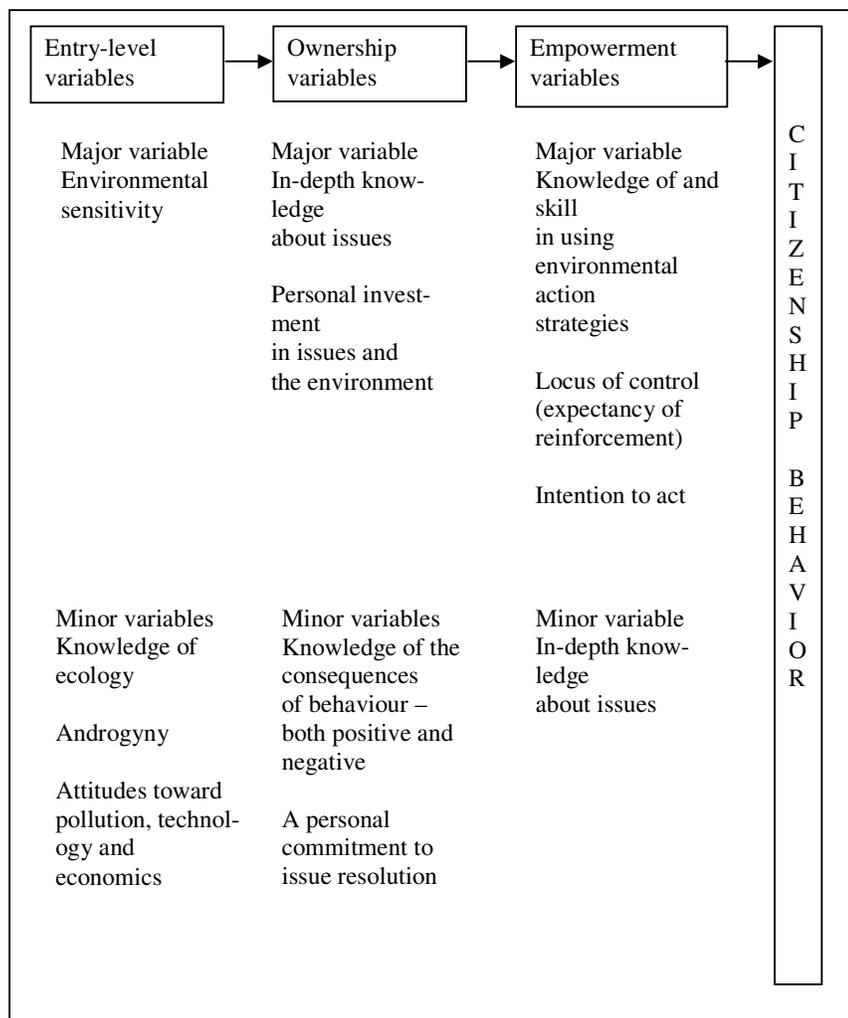


Figure 1. The Environmental behaviour model (Hungerford & Volk, 1990).

Personal investment means that a person is ready to spend money or time or to take trouble to work for the environment. Minor variables are knowledge of the consequences of one's behaviour, and a personal commitment to issue resolution. Empowerment is a cornerstone in EE. Variables of empowerment create a feeling that environmental action is important. Knowledge of and skills in using environmental action strategies create the will to behave in an environmentally responsible way (Hungerford & Volk, 1990).

The Onion model (Figure 2) is based on the Environmental behaviour model. Knowing and knowledge as ideological power factors are at the core of the model (Käpylä, 1995).

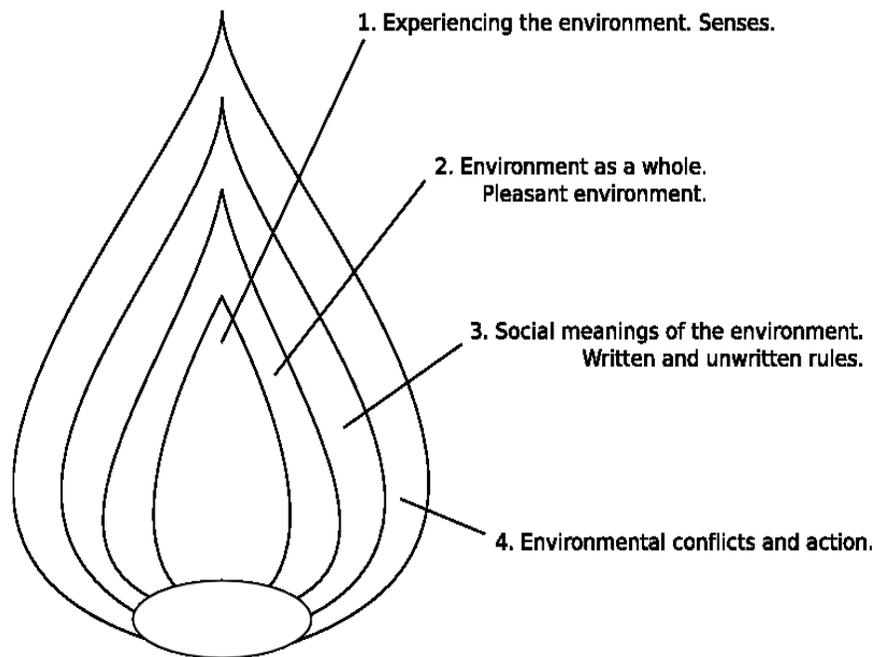


Figure 2. The Onion model (Käpylä, 1995).

The aim of EE is to support understanding of cultural meanings through emotions and affections. At the core of the model there is a person with her or his experiences. Käpylä (1995) argues that experiences cannot be divided into physical and spiritual parts, because human beings see meaningful issues instead of physical objects. The meanings of observations are understood through experiences, and experiential knowledge is non-theoretical and non-reflected. Responsible environmental behaviour develops step by step through three phases: entry-level variables, ownership variables and affecting variables. Successful EE includes strategies for knowing, feeling, willing and, if possible, also for action (Käpylä, 1995).

In *the Tree model* (Figure 3), implications for EE come from different ideologies or perspectives on the root causes of environmental problems (Palmer, 1998). Palmer recommends that all the components of the EE model should be addressed in a systematic way. It means that education about the environment, in the environment and for the environment should go alongside, interlinked with issue-based, action-orientated, and socially critical education.

The House model (Figure 4) is based on the idea that the development of senses and emotions is crucial in EE (Jeronen & Kaikkonen, 2002). The main aims in EE are to foster environmental sensitivity, to learn environmental awareness and knowledge and to acquire a readiness and responsibility to solve environmental problems. The aims are lifelong and hierarchic. This means that teachers should stress sensitivity education especially with younger learners, but also at the beginning of teaching and learning processes with older ones. Later on, they should gradually put more and more emphasis on awareness, knowledge, readiness and responsibility (Jeronen & Kaikkonen, 1994).

Environmental sensitivity means the kind of features in emotional life through which an emphatic relationship develops towards the environment (Jeronen & Kaikkonen, 2001). Environmental awareness means understanding of relationships between human beings and the environment. Its development is based on reflection of experiences, emotions, ideas, beliefs, and knowledge. Knowledge involves an understanding of phenomena and their relations. Readiness means that persons have the knowledge and the will, and a sense of responsibility for a commitment to work for a better world from the local to the global level.

