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To cite this article: Maria Hedefalk, Jonas Almqvist & Leif Östman (2015) Education for sustainable development in early childhood education: a review of the research literature, *Environmental Education Research*, 21:7, 975-990, DOI: [10.1080/13504622.2014.971716](https://doi.org/10.1080/13504622.2014.971716)

To link to this article: <https://doi.org/10.1080/13504622.2014.971716>



Published online: 03 Nov 2014.



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Education for sustainable development in early childhood education: a review of the research literature

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(Received 26 November 2013; accepted 15 September 2014)

The aim of the study is to describe and analyse research articles relating to the subject of education for sustainable development (ESD) for early childhood education (ECE), published during the years 1996–2013. This is done by answering three specific questions: (1) How is ESD defined by researchers in ECE? (2) What are the major research inquiries and results? (3) What does the research say about young children acting for change in relation to sustainability? Our analysis identified two different definitions of ESD: first, as a threefold approach to education based on questions concerning *education about, in and for the environment*; and, second, as an approach to education that includes *three inter-related dimensions*: economic, social and environmental. Two major research areas are identified in this study. The first area relates to how teachers understand ESD, while the second area focuses on how ESD can be implemented in educational practice. During the period studied, the research has evolved from teaching children facts about the environment and sustainability issues to educating children to act for change. This new approach reveals a more competent child who can think for him- or herself and make well-considered decisions. The decisions are made by investigating and participating in critical discussions about alternative ways of acting for change.

Keywords: ESD; child; education; sustainability; ECE

Introduction

Today, children are born into a world where climate change, poverty, pollution, CO₂ emissions and loss of biological diversity are major global issues. These issues are discussed by politicians, academics and the media throughout the world. They are also local problems, articulated and used as educational content in schools. Further, there is a strong movement to educate children to learn how to act in a sustainable way. This movement is often guided by ideas from sustainable development, which can be defined as the following:

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. (Brundtland 1988)

Sustainable development has become a key issue for the educational system as a whole, although in this article our focus is on education for very young children. It is clear that preschools around the world are showing a greater interest in education

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for sustainable development (ESD). This is evident, for example, in a range of relatively new awards, such as ECO teams (Bartusevica and Cedere 2003), ECO schools (Elliott and Davis 2009) and Green schools (Elliott and Davis 2009). Even though interest is increasing, some countries have not yet included sustainability in their curricula (Jóhannesson et al. 2011; Tal 2008).

In this article, we argue for the need for further research on ESD in early childhood education (ECE). In 2009, a review of the research on ESD in ECE was published (Davis 2009). Our aim is to follow up and complement this review, albeit with a slightly different approach. Davis's review resulted in a call for researchers to fill the research hole relating to ESD in ECE. She stressed that research on ESD was far more common in school research compared to preschool research (Davis 2009, 235). Her search for studies during the period of 1996–2007 showed that very few articles looked at both ECE and ESD. Instead, the studies mainly focused on environmental education (EE) aimed at teaching children about environmental issues rather than sustainability. Davis included 40 articles in her review; 33 of these articles were omitted in the present review, as they did not include sustainability. This study complements Davis's, as it has a clearer focus on sustainability.

Knowledge about natural phenomena and humans' impact on the environment is not enough to be able to act sustainably, according to recent research. Action skills for sustainable living involve the ability to change current patterns of action by making value judgements about different ways to act. The desired outcome is a future that includes a just and sustainable future for all. Examples of sustainable living include long-term health of human populations, health of global systems, education for all and peace (Davis 1998, 2009; Elliott and Davis 2009; cf. Pramling Samuelsson and Kaga 2008).

At a general level, ESD aims to teach students how to act critically (Scott and Gough 2004). However, the research field is diverse, and definitions of ESD differ at a theoretical level among researchers and at a practical level among teachers (Scott and Gough 2003). Thus, in order to gain a deeper understanding of the various definitions of ESD, the present study reviews various research results and extracts the different ways ESD is defined.

Aim and research questions

The aim of the study is to describe and analyse research articles in the selected journals relating to the subject ESD in ECE, published from 1996 to 2013. This is done by answering three questions:

- How is ESD defined by researchers in ECE?
- What are the major research inquiries and results?
- What does the research say about young children acting for change in relation to sustainability?