The content of EE includes five areas: nature, the built, aesthetic, social and ethical environment. Studies of the natural environment include information about ecology, environmental threats, and the relationship between human beings and nature. The contents of the built environment consist of economical, technical, and socio-cultural information. The aesthetic features of different environments are discussed in aesthetic environment studies. In the social environment, environmental problems and the meaning of the concept of 'active citizenship' are discussed from socio-cultural points of view. Studies of the ethical environment include reflections on values and moral issues (Jeronen & Kaikkonen, 1997).

Useful methods in EE are those related to sensitivity, science and values education. Sensitivity education is based on experiential learning with outdoor activities. According to Kolb (1981), knowledge is continuously gained through both personal and environmental experiences. The experiential learning method focuses on the individual learning processes. Students study through observation and interaction with their environments. However, as Dewey (1933) pointed out, experiences do not automatically equate learning. Therefore, reflective discussions on feelings, emotions and experiences are also important. Science education is based on inquiry-based learning including, e.g. fieldwork and laboratory work. It requires students to work together to solve problems rather than receiving direct instructions on what to do from the teacher. The teacher's job in an inquiry learning environment is therefore not to provide knowledge, but instead to help students along the process of discovering knowledge themselves. In this form of instruction, it is proposed that teachers should be viewed as facilitators of learning rather than vessels of knowledge (Welch et al., 1981). In values education, values clarification is a useful method. Dewey was a creator of a philosophy and methodology in which educators purposefully engage with learners in direct experience and focused reflection in order to increase knowledge, develop skills and clarify values. Dewey said that an educator must take into account the unique differences between each student. Each person is different genetically and in terms of past experiences. Even when a standard curriculum is presented using established pedagogical methods, each student will have a different quality of experience. Thus, teaching and curriculum must be designed in ways that allow for such individual differences (Neill, 2005).

Product and process evaluation, based on the aims, is emphasized in the House model and not only the teachers but also the pupils and parents should participate in the evaluation processes (Jeronen & Kaikkonen, 2001).

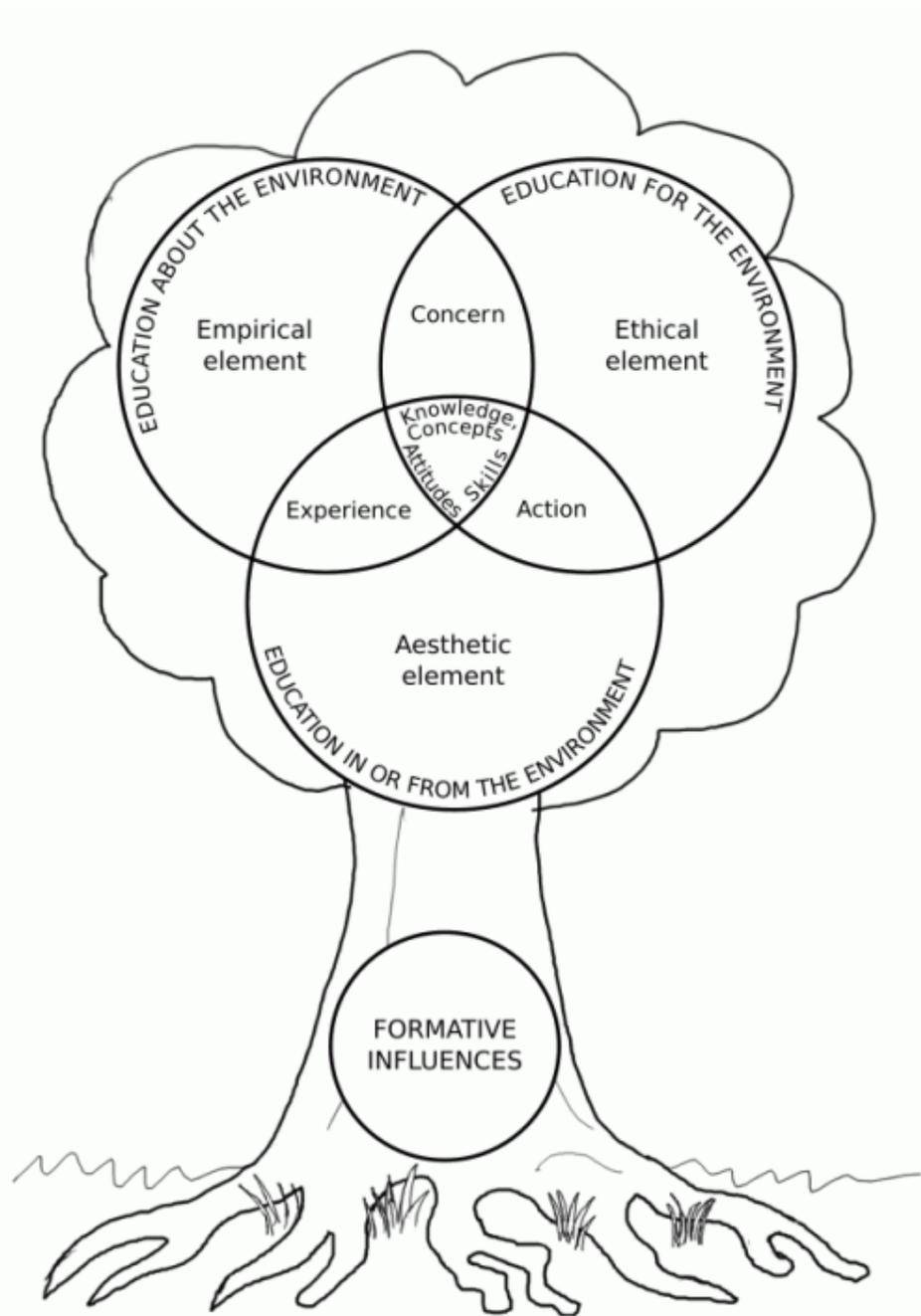


Figure 3. The Tree Model (Palmer, 1998).



Figure 4. The house model (Jeronen & Kaikkonen, 2002).

The Model of education for sustainable development (Figure 5) is based on the UNESCO declaration on ecological, economical and social development (cf. Education for Sustainable Development, 2005). In the model, biodiversity, environmental problems and the concept of SD form the core issues. EE is a part of ESD and is based on the Tree model (Åhlberg, 2005).

All the models presented above have the same purpose: education for the future. Their main aim is to develop skills and qualifications important for nature conservation, such as sensitivity for the environment, knowledge about nature and ecology, environmentally responsible emotions and values, understanding of environmental questions, critical thinking skills, social action skills, ethical growth, and responsible environmental behaviour (Cantell & Koskinen, 2004). They also share the idea that EE involves many different approaches. Active citizenship is mentioned as an important aim in the Onion and Tree models.

As was mentioned at the beginning of the section, Cantell and Koskinen (2004) and Wil-lamo (2005) have said that the models described above are widely known and used in Finland. However, as far the authors know, the curriculum developers emphasize more the Environmental behaviour model and the Tree model than the other ones as a basis of the curriculum. In the study, the authors used the models as a background when forming the research and questionnaire questions. They were also used in support of the data interpretation.

Case Study of Environmental Education in Nature Schools

The study arose from the findings that environmental experiences in childhood have an effect on environmental attitudes even in adulthood (Matikainen, 1995; Wahlström, 1997).

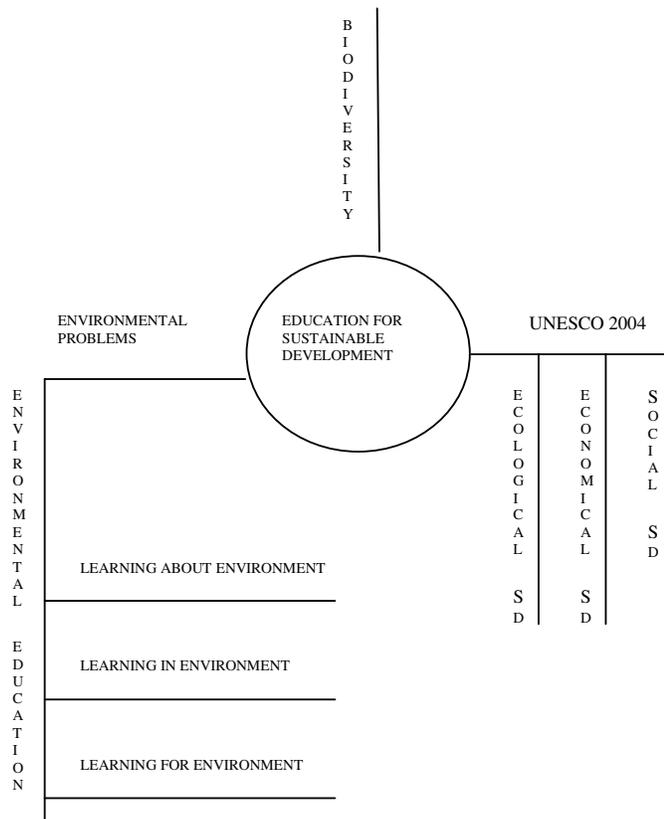


Figure 5. The Model of Education for Sustainable Development (SD = Sustainable Development) (Åhlberg, 2005).

New and interesting experiences in nature foster environmental sensitivity (Palmberg & Kuru, 2000) and awareness, and repeated experiences may have long-term effects which can change attitudes (Gilbertson, 1990; Rynning, 1993). In addition, long-term nature education adds to interest in nature, and facilitates the attainment of cognitive aims and development of social skills (Palmberg, 1989).

This study is important for the development of EE in NS and also in other schools. The aim of it is to get information on EE in Finnish NSs. The research questions are: 1) Who are the visitors to NS? 2) What are the educational aims in NSs? 3) What kind of educational methods and approaches do NS teachers use?

Material and Methods

The material was gathered in the 23 NSs mentioned on the website “luontokoulut.fi” in spring 2006. Data were collected using a questionnaire sent to the leader of each school. The leaders were asked to give it to a teacher who was responsible for planning curricula and taught in her or his NS.

After a reminder was sent, 61 % (14) NSs returned answers. 29 % (4) of the respondents complained that they were very busy and hard-pressed for a lack of time to answer. Most NSs were located in southern Finland. The NSs did not have students of their own. Classes from neighbourhood schools and kindergartens visited them. The number of visitors varied from 20 to 32 per group. 64 % (9) of the NSs informed that they belonged to a national network. In addition, 14 % (2) NSs indicated that they participated in international NS networks. National networks mentioned by them were Suomen ympäristökasvatuksen seura (Society of Environmental Education in Finland, <http://www.ymparistokasvatus.fi/pages/1.php>), Nature Schools in Finland (<http://www.luontokoulut.com/>), and the Green Flag (<http://www.ymparistokasvatus.fi/vihrealippu/>). Among the international projects, the BSR (Baltic Sea Region) – Eagle (<http://www.bsreagle.net/>) was mentioned.

61 % (23) of the teachers participated in the research. Their backgrounds were heterogeneous in nature: 39 % (9) of the respondents were qualified as different kinds of teachers (five subject teachers, four of whom were environmental educators and one was an art teacher; three class teachers; one kindergarten teacher), 35 % (8) had Master's qualifications in natural Sciences (six Masters in Biology and Geography, five of them were also qualified researchers in Biology; one Master in Agriculture and Forestry; one forest economist), 17 % (4) had different kinds of nature and educational qualifications (two nature guides, one Bachelor of Hospitality Management, one environmental manager), while 0.09 % (2) were freelancers. The last ones did not give any information about their educational background.

The questionnaire was an author-designed instrument. It was developed during a biology and geography educational seminar. The schedule of the questionnaire was discussed by 27 student teachers using the Discendum Optima platform. (The Discendum Optima is a learning environment developed to support online learning.) A supervisor at the university, two teachers and the co-ordination group (a teacher from the primary, lower, and upper secondary school, and a secretary) of EE at the university training school also discussed the questionnaire in their EE developing meetings.

The questionnaire was based on the research questions 1–3 and the EE models used in the Finnish EE. It included seven multiple-choice and five open questions. By open questions, the authors tried to get the kind of information that is difficult to get using only closed questions. The open questions were also used to achieve interrelated reliability of the answers. The closed questions included questions about the visitors to the NS and the used educational methods, while the open ones were related to the aims, educational approaches and curriculum of each NS. The answers to the multiple-choice questions were analyzed quantitatively, while the answers to the open questions were analyzed quantitatively and qualitatively using deductive and inductive content classification method (cf. Glaser & Strauss, 1967; Ryan & Bernard, 2000; Tuomi & Sarajärvi, 2002, 95–96, 106–108). At the beginning, the answers were written literally down and read through by two of the authors. Thereafter, the data was classified into categories on the basis of the research questions. By reading and rereading the information included in these categories, core expressions were found and they were coded by numbers. During the classification phase, the authors worked independently. After the classification processes, the findings were compared and the final classification was created based on these negotiations. Statistical tests were not made because of the small number of participants. The results are presented using bar graphs.

Results

The results are described below in the order of the research questions.

Who are the visitors to NSs?

When asked for whom NSs are intended, all the respondents, except one, included all comprehensive school (CS) age groups in their answers. “A *comprehensive school*” means a school with primary and lower secondary level classes, with pupils from 7 to 16 years old. (Figure 6). Pupils aged 10–16 were welcome in all the 14 NSs that answered to the questionnaire. 71 % of the NSs indicated that the NS was also intended for children who were younger than seven years old. 50 % of the NSs offer their services also for older visitors, because they wanted to support teachers and to share their ideas on the CS level. They have also linked their programmes to the curriculum of CS. Based on the answers, NSs seem to be intended mostly for CS aged pupils. Only 36 % NSs suggested that people of all ages belonged to their target group. A teacher (number 4) wrote: “...An objective is to foster environmental education in our area. Our target groups are all the schools, kindergartens, and institutes, but also professional educators.”

The NSs were also asked to identify the largest group of visitors classified by age. Some of the NSs selected two of the alternatives given (Figure 7). The most frequently mentioned group was pupils aged 10–12. The second one consisted of pupils from 7 to 9 years old. Next were the groups of children under 7 years old and pupils aged 13–16. The teachers gave similar reasons for the group selection as a teacher (number 6) who wrote: “In the nature schools, we try to wake up children to learn to observe nature.” None of the NSs answered that persons older than 16 years were their largest visitor group. Hence NSs were used mostly by children under seven years old and pupils aged from 7 to 12.

93 % of the NSs answered the question on the number of visitors they receive. The NSs have a total of 47,550 visitors a year, thus averaging 3396 (SD 2723). The smallest NS only had 200 visitors a year, while the largest had 8,000 visitors a year. In defining the number of visitors, the classes and persons who visited the NS more than once a year were counted once per visit. For example, 36 % NSs have so-called twin classes, and pupils from these classes visit the NS many times a year. A teacher (number 1) wrote: “A twin-school action forms the basis for the activities of our nature school. It makes possible for us to create closer and longer-lasting co-operation with schools”. She also stated that she has noticed positive changes in the attitudes and interest of the pupils who have visited their nature school.