Research articles about ESD in ECE

This review includes the same journals covered in a prior review by Davis (2009), with an addition of eight other publications. Six of these additional journals are from the Nordic countries. The other two international journals did not exist when the first

review was conducted.¹ A total of 22 journals are explored, all of which are peer-reviewed publications.

In the selection of articles for this review, we have included studies on sustainability concepts and those which focus on ECE up to five years of age.² Book reviews were excluded, as well as articles solely relating to children older than five years. In sum, 87 articles are included in this review.

We selected studies to include in the review by reading all the titles of the articles in each journal to determine whether they covered sustainability issues. If the title was unclear, the abstract was read in order to ensure that sustainability issues were not missed. When all the titles in a journal had been read, a quick search for the word 'sustain*' was made to check that no important article had been omitted. By reading the abstract and then the article if the abstract did not provide any clues, it was also possible to determine whether information about ECE was included. When the search for articles relating to sustainability issues *and* ECE had been completed, a detailed reading and analysis of each article was undertaken.

Several questions were asked about each article in the detailed reading: What kind of article is this (discussion paper, case study, etc.)? How is ESD defined in this study? What was the purpose of the study? What questions were asked? What are the results? What methods were used? The articles were sorted into different piles depending on the answers to the questions. Then the articles were sorted into different piles by theme. First, the piles were organised under the following headings: 'definitions of ESD', 'case studies' and 'discussion papers'. By reading the articles again, we could divide the piles into several smaller piles since, for example, the definitions of ESD varied, as did the inquiries and results. The result was four major piles: definitions of ESD – in turn divided into two piles – and the two research themes, divided into two piles. These piles provided input for the first two research questions in this study, and we answered the third question about children acting for change with help of all the articles (Table 1). Some of the selected journals have not published a single article about ECE and ESD, while others have published several. For example, the International Journal of Early Childhood dedicated two whole volumes (2009 and 2011) to ESD and ECE. The majority of the research articles in these volumes are from Sweden and Australia.³ *Environmental Education Research* is a journal that includes the greatest number of articles in this review. Articles related to ESD (total number of 21), although 12 of these articles do not specifically focus on ECE. The research questions involve investigations of curriculum and how to affect behaviour, environmental connectedness and understandings of ESD (Ballantyne, Connell, and Fien 2006; Beery 2013; Chawla and Cushing 2007; Cole 2013; Erdogan, Marcinkowski, and Ok 2009; Jóhannesson et al. 2011; Kennelly, Taylor, and Jenkins 2008; McNaughton 2012; McNichol, Davis, and O'Brien 2011; O'Gorman and Davis 2013; Pavlova 2013; Tal 2008). Eight articles in this journal focus on ECE, (Ärlemalm-Hagsér and Sandberg 2011; Barratt Hacking, Barratt, and Scott 2007; Chawla 2001; Davis 2009; Duhn 2012; Dymont et al. 2013; Ernst 2013; Flogaitis and Agelidou 2003; Hadzigeorgiou et al. 2011).

In 2007, *Environmental Education Research* published a special issue on the relationships between childhood, the environment and learning. Only three articles from this issue were included in this review, either because the children in the studies were older than five or because the content did not relate to ESD. The same journal had ESD as a theme in two issues (Vol. 12, No. 3, and Vol. 16, No. 1), although neither of them dealt with issues relating to ECE.

Table 1. Journals included in the study.