It was also asked in the questionnaire how many times each pupil visited the NS (Figure 8). In this question, many alternative answers were presented, and some of the NSs chose only one option, while others chose several. The most popular answer was “*a few times during the comprehensive school years*”. Many of the pupils visited the NS only once and some pupils did not visit the NS at all. It was quite rare that a pupil visited the NS every year, a few times a year, or once a month. A teacher (number 4) reported: “Most kindergarten groups wanted to pay a visit at least once a year. However, the demand is abundant and because groups which have not visited the nature school yet are selected, the “old soldiers” are reselected quite seldom.” A visit lasted a few hours (10 answers), or a day (3 answers). One NS also mentioned that it was possible that a pupil studies a whole week in the NS. Based on these answers, it seems that pupils from the CS visit NSs mostly a few times during their CS years and a typical visit lasts no longer than a day. In addition, 36 % NSs informed that their teachers visit CSs.

What are the educational aims in the NS?

There were also questions in the questionnaire about the educational aims of NSs. 71 % of the NSs described their aims well but the explanations of 29 % of the NSs were unclear (Figure 9).

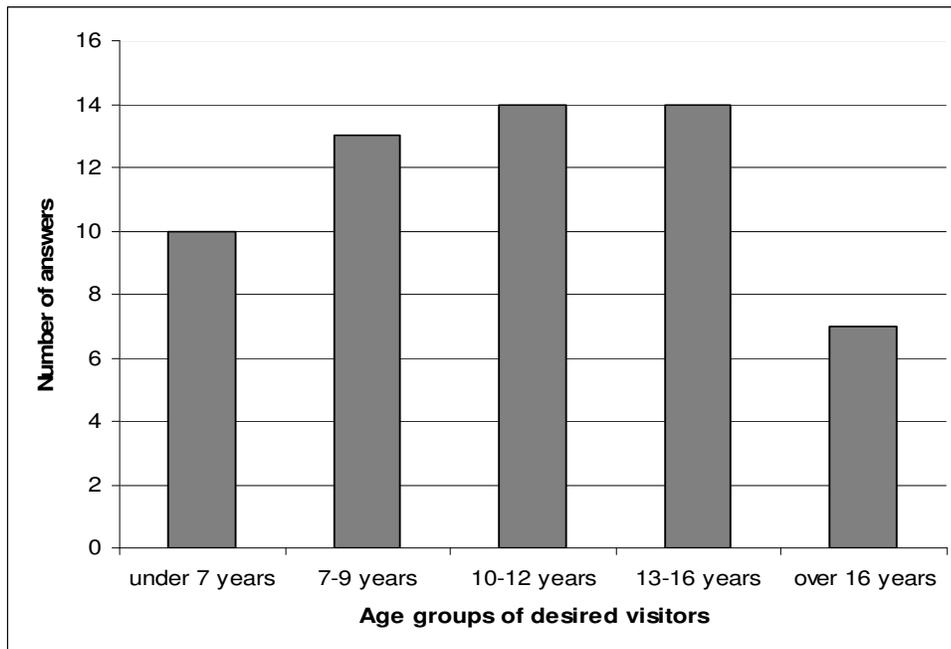


Figure 6. Distribution of the answers to who NSs are intended for.

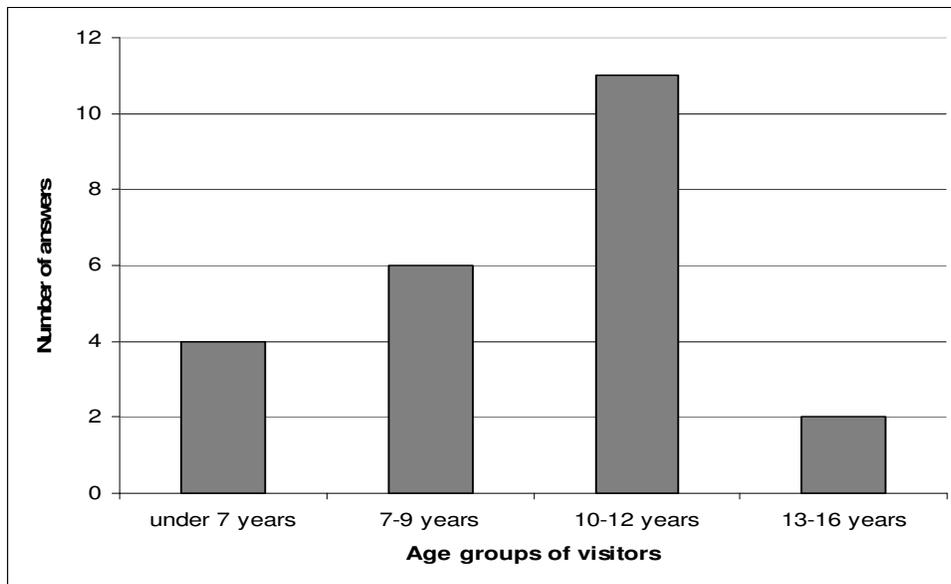


Figure 7. Distribution of the answers on the largest visitor group to NSs that answered this question. (Some of NSs selected one age group, others two).

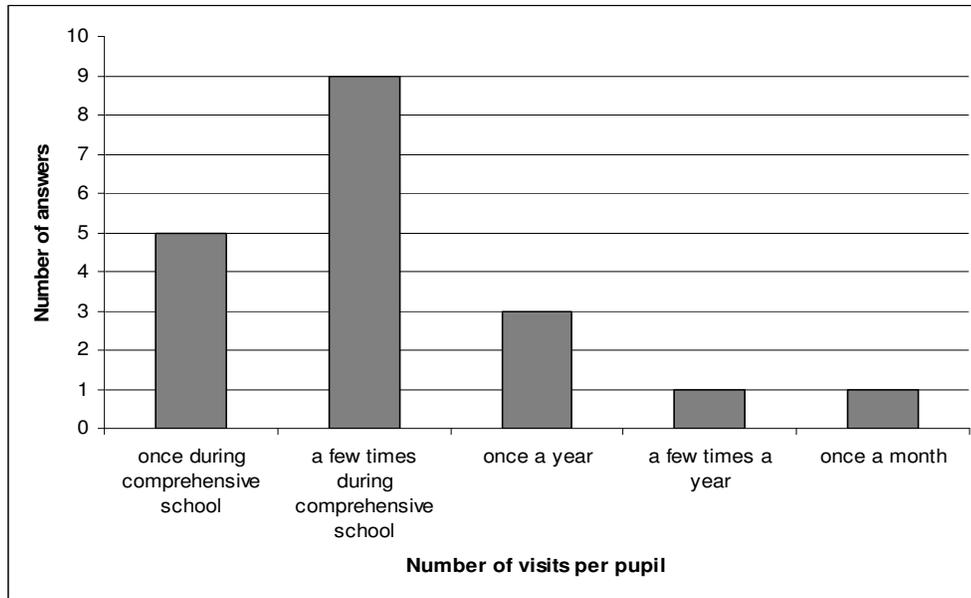


Figure 8. Distribution of the answers to the question "How many times does a pupil visit your nature school?" (The nature schools selected one or more of the given alternatives. "A comprehensive school" means a school with primary and lower secondary level classes).

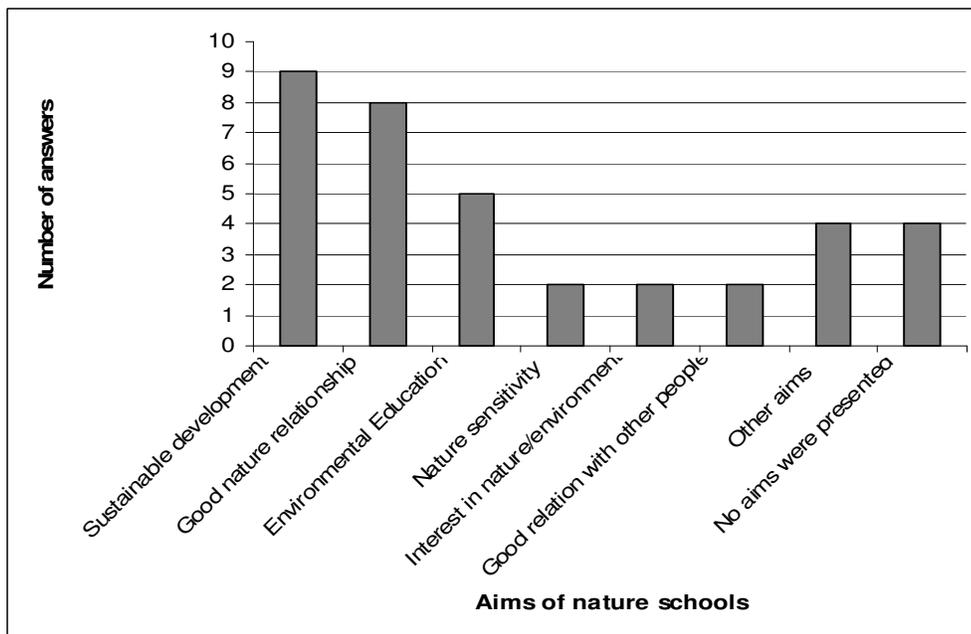


Figure 9. The aims of nature school education.

Most respondents selected several aims. Most of the NSs emphasized education for SD and fostering a good nature relationship. Environmental education at a general level was mentioned by 36 % of the NSs. Nature sensitivity, interest in nature and one’s own environment and good relationship with other people were mentioned by 14 % of the NSs. The remaining answers concerned the development of senses and observations, understanding nature, active citizenship, and enabling reflection of one’s own lifestyle. Each of these aims was mentioned by one respondent. In addition, 37 % of the NSs reported that they also take into account the national core curriculum for basic education when planning their curricula. A teacher (number 7) expressed this issue by saying: “We try to offer programmes which are linked to the national curriculum for basic education.” The cross-curricular theme “*Responsibility for the environment, well-being, and a sustainable future*” (National core curriculum, 2004) was seen to be particularly important. 29 % of the NSs said that they rewrote their curricula depending on the needs of the visitors.

What kind of educational methods and approaches do the nature school teachers use?

Most NS teachers valued nature experiences and therefore the most popular working method was nature trips (Figure 10). 86 % of the NSs made nature trips very often and one quite often. Only in one NS were nature trips seldom used. Games and playing were nearly as popular as trips. 57 % of the NSs used inquiry-based learning. The teachers of these NSs had an educational background. Among other things, the pupils familiarized themselves with plant and animal species in forest and water ecosystems, and wrote small research reports on landscapes and land use, the level of pollution etc. in near surroundings. A relatively popular method was also story telling. Hobby crafts, drawing, reading and writing tasks were not used very much. Drama, sense activities, nature exhibitions, earth walk, and experiential learning were used in 14 % of the NSs. These teachers gave similar reasons for their method selection as a teacher (number 8) who wrote: “The holistic learning conception is important. Nature education is based on everyone’s nature relationship and it tries to deepen this individual relationship. This is a way to foster nature love. Individual experiences create understanding on nature phenomena and the meaning of one’s own action.” Teacher-centred class teaching was used in 7 % (1) of the NSs.

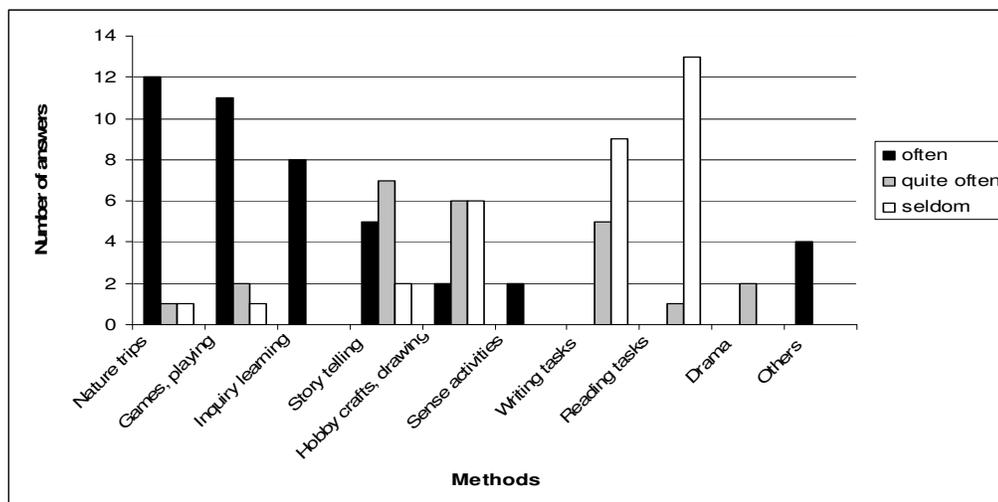


Figure 10. Methods used in the nature schools.

It was also asked in the questionnaire which approaches the NSs used to achieve their aims (Figure 11). 57 % of the NSs emphasized the importance of physical activity in nature and positive nature experiences. With physical activity the teachers meant walking and orienteering in nature, for instance. 43 % of the NSs identified that learning by doing was important in this sense. 29 % of the NSs used experiential learning and commented that it is important to use play and adventures, so that the pupils experience meaningful learning. 21 % of the NSs used different kinds of sensory activities. 36 % of the NSs answered that it was also important to teach educators to continue this kind of work in their own schools. The answers to the open-ended questions included ideas similar to the above. A teacher (number 12) stated: “Teachers can use a day in a nature school, a year as a twin-class, and their environmental course or camp school experiences as a stepping stone for environmental awareness at their school.”

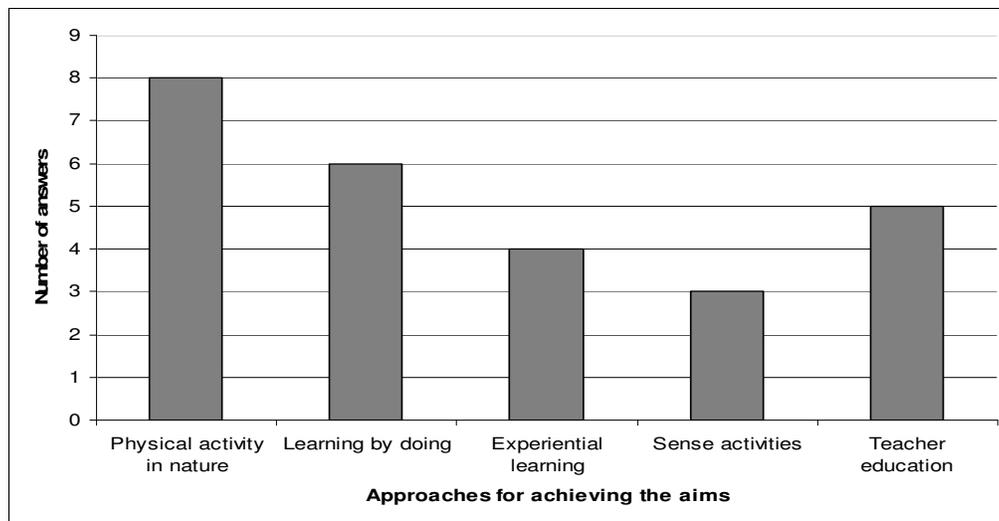


Figure 11. The most important educational approaches used by nature school teachers.