Journals	Number of articles
<i>Environmental education</i>	
Australian Journal of Environmental Education	13
Applied Environmental Education and Communication (started 2002)	2
International Research in Geographical and Environmental Education	6
The Journal of Environmental Education	2
Environmental Education Research	121
Canadian Journal of Environmental Education	3
Children's Geographies	1
Journal of Education for Sustainable Development (started 2007)	5
Cultural Studies of Science Education (started 2008)	2
<i>Early years education</i>	
Young Children	0
Early Childhood Education Journal	2
Contemporary Issues in Early Childhood (started 2000)	3
International Journal of Early Years Education	0
International Journal of Early Childhood	18
European Early Childhood Education Research Journal	1
Australasian Journal of Early Childhood	4
<i>Nordic journals of education</i>	
Pedagogisk forskning i Sverige (Educational Research in Sweden)	0
Pedagogisk tidskrift (Educational Journal)	0
Utbildning och demokrati (Education and Democracy)	1
Nordic Studies in Education	0
Journal of Baltic Science Education	3
Scandinavian Journal of Educational Research	0
<i>Total number of articles</i>	87

The journal with the second greatest number of articles included in this review is the *International Journal of Early Childhood* with a total of 18 articles. The articles report information from two different conferences, theorise about what ESD can be in ECE, and explore four ESD projects.

In the Swedish journal *Utbildning och Demokrati* (Education and Democracy), one volume is devoted to ESD, and ECE is mentioned in the introduction. Preschool is mentioned as being a part of an educational system in which sustainability issues are of central concern (Öhman 2011).

How ESD is defined in ECE

The studies included in this part of the article do not necessarily focus on the definition of ESD, at least not as an explicit research question. It is the researchers' starting points when studying ESD in different ways that we are interested in here.

Two different definitions were identified:

- (1) ESD as a threefold approach to education based on questions concerning *education about, in and for the environment*.
- (2) ESD as an approach to education that includes *three interrelated dimensions* (economic, social and environmental).

ESD defined as education about, in and for the environment

Various researchers refer to ESD in terms of education *about, in and for* the environment (Davis 1998, 2009; Deans and Brown 2008; Lee 2001; Lee and Ma 2006; Lewis, Mansfield, and Baudains 2010; Maynard 2007). Education *about* the environment emphasises knowledge about how natural systems work, such as water cycles, ecological systems and how plants grow. Education *in* the environment emphasises direct experiences in nature. Education *for* the environment emphasises active participation in solving environmental problems or making socially just and sustainable choices. The approach should, according to proponents of this definition of ESD, not be seen as three separate parts but, instead, used as a whole in order to learn about and in the environment and to be able to act for the environment (see also Lee and Ma 2006).

ESD defined as education involving three dimensions

Another way of defining ESD is the inclusion of economic, social and environmental dimensions of sustainability in the teaching content.⁴ These dimensions have also been addressed in several UN documents (see, e.g. UNCED 1992; UNESCO 2005; Brundtland 1988). The environmental dimension involves the protection of ecosystems and their biological diversities. The social dimension involves justice, equality and a democratic approach. The economic dimension involves a financial approach to resources where economic development affects humans and/or the environment in a positive way. The dimensions highlight the interrelationships between economic development, environmental protection and social justice in education (Öhman 2011). They also illustrate how people's lifestyles, nature and society are related to each other (Pramling Samuelsson 2011).

For example, environmental topics such as the ecology of hens have social, economic and environmental dimensions. On a social level, the treatment of animals can be dealt with as a moral issue, as different hens live in very different circumstances. Some live in small cages, without a sitting place of their own and have to stay indoors all their lives. This way of handling the chickens results in cheaper eggs – a positive impact on the economy but a negative impact on the quality of the life of the chicken. By including all the dimensions in a curriculum, sustainability issues can be problematised, in that the dimensions facilitate discussions about conflicting interests between humans–humans and humans–animals, in this case. Children at a Swedish preschool did not want to participate in poor treatment of chicken and managed to affect the municipal authorities to buy organic eggs from a place where the chickens could go outside and live a good life (Pramling Samuelsson 2011). The quality of the chickens' lives (social dimension) was valued higher than keeping the costs lower (economic dimension) at the preschool.

Summary of definitions of ESD

Both definitions have the aim of educating children to act for sustainable development and make decisions that value natural resources with the understanding that they are limited and should not be wasted. The different definitions are similar in many ways, but what separates them is that the sole focus of one is on the environment, while the second includes other aspects as well.

ESD as defined as education in, for and about the environment focuses on EE, namely, how unsustainable problems arise in the environment and how children learn to deal with these problems. For example, educational issues can include the problem of polluted rivers and the negative effect on the environment (Deans and Brown 2008). Children here learn why pollution is bad for the environment, and they might also learn how to act in different ways so that the environment does not get polluted. EE in this sense results in knowledge development based on scientific facts. Ethical value judgements in connection to the sustainability problem based on sources outside of science are not evident. The right answer of how to act is found in science.

The definition of ESD in regard to economic, environmental and social issues seems to have a broader aim, in that here the environment is not the only aspect in focus. Sustainability problems are also connected to society at large and to human actions. Educational issues can include the effect of the consumer society on human rights in various parts of the world. For example, the connection between consumer choices and childhood obesity is a growing health problem in Australia, which has resulted in a need to change both the current and future climate around the issue of obesity (Skouteris et al. 2010). To solve this problem ESD helps children make sense of digital media, which affects their behaviour in a negative way, as it promotes children eating energy-dense and nutritionally poor foods. Defined in this way, ESD enables children to act for a sustainable future by making connections between consumer choices, obesity, environmental sustainability and the use of digital technologies.

Two reoccurring research themes

Two major research themes were identified in this study. The first theme relates to how teachers understand ESD, while the second theme focuses on how ESD can be implemented in educational practice. These two themes will be briefly described below and further described in the next text passage containing the results of the research questions.

Teachers' comprehensions of ESD

In the analyses, we categorised eight articles as focusing on teachers' understandings of ESD. In these articles, teachers were interviewed or responded to a questionnaire or a test about their understandings of ESD (Ärlemalm-Hagsér and Sandberg 2011; Dymont et al. 2013; Flogaitis and Agelidou 2003; Kennelly, Taylor, and Jenkins 2008; Lee 2001; McNaughton 2012; Öhman 2011; Sandberg and Ärlemalm-Hagsér 2011).

Amongst the investigated teachers in the journals analysed, we found three major understandings of ESD: Teachers understood ESD as teaching children facts about the environment (Lee 2001; Sandberg and Ärlemalm-Hagsér 2011), manipulating students' behaviours (Kennelly, Taylor, and Jenkins 2008) and developing children's critical thinking skills (Ärlemalm-Hagsér and Sandberg 2011; Dymont et al. 2013; Kennelly, Taylor, and Jenkins 2008; Lee 2001; McNaughton 2012; Öhman 2011; Sandberg and Ärlemalm-Hagsér 2011). The results of these studies are presented later in the article.

The implementation of ESD

The majority of the articles in the study (79 articles) focused on research questions about how to implement ESD in ECE. The articles can be divided into two groups: the *potential* of implementing ESD (54 articles) and the *performance* of implementing ESD (25 articles). The potential of implementing ESD theoretically discusses how the implementation of ESD can be done, while the performance of implementing ESD examines how ESD has been implemented in practice. The potential of implementing ESD group consists of 540 articles: 48 discussion papers, two articles about curricula and four reviews.⁵ The performance of implementing ESD group consists of six case studies and 19 documentations of projects. The case studies are arranged in the form of pre-tests, interventions and post-tests; some with test groups and some with control groups. The documentation of projects describes the planning and the outcomes of projects that have been undertaken. The results of these studies are presented in the next section.

The main results of the research inquiries

The main results in the articles studied are presented here. The results focus on teachers' different understandings of ESD and how to implement ESD in practice.

Three different understandings of ESD among teachers

One understanding of ESD is to *educate children about the environment*. Teachers with this understanding see ESD as environmental issues, involving nature and science (Ärlemalm-Hagsér and Sandberg 2011). Environmental concepts are taught, such as pollution (Lee 2001). Other topics described in the studied articles are the cycle of nature, deforestation and facts about animals and plants. For example, one of the teachers says: 'Here we gathered all our knowledge of worms on a flip chart and the children know quite a lot about worms' (Ärlemalm-Hagsér and Sandberg 2011). The studied teachers use closed questions/answer techniques and direct instructions to teach environmental concepts. Storytelling is also used to explain environmental issues (Lee 2001). Studies by Flogaitis and Agelidou (2003) and Lee (2001) highlight that teachers' knowledge about the environment is often limited. Some teachers cannot differentiate the environment from nature. Their understanding of nature is simplistic and romantic, and they do not include moral, economic or sociopolitical content in their teaching. According to Flogaitis and Agelidou (2003) and Lee (2001), some teachers do not encourage children to act for social improvement while others do (Sandberg and Ärlemalm-Hagsér 2011). There is an assumption that if children know enough about the environment they will automatically act for change by taking care of the environment.