Discussion

In the study, we wanted to get information for the development of EE. We gathered information from NSs in Finland about their visitor groups, aims, educational methods and approaches. The Tbilisi Declaration (1978) and the EE models involve the idea that EE should be intended for all age groups. Based on the results, the NSs offer their services almost exclusively for children and young people. The main visitor group to the NS were pupils from the CS. One possible reason for the situation is that the programmes of many NSs are linked to the CS curriculum. The impact and meaning of the NS for environmental awareness cannot be very strong when each pupil typically only visits a NS once or twice during her or his entire compulsory education. Consequently, a challenge for the NSs is how they could offer their services to all the age groups and at least to all students.

Based on the criteria of the Finnish nature and environmental schools and also of National core curricula (2003; 2004), important objectives of NSs are to foster a sustainable way of life and environmental responsibility. These ideas were mentioned by most respon-

dents. In addition, two NSs mentioned EE. Other answers were only provided in a few cases. As for aims such as sensitivity and knowledge, the results matched the ones presented in the programmes of the NSs and the EE models. Based on the results, it seems that the NSs have tried to adopt the ecological idea of sustainable development, and their aims evolve through efforts to achieve SD. However, based on this study, one cannot draw any conclusions on the impact of the NS on the conceptions or behaviour of a single pupil or on a school culture because it was not evaluated how the visitors understood the aims and how well the aims were achieved. The impact was perhaps not very strong, because a typical visit to a NS was very short and each pupil typically visited a NS only a few times. For changes to occur in environmental awareness, attitudes and conceptions, repeated experiences (Gilbertson, 1990; Rynning, 1993) and long-term nature education (Palmberg, 1989) are needed. This question is left to be studied on a later occasion.

Positive nature experiences in early childhood have been seen to be important for the development of nature sensitivity (Nykänen & Kinnunen, 1992). The teachers in the NSs reported that they had adopted this idea well. However, they had highly diverse backgrounds. Only nine respondents were qualified as teachers. Several of the respondents did not have a background in educational sciences at all. Lack of educational studies unavoidably has its effects on teaching views and processes. However, we do not know what the effects are and what insufficient education means from the viewpoint of the use of the various methods. These issues should be studied by observing these teachers in action.

Nature trips, games and playing in nature were mentioned as the most widely used educational methods. The result supports earlier findings (Vuolle, 2003; Prüter, 2003). Nature experiences have been seen to be important for the development of environmental sensitivity (Hungerford & Volk, 1990; Jeronen & Kaikkonen, 2002) and an emphatic relation towards nature (Palmberg & Kuru, 1998; Bogner, 1998). However, van Matre (1998) has argued that these kinds of activities leave EE without any deeper meaning, hindering people from creating a holistic conception of environmental phenomena. Based on the results of the study, it can make a difference and the effects of nature activities should be studied e.g. by interviewing students and teachers in the future.

Knowledge as such is valued e.g. by Uusitalo (1993) and in the Environmental behaviour and House models. Some teachers in the NSs used inquiry learning methods where pupils have opportunities to construct their own knowledge. Unfortunately, most pupils only had the possibility to do such work a few times, and in some of the NSs inquiry learning was not used at all.

Aesthetic and ethical EE is seen to be important in the Tree and the House models (cf, Pantzar & Siebert, 1993). Emotional methods were used only in a couple of the NSs. Although many of the NS teachers used either physical activity, positive nature experiences or learning by doing approaches, there were also many who did not. However, firm conclusions cannot be drawn concerning the effects of the various methods and approaches to achieve the aims, because teachers and pupils were not observed during the visits to NSs. This question should be studied in the future.

In the Onion and the Tree models, the idea of active citizenship is mentioned as an important aim in EE. In this study, only one of the respondents mentioned it. The result supports the conception of Hungerford and Volk (1990) that students do not have an active role during EE studies. Consequently, they cannot act as active processors of information and proactive constructors of their own knowledge capital as they should when viewed against the ideas of the national core curricula (2003, 2004). This means that in the NS, education for readiness and responsibility should be emphasized further.

The NS is an important initiative to achieve sustainable development and environmental awareness. NS teachers have noticed it when setting the objectives. But we do not know

whether they achieve the objectives. Based on the results, it seems that the teachers did not take into account the meaning of evaluation. None of the respondents mentioned it as a part of EE. From the pedagogical point of view, process and product evaluation in authentic situations made by the individuals themselves, their peers, teachers and parents, as presented in the House model, could be a useful way to support individuals and groups to approach the set goals.

The vision in EE is to diminish atomism in teaching and learning processes, to motivate teachers for co-operation, to open windows into everyday life, and to link schools with society. Concrete action plans are pedagogically important. When pupils have positive experiences with environmental issues in their school years, they also grow up to take care of the environment from the ethical, ecological, economical and social points of view in the future.

No major problems were encountered during the study. The first minor problem was that the number of respondents who answered was quite small (61 %). The percentage could perhaps have been higher if more reminders had been sent. However, most of the NSs in Finland have very few employees, usually only one or two, and the possibility to answer questionnaires like this depends not only on personal motivation and will to answer, but also on occasional issues such as vacations and the timetables of the teachers. Some respondents also wrote that they had a shortage of time to answer the questionnaire. Hiidenkivi (2001) has pointed out that the result of an inquiry is considered reliable, if the response rate is over 50 %. The second difficulty was related to the ambiguity of the replies to the open questions. A problem with using open questions was that some of the respondents did not understand precisely what the researchers meant. A reason for confusions is that the educational language of the questionnaire caused problems to some of the respondents due to their lack of studies in educational sciences. The third problem was that the information gathered was rather superficial. The misunderstandings could have been avoided and more exact information obtained by using face-to-face interviews. Unfortunately, this was not possible due to a lack of time and financial resources.

Conclusion

Based on the results, it seems that many ideas presented in the EE models and in the criteria of the Finnish nature and environmental schools, have been taken into account in the programmes and practices in the Finnish NSs. However, it is not clear whether the NSs really contribute to environmental awareness and responsibility. With respect to holistic environmental education, there seems to be a gap between the EE models and teaching and learning processes. Nature activities were clearly stated, but active citizenship, for instance, was only mentioned by one respondent. The methods and approaches used in the NSs were various, but they were mostly suitable for children and young people.

Consequently, some of the important questions that warrant further consideration include: How should values and knowledge education be provided to be suitable for all age groups? Which educational methods and approaches are suitable and interesting for adults? How should evaluation be carried out to support the set goals? And how many times and how long per a visit should a person study in NS to change her or his environmental attitudes and behaviour?