The second understanding is that ESD should *affect children's behaviours* to act for sustainable development. Here, the focus is on fostering children's environmental awareness in order to encourage them to develop environmentally friendly approaches, so that they will protect the environment, both now and in the future (see e.g. Kennelly, Taylor, and Jenkins 2008, Lee 2001; Sandberg and Ärlemalm-Hagsér 2011). One of the teachers says: 'To a large extent the role of the children was directed' (Kennelly, Taylor, and Jenkins 2008), suggesting that children are not taught to think for themselves, only to act a certain way. In Kennelly, Taylor, and

Jenkins' study (2008), this understanding of ESD was rare (two out of eight teachers). These teachers explained that they could affect students' behaviours by rewarding them. 'Where kids are being rewarded for something in some tangible or intangible way, they keep doing that', a teachers says. Another description of a method to affect children's behaviour is for teachers to act as role models (Sandberg and Ärlemalm-Hagsér 2011).

The third way teachers understand ESD is as a strategy to *educate children to think critically*. Children can learn to think critically by problematising the connection between the environment and society (Ärlemalm-Hagsér and Sandberg 2011; Dymont et al. 2013). In one article (Kennelly, Taylor, and Jenkins 2008), a preschool teacher describes how they teach children about the connection between the environment and society by separating recyclable waste from other waste. One boy at this preschool shows that he understands that there is a problem if humans trash the environment. The boy says: 'If we throw our rubbish out in the fields and forest, they can't breathe'. This approach raises questions about morals and ethics, as the children need to think about humans' relationships to nature. A teacher says that she wants children to say, 'This isn't good. How could we make a difference?' According to the teachers, these children are likely to be driven to make decisions for themselves. These children are also thinking critically: they make value judgements by comparing one way of acting with another way they want to act. These teachers encourage children to make changes in society by involving them in meaningful projects where they participate in problem identification and decision-making. Another teacher expresses that controversial issues provokes children to debate. They have to look at different perspectives, which help them to realise that decisions are not always easy to make. (McNaughton 2012). In this way, the children can also take part in a democratic process (Ärlemalm-Hagsér and Sandberg 2011; Öhman 2011; Sandberg and Ärlemalm-Hagsér 2011). In another article, a teacher says, 'The children should have opportunities to experience and discover the meaningfulness of their own actions, to understand that they can influence and be part of the process' (Ärlemalm-Hagsér and Sandberg 2011).

How to implement ESD

The focus of the *potential* of implementing ESD is on children participating in decisions and problem-solving (Filho, Pace, and Manolas 2010; Mbebeb 2009; Mueller 2009; Skouteris et al. 2010). Children's rights and abilities to act are highlighted and connected to a democratic approach (Chawla and Cusing 2007; Engdahl 2011; Filho, Pace, and Manolas 2010; Johansson 2009; Moss 2010; Pramling Samuelsson 2004). The democratic approach involves children who collaborate in their everyday lives and make meaningful contributions to the environment. Teachers can make it possible for children to discuss issues in society, test sustainable development ideas and explore the contradictions inherent in sustainable living (Chawla and Cusing 2007; McNaughton 2012). These children are expected to learn how to consider a range of perspectives and to think through what they themselves believe (Chawla and Cusing 2007).