A starting point for environmentally responsible behaviour is environmental sensitivity and knowledge about ecology. Although the problems are complicated, it is necessary to strive continuously for a sustainable future.

References

- Åhlberg, M. (2005). YK:n Kestävää kehitystä edistävän kasvatuksen vuosikymmen (2005–2014) biologian ja kestävä kehityksen didaktiikan ja opettajan työn näkökulmasta. (United Nations Decade 2005–2014). *Natura*, 2, 9–14.
- 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.
- Bulkeley, H. (2000). Common knowledge? Public understanding of climate change in Newcastle, Australia. *Public Understanding of Science*, 9, 313–333.
- Cantell, H. (Ed.) (2003). *Ympäristökasvatuksen käsikirja*. (Textbook for Environmental Education). Jyväskylä: PS-kustannus.
- Cantell, H. & Koskinen, S. (2004). Ympäristökasvatuksen tavoitteita ja sisältöjä. (Aims and contents in EE). In H. Cantell (Ed.), *Ympäristökasvatuksen käsikirja* (pp. 60–79). Jyväskylä: PS-Kustannus.
- Culen, G.R. & Volk, T.L. (2000). The effects of an extended case study on environmental behavior and associated variables in seventh and eighth grade students. *Journal of Environmental Education*, 31(2), 9–16.
- Dewey, J. (1933). *How we think: A restatement of the relation of reflective thinking to the educative process*. Boston: DC Heath.
- Documents (2007). Agenda 21. Retrieved July 6, 2007 from <http://www.un.org/esa/sustdev/documents/agenda21/index.htm>.
- Education for Sustainable Development (2005). United Nations Decade 2005–2014. United Nations Educational, Scientific and Cultural Organization. Retrieved July 22, 2008 from http://portal.unesco.org/education/en/ev.phpURL_ID=23279&URL_DO=DO_TOPIC&URL_SECTION=201.html.
- Gilbertson, K.L. (1990). Environmental Literacy: Outdoor Education training and its Effect on knowledge and Attitude toward the Environment. *University Microfilms International*, 237. USA, Michigan: Ann Arbor.
- Glaser, B.G. & Strauss, A.L. (1967). *The discovery of grounded theory: strategies for qualitative research*. New York (N.Y.): Aldine de Gruyter.
- Hiidenkivi, H. (2001). Palvelumittarin kehittäminen sairaalan poliklinikalla. (Development of service gauge.) *Acta Universitatis Tamperensis*, 833, 36–37. Tampere: Yliopistopaino, Juvenes Print.
- Hines, J.M., Hungerford, H.R., & Tomera, A.N. (1987). Analysis and synthesis of research on responsible environmental behavior: A meta-analysis. *Journal of Environmental Education*, 18, 1–8.
- Hungerford, H.R. & Volk, T.L. (1990). Changing learner behavior through environmental education. *The Journal of Environmental Education*, 21(3), 8–21.
- Jeronen, E. & Kaikkonen M. (1994). *Integrating the values of school culture in environmental education*. Paper presented at the ATEE-conference 1994, Prague, Czech Republic 4–9 September 1994.
- Jeronen, E. (1995). Ympäristökasvatus eettisenä kasvatuksena koulussa ja opettajankoulutuksessa. (Environmental Education as ethical education at schools and in teacher education). In S. Ojanen & H. Rikkinen (Eds.), *Opettaja ympäristökasvattajana. Opetus 2000* (pp. 85–93). Juva: WSOY.
- Jeronen, E. & Kaikkonen, M. (1995). Ympäristökasvatus eettisenä kasvatuksena paikallisen kulttuurin omaksumisessa. (Environmental Education as ethical education when studying local culture). In S. Tella (Ed.), *Juuret ja arvot. Etnisyys ja eettisyys – aineen opettaminen monikulttuurisessa oppimisympäristössä. Ainedidaktiikan symposiumi Helsingissä 3.2.1995*. Helsingin yliopiston opettajankoulutuslaitos. *Tutkimuksia*, 150, 207–220.
- Jeronen, E. & Kaikkonen, M. (1997). Ympäristökasvatuksen kokonaisvaltaisten opetussuunnitelmien kehittäminen koulutuksen eri muodoissa ja asteilla. (Development of curricula in EE.) In E. Jeronen & M. Kaikkonen (Eds.), *Miksi, mitä ja miten? Ympäristökasvatuksen suunnittelu ja toteuttaminen eri kouluasteilla. Oulun Yliopiston kasvatustieteiden tiedekunnan opetusmonisteita ja se-losteita*, 10, 7–14. Oulu: Yliopistopaino.

- Jeronen, E. & Kaikkonen, M. (2001). Ympäristökasvatuksen kokonaismallin tavoitteet ja sisällöt arvioinnin kehittämisen tukena. (The aims, content and evaluation in EE.) In E. Jeronen & M. Kaikkonen (Eds.), *Ympäristötietoisuus – Näkökulmia eri tieteenaloilta. Kasvatustieteiden tiedekunnan selosteita ja katsauksia*, 3, 22–41. Oulun yliopisto.
- Jeronen, E. & Kaikkonen, M. (2002). Thoughts of Children and Adults about the Environment and Environmental Education. *International Research in Geographical and Environmental Education*, 11(4), 341–363.
- Jääskeläinen, L. (1997). Luontokoulujen rahoitusmahdollisuuksia. (Financial opportunities for NS.) In Luontokoulutoiminta. Palvelut. Kehittämisideat. Verkostot, 30–31. Helsinki: Ympäristöministeriö, Ympäristöpolitiikan osasto.
- Kajanto, A. (Ed.) (1993). *Ympäristökasvatus*. (EE) Helsinki: Kirjastopalvelu.
- Kansallinen ympäristökasvatusstrategia (1992). (A national strategy for EE.) Kansallisen ympäristökasvatusstrategian työryhmä. *Suomen Unesco-toimikunnan julkaisuja*, 59. Helsinki.
- Kestävää kehitystä edistävän kasvatuksen ja koulutuksen strategia ja sen toimeenpanosuunnitelma vuosille 2006–2014. (2006). (Strategy for SDE.) Kestävän kehityksen toimikunnan koulutusjaosto. Helsinki.
- Kolb, D.A. (1981). Experiential learning theory and the Learning Style Inventory: a reply to Freedman and Stumpf. *Academy of Management Review*, 6(2), 289–296.
- Kuronen, J. (1997). Luontokoulutoiminnan taustaa. (Background for NS education.) In Luontokoulutoiminta. Palvelut. Kehittämisideat. Verkostot. Ympäristöministeriö, Ympäristöpolitiikan osasto, 28–29. Helsinki.
- Käpylä, M. (1995). Ympäristökasvatus koulun oppimis- ja tiedonkäsitteiden muuttamisen välineenä. (EE as a tool when changing learning and information conception.) In S. Ojanen & H. Rikkinen (Eds.), *Opettaja ympäristökasvattajana* (pp. 24–39). Porvoo: WSOY.
- Luontokoulutoiminta. (1997). Palvelut. Kehittämisideat. Verkostot. 1997. (Action in nature schools.) Ympäristöministeriö, Ympäristöpolitiikan osasto. Helsinki.
- Luonto- ja ympäristökoulut Suomessa (2008). (Nature- and environmental schools in Finland.) Suomen luonto- ja ympäristökoulujen liitto. Retrieved November 22, 2008 from <http://www.luontokoulut.com/luontokoulut.html>
- Matikainen, P. (1995). Ympäristökasvatus luokan- ja aineenopettajan koulutuksessa. (EE in class and subject teacher education.) In S. Ojanen & H. Rikkinen (Eds.), *Opettaja ympäristökasvattajana* (p. 48). Juva: WSOY.
- National core curriculum for basic education (2004). Finnish National Board of Education, 12, 39, 40. Vammala: Vammalan kirjapaino. Retrieved April 25, 2006 from http://www.oph.fi/info/ops/pops_web.pdf.
- National core curriculum for upper secondary schools (2003). Finnish National Board of Education, 16–28. Vammala: Vammalan kirjapaino. Retrieved April 25, 2006 from http://www.edu.fi/julkaisut/maaraykset/ops/ops_uusi.pdf.
- Neill, J. (2005). *John Dewey, the modern father of experiential education*. Retrieved December 20, 2008 from <http://wilderdom.com/experiential/ExperientialDewey.html>.
- Nykänen, R. & Kinnunen, J. (1992). *Taivaan merkit – pienten lasten ympäristökasvatus*. (EE for children.) Helsinki: Mannerheimin lastensuojeluliitto.
- Palmberg, I. (1989). Lägerskolan i grundskolans biologi/geografiundervisning. Stoff och arbetssätt med tonvikt på lägersskolan i Äkäslompolo. *Rapporter från Pedagogiska Fakulteten*, 54–60. Åbo Akademi, Åbo.
- Palmberg, I. & Kuru, J. (1998). Outdoor activities as a source of environmental responsibility. In J.A. Palmer (Ed.), *Environmental Education in the 21st century. Theory, practice, progress and promise* (pp. 253–257). London: Routledge.
- Palmberg, I. & Kuru, J. (2000). Outdoor Activities as a Basis for Environmental Responsibility. *The Journal of Environmental Education*, 31(4), 32–36.
- Palmer, J.A. (1998). *Environmental Education of the 21st century: Theory, practice, progress and promise*, 267–277. London: Routledge.