In ESD, the teaching content usually involves the natural environment in one way or another (Ogelman 2012). Some researchers (Capra 2007; Chawla and Cushing 2007; Malone 2004) argue that children who experience the environment (green spaces) will automatically develop a sense of responsibility for their

environment. They also argue that children who spend time outdoors will automatically be more interested in the future of the environment (Malone 2004; Maynard 2007; Gambino, Davis, and Rowntree 2009). The same argument can be found in research, with respondents from across the world giving similar answers (Chawla and Cushing 2007). These answers come from those who (as youths or adults) are environmentally active, and those who have experienced nature in different ways as children. Examples of how children are exposed to the environment in practice are explored in articles describing performed projects. Several projects we studied are described as ‘education for the environment’ (Davis 2005; Gambino, Davis, and Rowntree 2009; Lee and Ma 2006; Lewis, Mansfield, and Baudains 2010; Maynard 2007; Mackey and Vaealiki 2011; Mbebeb 2009; Hägglund and Pramling Samulesson 2009). In these studies, the children encounter animals and insects, plant seedlings, harvest crops and clean up rivers (Chan, Choy, and Lee 2009; Deans and Brown 2008; Gambino, Davis, and Rowntree 2009; Hadzigeorgiou et al. 2011; Lee and Ma 2006; Lewis, Mansfield, and Baudains 2010).

The *performance* of implementing ESD focuses on different ways of implementing ESD. Some projects originate from children’s questions (Davis 2005; Edwards and Cutter-Mackenzie 2011; Lewis, Mansfield, and Baudains 2010; Mackey and Vaealiki 2011), while other projects have already been defined by the teachers in advance (Chan, Choy, and Lee 2009; Gambino, Davis, and Rowntree 2009; Hadzigeorgiou et al. 2011). Projects that are based on children’s questions about sustainable issues characterise the child as competent and able to act for change (Deans and Brow 2008; Engdahl 2011; Mahruf, Shohel, and Howes 2011; Prince 2010). In one project, the children talked about the sustainability issues that surfaced during a group walk (Deans and Brown 2008). These children noticed that the birds were pecking for food among the rubbish. The questions that arose from this experience formed the starting point of a project where the children investigated where the rubbish came from and the effects of drought on rivers. Another project took its departure point from the children’s interest in the preschool’s vegetable garden and the worms in the soil (Edwards and Cutter-Mackenzie 2011). In this project, children explored worm farms using different play experiences: open-ended play, modelled play and framed play. At one preschool, the children found out that the polar bears are at risk because of global warming. These children decided to reduce their own CO₂ emissions to help the bears (Engdahl 2010).

Some studies describe how teachers gain knowledge about children’s interests and get children to participate in democratic ways (see, e.g. Deans and Brown 2008; Mackey and Vaealiki 2011). The researchers argue that knowledge alone is not sufficient to encourage children to act sustainably. Instead, they describe the importance of children’s engagement in sustainability issues and the feeling that they can bring about change (see, e.g. Astbury, Huddart, and Théoret 2009). Issues linked to ethics and values, for example, can result in discussions about whether it is acceptable to keep animals caged or not. The topic connects social and economic life in a concrete way that the children could understand, as keeping animals caged means more money for food for their families (Engdahl 2010).

Projects in which the content is decided in advance focus on developing children’s knowledge about a topic within ESD (Bartusevica and Cedere 2003; Chan, Choy, and Lee 2009; Gambino, Davis, and Rowntree 2009; Hadzigeorgiou et al. 2011). In one study, the children were educated about ‘the importance of trees’; the aim of the study was to investigate which methods help children to understand why

trees are important in our lives. Another study focused on developing the children's knowledge about the endangered bilby, a unique Australian animal (Gambino, Davis, and Rowntree 2009). Here, the researchers argue that while learning about trees or endangered species, the children also develop an interest in caring for the environment and acting sustainably (Chan, Choy, and Lee 2009; Gambino, Davis, and Rowntree 2009; Hadzigeorgiou et al. 2011). The argument seems to be that knowledge helps children to change their attitudes, and thereby act for sustainable development. As Bartusevica and Cedere (2003, 7) argue, 'knowledge promotes motivation'.

Young children acting for change

Twenty-two of the articles highlight the different ways in which children can act for change. One way of educating children to act for change is by teaching them about the environment (Lee 2001; Sandberg and Ärlemalm-Hagsér 2011). This can be done by teaching facts and by spending time in greens spaces. Although children do not act for change during the teaching activity, there is an assumption that they will do so in the future when the opportunities arise. In Davis' (2009) review, this kind of research was the most common (children's relationships with nature and children's understandings of nature). Educating children to act for change by teaching facts, not actions, is still popular.

Research on children dealing with sustainability issues was almost absent in Davis' review (2009). In more recent research, we can see projects where children act for change, dealing with sustainability issues by exploring them and testing actions to make change. As opposed to limiting the teaching strategy to learning facts about sustainability or making value judgements about different ways to act for a more sustainable way of living, these children also test actions. For example, they clean up rivers (Deans and Brown 2008), make life better for exposed animals (Gambino, Davis, and Rowntree 2009; Lewis, Mansfield, and Baudains 2010) and reduce the usage of water when it becomes a scarce resource (Davis 2005). Even though there are articles that describe actual performed practices, the majority of the articles focus on theories about how to enable children to test actions for change.

This new research involves education that encourages children to think and act critically (Ärlemalm-Hagsér and Sandberg 2011; Kennelly, Taylor, and Jenkins 2008; Lee 2001; Öhman 2011; Sandberg and Ärlemalm-Hagsér 2011). This new strategy of teaching also uses a democratic process, where children participate in decisions and actions.⁶ The research has evolved from teaching children facts about the environment and sustainability issues to educating children to act for change, where the child is regarded as a more competent individual who can think for him- or herself and make well-considered decisions. The teacher is seen as a co-researcher, rather than someone who has all the knowledge and all the answers.

General discussion and implications

The articles describe two different definitions of ESD in ECE: one which focuses on education about, in and for the environment as a three-part interrelated approach, and the other that involves three interrelated dimensions (economic, environmental and social). Both of the definitions have the same aim, namely, to educate children to act for a sustainable future – in other words, act for change. In essence, the

difference is that the sole focus of the first is on the environment, while the second includes other aspects as well.

The reviewed articles show that there are different ways of using the definitions. For example, it is possible to limit the interpretation of education about, for and in the environment to teach children facts about natural phenomena, and it is also possible to interpret the definition more broadly and include investigations and critical discussions about the connection between society and nature. In the same way, some researchers use all three dimensions, whereas others limit the research project to one dimension. Our interpretation is that the sometimes rather confusing spectrum of definitions is a result of the fact that the research field of ESD in ECE is still being formed. Despite this confusion, the common aim of ESD seems to be teaching children to act for change.

The major research areas identified in this review are teachers' understandings of ESD and implementations of ESD. In both areas, there is an underlying assumption within some of the research projects that if children develop knowledge about the environment, they will develop pro-environmental attitudes and the skills to act for sustainability. Research into the connection between knowledge, attitudes and behaviour is also known as KAB-research. The above-mentioned assumption is also expressed in two reviews of EE (Hart and Nolan 1999; Rickinson 2001) describing studies that investigate whether students' views of environmental issues have an impact on their behaviours. The reviews show that there is no evidence for this hypothesis because the researchers have not been able to show any long-lasting changes in behaviour. However, research in line with this hypothesis is apparent in this study.⁷ One example is a study where children learn about the importance of trees (by storytelling or by instruction) and were then tested to investigate which of the two groups of children were more willing to participate in a tree planting activity (Hadzigeorgiou et al. 2011). Underlying this experiment is an assumption that learning facts about trees (in different ways) will result in children wanting to act for change. A focus on facts is also described in two articles where children learn about worms (Ärlemalm-Hagsér and Sandberg 2011; Edwards and Cutter-Mackenzie 2011). Here, the facts about the worms are important, not the ways facts relate to sustainability or actions for sustainability. The belief that children will automatically act for change if they learn facts is apparent. KAB-research is not directly connected to the research we surveyed, as this study detects a shifting focus towards research projects where children are taught environmental facts *as well* as how to critically respond. Consequently, several researchers now stress the importance of including a socio-critical dimension in the teaching content. Jensen and Schnack (1997) describe the need to learn to analyse social issues in a critical way in order to understand environmental problems. They argue that when children know how to understand and discuss the connection between the environment and society they can also act for change in a well-informed way.