- Palmer, J. & Neal, P. (1994). *The handbook of environmental education*. London: Routledge.
- Pantzar, E. & Siebert, H. (1993). Tarvitaanko ympäristökasvatusta? (Do we need EE?) Suomalais-saksalainen näkökulma aikuiskasvatuksen ajankohtaiseen haasteeseen. *Ympäristökasvatus*, 85. Helsinki: Kirjastopalvelu.
- Prüter, J. (2003). Philosophy and Practice for Research and Environmental Education in a Northern German Academy for Nature Conservation. In L. Lovén (Ed.), *Ympäristökasvatus* (pp. 117–125). Seminaari Kolin kansallispuistossa 18.–19.4.2002. Metsäntutkimuslaitoksen tiedonantoja, 887.
- Rajakorpi, A. & Salmio, K. (Eds.) (2001). *Toteutuuko kestävä kehitys kouluissa ja oppilaitoksissa?* (Does sustainable development come true at schools and educational institutes?) Arviointi, 3. Helsinki: Opetushallitus.
- Robottom, I. & Hart, P. (1993). *Research in Environmental Education – Engaging the Debate*. Deakin University, 18–27, Victoria: Geelong.
- Ryan, G.W. & Bernard, H.R. (2000). Data management and analysis methods. In N. Denzin & Y. Lincoln (Eds.), *Handbook of Qualitative Research* (pp. 769–793). London: Sage Publications.
- Rydén, L. (2007). The value base of sustainable development. In T. Kaivola & L. Rohweder (Eds.), *Towards sustainable development in higher education – reflections. Publications of the Ministry of Education*, 6, 28–34.
- Rynning, M. (1993). Asenteiden muuttumisen edellytykset ja lainalaisuudet (Changing attitudes, Environmental Education.) In A. Kajanto (Ed.), *Ympäristökasvatus* (pp. 69–80). Helsinki: Kirjastopalvelu.
- Tuomi, J. & Sarajärvi, A. (2002). *Laadullinen tutkimus ja sisällönanalyysi*. (Qualitative research and content analysis). Helsinki: Tammi.
- UNESCO-UNEP (1987). The Tbilisi Declaration: Final report intergovernmental conference on environmental education. Organized by UNESCO in cooperation with UNEP, Tbilisi, USSR, 14–26 October 1977, Paris, France.
- Uusitalo, L. (1993). Asenteiden ja käyttäytymisen ristiriita – Haaste ympäristökasvatukselle. (Conflict between attitudes and behaviour.) In A. Kajanto (Ed.), *Ympäristökasvatus* (pp. 62–63). Helsinki: Kirjastopalvelu.
- Wahlström, R. (1997). Ympäristöherkkyys ympäristökasvatuksen näkökulmasta. (Environmental sensitivity.) In M. Käpylä & R. Wahlström (Eds.), *Vihreä ihminen. Ympäristökasvatuksen menettelmäopas 2* (pp. 1–8). Jyväskylän yliopiston täydennyskoulutuskeskus. Jyväskylä: Yliopistopaino.
- Van Matre, S. (1998). *Maakasvatus. Uusi alku*. (Earth Education.) Jyväskylä: Gummerus Kirjapaino.
- Welch, W., Klopfer, L., Aikenhead G., & Robinson, I. (1981). The role of inquiry in science education: analysis and recommendations. *Science education*, 65, 33–50.
- Vilka, L. (1993). *Ympäristöfilosofia. Vastuu luonnosta, eläimistä ja tulevista sukupolvista*. (Environmental philosophy. Responsibility for nature, animals and future generations.) Helsingfors: Yliopistopaino.
- Vilka, L. (1996). Ympäristöetiikka – luonnon arvot ja ihmisen asenteet. (Environmental ethics – nature values and attitudes of human beings.) In L. Vilka & P. Pitkänen (Eds.) Ihmisen suhde luontoon. Luonnon arvottamisen filosofiaa. *Joensuun yliopiston täydennyskoulutuskeskuksen julkaisuja*, B (18), 88–98.
- Willamo, R. (2005). Kokonaisvaltainen lähestymistapa ympäristönsuojelutieteessä. Sisällön moniulotteisuus ympäristönsuojelijan haasteena. (The holistic view in environmental sciences.) *Environmentalica Fennica*, 23. Helsinki: Yliopistopaino. Disputation thesis.
- Vuolle, P. (2003). Ympäristökasvatus, elämyspedagogiikka, luontoliikunta; kasvua kestäväan kehitykseen. (EE – tools for SD.) In L. Lovén (Ed.), *Ympäristökasvatus* (pp. 9–18). Seminaari Kolin kansallispuistossa 18.–19.4.2002. Metsäntutkimuslaitoksen tiedonantoja 887.

Authors

Eila Jeronen, PhD, is a Senior Lecturer in Biology and Geography Education at the University of Oulu, Finland. She is also a Docent in Education, especially in Environmental Education. Her research interests include teaching, studying and learning processes in natural science, environmental education, health education and teacher education. **Correspondence:** University of Oulu, Department of Educational Sciences and Teacher Education, P.O.Box 2000, 90014, Finland. E-mail: Eila.Jeronen@oulu.fi.

Juha Jeronen is a M.Sc. in Mathematics and postgraduate student in information technology at the University of Jyväskylä. His research interests include topics related to process industry, such as the instability of moving materials. He occasionally also follows, and writes on, environmental education and education in natural science.

Hanna Raustia is a M.Sc. in Biology at the University of Oulu. Her research interests include issues on global change and environmental ecology.