Education about the environment does not automatically include sustainability issues. However, the understanding of classic EE as knowledge about topics such as ecology, biodiversity and life cycles can be linked to critical questions about society to broaden the EE teaching content into ESD (cf. Pavlova 2013). One possible reason that teachers stay within EE instead of broadening their curricula to include ESD can be explained by the view that children are innocent and in need of protection (Duhn 2012). This view may make teachers avoid nature because they think it is physically dangerous for the children (Davis 2009; Malone 2004, 2007). Seeing

children as innocent and vulnerable can also result in wanting to protect them from harsh realities (Duhn 2012).

Some of the studies characterise children as competent and able to act for change. When acting for change, there is a need to understand a problem and identify what is not sustainable. Economic issues or social issues may lie behind the unsustainable practice (Jensen and Schnack 1997). In the projects described in the articles, children are able to detect a lack of sustainability. For example, they discover that animals and plants are endangered in different ways and that resources are not used efficiently. Children also realise that they are not using water economically and discover that their ecological footprint is too big. There are no articles about children focusing on larger social issues related to sustainability, such as people starving, getting sick from harvesting bananas sprayed with pesticides or lacking of possibilities to get an education. These are also sustainability issues that do not solely focus on the environment. Maybe the absence of these issues is a conscious decision to protect children from harsh realities, or maybe the teachers do not see this dimension as related to ESD because the environmental dimension overshadows it. Teaching for change involves children identifying a problem, learning more about it and, finally, acting to solve it. The education links EE and ESD, in that children learn facts about how the environment works, learn to view it in a critical way and, finally, learn to act for change in the society where they live.

This study shows that ESD is a growing topic of interest in the field of ECE research. During the years since Davis' review, there has been an increase of articles including sustainability issues. More than double the amounts of articles have been published in the time between 1996–2007 and 2007–2012. The definition of ESD needs to be further discussed to connect the learning content and teaching methods with the goal for children to understand and act for sustainable development. However, as most of the research focuses on the theoretical aspects of ESD, there is a need for more empirical work on the teaching and learning of ESD in ECE. Some projects analyse practices using interviews, surveys and, in some cases, observations. However, research into children's learning processes is scarce. By investigating the learning process, we can explore how young children learn and what they learn in ESD. There is, therefore, a need for more research into the learning process by observing young children in action. Such studies can hopefully deepen our understanding and help researchers and teachers to develop research-based methods for implementing ESD in ECE.

Notes

1. The journals *Journal of Education for Sustainable Development* (started in 2007) and *Cultural Studies of Science Education* (started in 2008) were chosen due to the probability that they would contain articles about sustainable educational issues. *Cultural Studies of Science Education* builds bridges between science education and social studies of science, which is interesting from a sustainability perspective (Jóhannesson et al. 2011).
2. The definition of ECE used in this study is education for up to five years of age.
3. Volume 41, Issue 2, includes five articles from Sweden and two from Australia, for the total of nine articles included in this review. Volume 43, Issue 2, includes three articles from Sweden out of a total of four articles included in this review. This suggested the importance in including Swedish journals in the study. The articles written in Swedish can be translated by the authors as it is their mother tongue.
4. Pearson and Degotardi (2009), Hägglund and Pramling Samuelsson (2009), Pramling Samuelsson (2011), Öhman (2011), Prince (2010), Astbury, Huddart, and Théoret

- (2009), Johansson (2009), Jóhannesson et al. (2011), Filho, Pace, and Manolas (2010), Flogaitis and Agelidou (2003), Siraj-Blatchford and Björneloo (2009), Siraj-Blatchford (2009). Chan, Choy, and Lee use the three dimensions as well as education about, for and in the environment to define ESD.
5. A discussion paper is here defined as an article in which the researcher theorises about an issue.
 6. Årlemalm-Hagsér and Sandberg (2011), Chawla and Cusing (2007), Engdahl (2010), Filho, Pace, and Manolas (2010), Johansson (2009), Mbebe (2009), Moss (2010), Mueller (2009), Öhman (2011), Pramling Samuelsson (2004), Sandberg and Årlemalm-Hagsér (2011), Skouteris et al. (2010).
 7. Initially, articles dealing with ESD as solely 'education about the environment' without a connection to sustainability were excluded from this study. Even though these articles were excluded, this way of understanding and implementing ESD was still found in the study.

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